Advances in CHILD DEVELOPMENT AND BEHAVIOR
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Preface

The amount of research and theoretical discussion in the field of child development and behavior is so vast that researchers, instructors, and students are confronted with a formidable task in keeping abreast of new developments within their areas of specialization through the use of primary sources, as well as being knowledgeable in areas peripheral to their primary focus of interest. Moreover, journal space is often simply too limited to permit publication of more speculative kinds of analyses that might spark expanded interest in a problem area or stimulate new modes of attack on a problem.

The serial publication *Advances in Child Development and Behavior* is intended to ease the burden by providing scholarly technical articles serving as reference material and by providing a place for publication of scholarly speculation. In these critical reviews, recent advances in the field are summarized and integrated, complexities are exposed, and fresh viewpoints are offered. These reviews should be useful not only to the expert in the area but also to the general reader. No attempt is made to organize each volume around a particular theme or topic. Manuscripts are solicited from investigators conducting programmatic work on problems of current and significant interest. The editor often encourages the preparation of critical syntheses dealing intensively with topics of relatively narrow scope but of considerable potential interest to the scientific community. Contributors are encouraged to criticize, integrate, and stimulate, but always within a framework of high scholarship.

Although appearance in the volumes is ordinarily by invitation, unsolicited manuscripts will be accepted for review. All papers—whether invited or submitted—receive careful editorial scrutiny. Invited papers are automatically accepted for publication in principle, but usually require revision before final acceptance. Submitted papers receive the same treatment except that they are not automatically accepted for publication even in principle, and may be rejected.

I acknowledge with gratitude the aid of my home institution, Purdue University, which generously provided time and facilities for the preparation of this volume.

Robert V. Kail
FROM THE INNOCENT TO THE INTELLIGENT EYE: 
THE EARLY DEVELOPMENT OF PICTORIAL 
COMPETENCE

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I. Introduction

The terms in our title are borrowed, respectively, from two very influential theorists of picture perception—the “innocent eye” from Ernst Gombrich (1969) and the “intelligent eye” from Richard Gregory (1970). In this chapter we argue that the process of developing an “intelligent eye” to interpret and understand pictures is a very complex and protracted process, a process infants begin with a relatively (but not a fully) “innocent eye.”

Understanding and using pictures is not only a complex process, but it is also a very important one. Pictures are ubiquitous in most modern societies, as this passage by William Ittelson so clearly illustrates:

As I sit at my breakfast table, my morning newspaper has printing on it; it has a graph telling me how the national budget will be spent, a map trying to tell me something about the weather, a table of baseball statistics, an engineering drawing with which I can build a garden chair, photographs of distant places and people, a caricature expressing what the editor thinks of a political figure, and an artist’s rendition of what the city will look like 20 years from now … On the wall in front of me hangs an abstract painting … All this and more, and I haven’t even turned on the TV or the computer. (Ittelson, 1996, p. 171)

Pictures are similarly important in the lives of many very young children. In the United States, toddlers and preschool children spend hours every week in picture book interactions with their parents, as well as watching TV and videos. They presumably learn a great deal from their extended experience with various pictorial media. For example, children acquire many vocabulary terms and concepts as a result of “reading” picture books with their parents (Gelman et al., 1998; Ninio & Bruner, 1978; Snow & Goldfield, 1983; Whitehurst et al., 1988). From pictures, most infants and toddlers learn many words for entities, such as tigers and tugboats, which they have never personally experienced, including some, such as dinosaurs, fairies, and unicorns that they will never experience. Video is also a source of early vocabulary learning (Rice et al., 1990; Rice & Woodsmall, 1988), and a variety of cognitive benefits have been attributed to young children’s viewing of educational TV programs such as Sesame Street (Ball & Bogatz, 1970; Bogatz & Ball, 1972; Fisch, 2000; Hughes et al., 1999; Wright & Huston, 1995; Wright et al., 2001).

Our goal is to present an account of some of the early steps in the development of what we have referred to as pictorial competence (DeLoache & Burns, 1994; DeLoache, Pierroutsakos, & Troseth, 1996). This term is meant to encompass the many different aspects of perceiving, interpreting, understanding, and using pictures, ranging from the straightforward perception and recognition of simple pictures to the most sophisticated understanding of the conventions and techniques of highly complex ones.
An enormous amount of development is embraced by this concept, as illustrated by the following examples of relatively innocent and highly intelligent interactions with pictorial images.

At 20-month-old Chloe’s preschool, family snapshots had been affixed to the tops of the play tables. Spotting her father in the background of one of the pictures, Chloe became quite upset. She pointed to the image of her father, crying, “Daddy out! Open! Daddy out!” Unable to soothe her, Chloe’s teacher finally removed the picture from the table and handed it to her. At first she tried to pluck her father from the picture; failing at this, she hugged the photograph to her face. (DeLoache et al., 1996)

Now consider an astronomer interpreting images fed back to her computer from the Hubble telescope. Although she knows that the images on her computer screen are the result of many transformations of purely digital data, and that many aspects of those images (such as color) are quite arbitrary, she finds them meaningful and highly informative—perhaps even the basis for a new discovery about the reality they so distantly represent. How does a young Chloe, confused about the relation between a photograph and reality, become the adult astronomer willing to accept and use a far less obvious picture-reality relation? Only via the many steps in the complex developmental path that transforms the innocent into the intelligent eye.

A. DEFINITION AND DUALITY

Part of the reason that the development of pictorial competence is so complex is that pictures themselves are complex, much more so than first seems to be the case. As James Gibson (1980) pointed out,

most people think they know what a picture is, anything so familiar must be simple. They are wrong. (p. xvii)

Even defining what is meant by the term “picture” is surprisingly difficult; indeed, Ittelson (1996) noted that there is no definition that is generally accepted in psychology. In our own attempt, we have followed Ittelson’s lead by adopting a very general definition that incorporates human intention as a crucial feature: “A picture is constituted of marks on a delimited surface resulting from someone’s attempt to communicate, preserve, or express an object, event, idea, or emotion” (DeLoache et al., 1996, p. 3). The marks can be static, as in a photograph, drawing, or painting, or kinetic, as in a video or movie. A picture can be realistic, resembling to some degree what it stands for, or fully abstract, with no visual similarity to what it represents. The discussion that follows, and the research base for it, has primarily to do with realistic pictures.
The complexity of pictures stems from their inherently dual nature, as many theorists have recognized:

Pictures are unique among objects; for they are seen both as themselves and as some other [entirely different] thing … (Gregory, 1970, p. 32)
A picture is both a surface in its own right and a display of information about something else. [It] always requires two kinds of apprehension that go on at the same time … (Gibson, 1979, p. 282–283)

This duality presents substantial challenges to the innocent eye. In the following sections, we outline aspects of the development of pictorial competence from infancy to adulthood.

B. THE THREE R’S

Full pictorial competence involves mastery of the dual nature of pictures, or what we have called the “three R’s” (DeLoache et al., 1996). A picture itself is a representation that displays information about something else—its referent. In perceiving and interpreting a picture, the viewer sees both the representation—the picture surface—and “sees through” the picture to its referent. In addition, the viewer must understand something about the relation between representation and referent.

Chloe certainly saw through the photograph of her father. What she did not do, however, was to understand very much about the relation between representation and referent: She confused the real referent (her father) with the representation, apparently not understanding that the only property shared by picture and papa was visual similarity. Our hypothetical astronomer does not understand everything about how light striking the far away telescope becomes converted into images for her perusal, but she has sufficient knowledge to accept that there is a meaningful relation between the blobs and blips on her screen and events and entities in the far reaches of space.

Pictorial competence thus involves both perceptual and conceptual processes, with conceptual knowledge contributing in two different ways. First, relevant conceptual representations are effortlessly activated by perception of pictured information; perceiving their respective images led to Chloe’s immediate recognition of her father and to the astronomer’s recognition of particular galaxies. The second conceptual contribution concerns knowledge about pictures (Liben, 1999). In both of our examples, the viewers brought to bear their vastly different levels of knowledge about pictures, leading to Chloe’s confusion and the astronomer’s accuracy. The first has a shaky, the second a firm, grasp of what we have referred to as the “picture concept” (DeLoache et al., 1996).
C. THE PICTURE CONCEPT

1. Initial Concept

The picture concept develops through experience interacting with pictures in the culturally prescribed manner. The concept of “picture” includes features such as two-dimensional, non-tangible, and non-real, as well as some representation of the contexts in which pictures typically occur and how they are used. Encounters with pictures result in a two-part, or dual, mental representation; thus, a picture of \( x \) would be represented as both “picture of” and “\( x \)”.

The mental representation “\( x \)” contains what one knows about the referent \( x \). Seeing a picture calls to mind that information just as seeing the real entity would do so. In Ittelson’s (1996) terms, the informational content of the picture is “decoupled” from its source—the surface of the picture.

The other part of the dual representation—“picture of”—indicates that this particular \( x \) is not a real \( x \). “Picture of” signifies that part of the child’s mental representation of \( x \) does not apply to this particular stimulus; specifically, all attributes having to do with its physical reality other than its visual appearance are null in this situation. Picture of operates like similar mechanisms proposed for keeping non-literal representations from intruding on serious ones in symbolic play (Harris & Kavanaugh, 1993; Leslie, 1987). Thus, representing a stimulus as “picture of” “\( x \)” specifies that part of the normal mental representation of \( x \) does not apply in this particular situation.

It is the combination of the two representations—\( x \) and picture of—that tells a viewer how to respond to a picture. The astronomer’s mature picture concept tells her how to interact with the images on her screen. Because of Chloe’s immature concept, her mental representation of \( x \) (Daddy) is not clearly designated as “picture of”, and she responds inappropriately.

What does the astronomer know that Chloe does not? In other words, what kinds of knowledge about pictures are acquired in the course of the development of pictorial competence?

2. Conceptual Knowledge about Pictures

Adults have an enormous store of knowledge about pictures, and children begin to acquire some of that knowledge in their initial years of life. Surely, the single most important thing to know about pictures is that they are not real, but merely representations of something other than themselves. Even though pictures effectively call to mind their real referents, they have none of the action affordances of real objects: Hitting a photograph of a glass of milk will not cause it to spill, nor will turning the picture upside down. In the following section of this chapter, we consider the initial steps in the acquisition of this particular category of knowledge, as well as lingering difficulties such as that described for Chloe.
A second form of knowledge about pictures concerns their origin, specifically, that they are artifacts intentionally created through human action. Children as young as 2–3 years at least partially understand this aspect of pictures. They reject as a picture an image they have been told was produced accidentally by someone spilling some paint, but they consider the same image to be a picture when it has been described as something that a person worked hard to create (Gelman & Ebeling, 1998). Similarly, 3- and 4-year-olds seem to believe that the crucial determinant of the content of a drawing is whatever the artist intended it to be (Bloom & Markson, 1998), regardless of how much it does or does not look like that particular entity.

Children also develop knowledge about the creation of pictures. For example, Beilin and his colleagues (Beilin, 1983; O’Connor, Beilin, & Kose, 1981) reported that 6-year-old children distinguish between the production of a painting or drawing versus a photograph. They realize that the former might not represent real entities, but know that the latter has a real referent that at some specific time stood before a camera—“knowledge” that has suddenly become antiquated now that compelling “fake” photographs can be produced readily.

A related form of conceptual knowledge about pictures concerns the many different kinds of “relations between picture and referent”. For example, pictures can represent events and entities in any time frame—past, present, or future—regardless of when the picture was created. Pictures can illustrate real or fictional entities, or some hybrid between the two. Consider the dinosaurs of the movie Jurassic Park. The images on the movie screen appear to be footage of living, breathing creatures interacting with humans. The depictions were largely based on knowledge and surmisal about the appearance and behavior of the real dinosaurs, but were created using computer animation and robotics. Because of such advanced technology, the evidentiary basis of photographs, that is, the assumption that they represent reality, is being increasingly undermined.

Adults also have substantial knowledge about the many functions that pictures can serve, almost all of which have some kind of communicative intent. To complicate matters, a given picture can serve multiple purposes, and it may play different roles for its creator, the person displaying it, and the viewer of the display. The following brief catalog of the uses of pictures is by no means a complete list.

Pictures are a potent source of information. As mentioned before, infants and young children acquire new knowledge via pictures. Pictures are used to amplify or intensify a communication in some other medium—a news story about a deadly tornado has more impact when accompanied by a photograph of the fearsome storm. Pictures can update information, informing the viewer about the current state of some entity; for example, people who saw Michelangelo’s Sistine Chapel ceiling many years ago may be stunned by photographs of the vivid, cartoonish colors that emerged from its cleaning in the late 1980s. Pictures extend
human memory: We use them to **commemorate** meaningful events and people, and to **document** important results of scientific research. A major use of pictures is to **influence** others, creating a desire for a new automobile or pair of shoes.

Pictures have **evocative** power, serving as a stimulus to emotion. Religious pictures are designed to inspire awe and devotion. A portrait of a loved one evokes feelings of tenderness, and a good political cartoon can provoke laughter. Pictures also provide esthetic experiences of many sorts, from the simplest enjoyment of a picture we find beautiful to reflection on the ideas an artist is trying to convey.

Given this extensive, albeit partial, list of common functions and uses of pictures, it is clear that the appropriate interpretation and use of pictures requires a certain degree of cognitive flexibility. A viewer must figure out how a picture is to be used in a given situation. Imagine a teacher showing a reproduction of Constable’s famous painting of Salisbury Cathedral. Her goal in doing so could be to teach her students about Constable himself, about English landscape painting in the 19th century (with Constable simply being one example), or about Gothic cathedrals in England (in which case Constable himself is wholly irrelevant). A student who understands the teacher’s intention is likely to learn more from the picture about the point she is trying to make (and hence will probably do better on the test).

The development of the intelligent eye to interpret and understand pictures thus involves conceptual knowledge that is acquired over many years. The earliest, and central, aspect of this knowledge is the realization that a depicted object is not a real object, but merely a representation. With this foundation in place, children can begin to use pictures as a source of information. While they are gaining pictorial competence, however, children sometimes respond to pictures in ways that reflect their incomplete understanding.

### II. Research on Early Pictorial Competence

We turn now to research from our laboratory investigating three aspects of the very early development of pictorial competence. First, we review work on the initial acquisition of the picture concept by infants. Second, we discuss research examining very early understanding of picture-referent relations by 18- to 36-month-old children. Last, we focus on studies of 24- and 30-month-old children’s use of video as a source of information about reality.

#### A. THE MANUAL INVESTIGATION OF PICTURES BY INFANTS

In this section, we discuss research that leads us to both agree with and take exception to this statement by Lopes (1996): “No picture is seen with an innocent
eye, because we come to pictures primed with beliefs, expectations, and attitudes about systems of representation” (p. 33). As will be clear from the research we discuss, we agree that no picture is ever seen with an innocent eye, but our reason for saying so is that even young infants bring to bear whatever knowledge they have about the real-world entity depicted in a picture. We disagree with the second part of the quotation, because it lacks any developmental perspective; infants do not come to pictures primed with any knowledge about pictures or representation *per se*, resulting, as our research shows, in some very interesting consequences.

Infants in many countries are exposed to pictures virtually from birth, such as the family photographs displayed in their homes, the decals on their high chairs, and the video images on family TV sets. From a young age, infants are able to recognize objects and people depicted in such pictures and to discriminate depicted objects from actual objects. There is ample evidence for these capacities (Barrera & Maurer, 1981; DeLoache, Strauss, & Maynard, 1979; Dirks & Gibson, 1977; Hochberg & Brooks, 1962; Rose, 1977; Slater, Rose, & Morison, 1984). For instance, DeLoache, Strauss, and Maynard (1979) found that after habituating to a small doll, 5-month-olds transferred their habituation to both color and black-and-white photographs of the doll; that is, they looked longer at the photo of a novel doll. Furthermore, when habituated to color photos of a face, infants transferred to line drawings of the same face. These results indicate that at 5 months, infants perceive correspondences between objects and pictures across varying degrees of similarity.

In the same set of experiments, 5-month-old infants also discriminated pictures of objects from the actual objects (DeLoache *et al.*, 1979). When presented with a pair of stimuli, a real doll and a color photograph of it, the children looked longer at the doll. Thus, infants can both discriminate between an object and its picture and perceive the correspondence between the two. Evidence of discrimination between objects and pictures has been found, using a variety of stimuli, in 3- to 6-month-old infants (e.g., Field, 1976; Rose, 1977) and even in newborns (Slater *et al.*, 1984).

Despite their ability to discriminate pictured from real objects, there are suggestions from informal reports that infants do not understand the meaning of the differences they perceive. For example, Perner (1991) described his 16-month-old son intently trying to step into a picture of a shoe. Murphy (1978), in a study of mother–child picture book interactions, noted that the 9-month-old children “hit the pictures in the book and scratched at the pages as if trying to lift the picture from the page” (p. 379). Ninio and Bruner (1978) reported that one child observed from 8–18 months of age initially scratched at and attempted to grasp the pictured objects on the page. During the subsequent months, these behaviors decreased. In one study (Beilin & Pearlman, 1991),
even older children (3- to 5-year-olds) occasionally responded to pictured objects as if they were real objects.

It is important to know whether these reports describe isolated incidents, occasional lapses made by a few young children, or a pervasive lack of understanding of the nature of pictures. To examine this issue, we presented infants with pictures of objects and systematically examined their responses (DeLoache et al., 1998). The experimental situation was designed to permit infants to manually investigate depicted objects if they were so inclined. Each infant sat in a high chair, and a book was placed on the tray directly in front of him or her. The specially constructed book contained highly realistic color photographs of single objects (common plastic toys). The size of the depicted objects was scaled to the size of an infant’s hand (approximately 1/3 to 1/2 of actual size): If the picture were an actual object, the infant would be able to pick it up. Manual investigation of the pictures was coded from videotapes.

From the occasional informal accounts of children’s exploration of picture surfaces, it was not clear whether to expect such behaviors in a brief experimental session. To our surprise, every one of the ten 9-month-old infants in the initial study manually investigated the pictured objects. Infants rubbed and sometimes hit the surface of the pictures. They even grasped at the pictures as if trying to pick up the depicted objects. Although all the infants manually explored the pictures at least once, there was substantial variation in the extent of such activity. Some babies were notably persistent, making repeated attempts to pluck the objects from the page. One child made multiple grasps at every picture in the book. Others reacted vigorously to some but not all of the pictures, and a few were satisfied with a lone attempt.

1. The Motive for Manual Exploration

Why do 9-month-old infants manually investigate depicted objects? One possibility is that they cannot perceptually discriminate pictured from real objects. They might grasp at a picture of a toy rattle because they fully expect to be able to pick it up and shake it. By this account, 9-month-olds are totally unaware of the two-dimensionality of the surface of the pictures. Given the well-established ability of even younger infants to discriminate between pictures and objects, this seems unlikely. To confirm that 9-month-old infants could differentiate two- and three-dimensional stimuli in the context of our experimental setting, we simultaneously presented a series of objects paired with pictures of those objects (DeLoache et al., 1998). The infants almost always reached for the object first, indicating clear discrimination. Thus, when 9-month-olds rub, hit, and grab at the objects shown in pictures, this behavior does not simply reflect an inability to discriminate between pictures and objects.

A second possibility is that the manual behavior exhibited by the 9-month-olds in our research stems from the dual nature of pictures. The babies perceive
the depicted object, and in many ways it looks like a real object. In other ways, of course, it does not. The infants do not yet understand the significance of this difference; they do not know how objects and pictures of objects differ. As a result, they respond to a depicted object as if it were a real object, although more tentatively than they would to the object itself.

According to this view, babies might expect depictions to be not only “graspable” but to have the same qualities, including texture or shape, as the actual objects. If so, one would expect infants to adjust their manual investigation of pictured objects to the specific qualities of the depicted objects. To examine this possibility, Pierroutsakos (2000, 2001) presented 9-month-old infants with pictures of objects that varied with respect to texture and substance.

In one study (Pierroutsakos, 2000), the objects in the pictures varied in terms of their salient texture. All of the depicted objects had a solid handle, but the opposite end was either of the same material in a different color or a different material of a highly salient texture. For instance, one of the textured objects was a feather duster, another a spongy dish cleaner, and yet another a hairbrush. The textureless objects included a ladle, a toy hammer, and a spoon. Infants’ manual behavior was coded as to whether it was directed toward the handle or the end of the objects.

As shown in Figures 1 and 2, the infants in this study took the texture of the objects into account when manually investigating pictures of those objects. When the objects had one end with salient texture, the infants responded more to the textured end than to the handle. In particular, they very actively and persistently rubbed the depicted texture. In addition, the babies tended to grasp more at the handles than the textured ends. When presented with pictures of objects without salient texture, the infants behaved similarly to the handles and ends of the objects: They most often rubbed both parts. Thus, when the parts of the objects differed in terms of texture, infants manually investigated them differently, but when the two parts were homogeneous, the infants responded similarly to them.

In another study (Pierroutsakos, 2001), the effect of solidity was examined. The infants in this study were presented with a series of pictures, some of solid objects and some of non-solid substances. The substances included a mound of whipped cream, a pile of sugar, a puddle of applesauce. The solid objects were matched in color, overall shape, and size to the substances. The infants adjusted their behavior to the nature of the depicted stimuli: They rubbed the non-solid substances substantially more than the objects, and they grasped slightly more often at the objects than the substances.

These two studies suggest that infants expect pictured objects to have some of the qualities of real objects, that is, to be fuzzy and squishy or solid and graspable. These results indicate that infants perceive the affordances of the object depicted and tailor their behavior toward the depictions accordingly. They more often
rub depictions of salient texture or substances than solid objects or parts of objects. Grasping occurs more frequently to solid objects or parts.

2. Degree of Realism

If infants are responding to depictions as if they were real objects, one would expect their behavior to be influenced by the extent to which the depicted objects resemble their real counterparts. Pierroutsakos and DeLoache (2003) predicted that less realistic pictures (pictures that look less like real objects) would evoke less manual investigation. Four books with pictures of the same eight objects were used, but each book contained a different type of picture: (1) color photographs (as in the original study), (2) black-and-white photographs, (3) color line drawings, and (4) black-and-white line drawings. Each 9-month-old infant received only one type of picture.

The results were as predicted: Manual investigation varied as a function of the degree of realism in the pictures. The infants actively explored the color photographs, but they hardly ever felt or tried to grasp the black-and-white line drawings. Thus, the more a picture resembled an actual object, the more behavior
it evoked, supporting the idea that the infants in our studies responded to realistic depicted objects as objects.

Following this logic, a video image of an object might evoke even higher levels of manual investigation. Although video is a two-dimensional pictorial medium, it can include the depiction of motion, making an object in a video presentation even more realistic-looking than one in a color photograph. Pierroutsakos and Troseth (2003) modified the procedure used with pictures to explore infants’ responses to video. Nine-month-olds were seated in front of a monitor and watched a video presentation featuring the objects from the earlier picture studies. On the screen, the child saw a hand placing each object in turn on a tabletop, leaving it for 15 sec. Two moving objects were also included: a Big Bird toy that rocked slowly from side to side, and a mechanical snail that lumbered across the screen.

The 9-month-old infants grasped at and tried to pluck the objects off the video screen, just as children of this age did in the picture studies. The children were particularly persistent with the moving objects, often following the moving snail off the screen, repeatedly grasping at it. For example, the infant shown in Figure 3 grasped with his right hand, his left hand, then crossed the midline to grasp again with his right hand.

3. Infants’ Emotional Reactions to Video

Pictures and video images clearly evoke manual reactions that are very similar to those arising from exposure to the actual depicted objects. Pierroutsakos, Diener, and Roberts (2003) subsequently found that infants’ emotional reactions to events and objects on video also parallel their reactions to live presentations. They compared 9-month-old infants’ manual and affective reactions to a series of live events with their reactions to video images of the same events,
Fig. 3. A 9-month-old infant grasps with his right hand (top), then his left hand (middle), then makes one last attempt (bottom) to pick up a mechanical snail moving across the screen of the video monitor. In all three panels, the small inset picture shows the child’s pincer grasp directed at the depicted object.
including presentation of a series of masks and toys and of a person speaking to them. Infants were very interested in the video presentation: they looked at it, reached for the depicted entities, and vocalized in response to it. Infants also reacted affectively to the video, showing fear in response to scary masks and interest and positive affect in response to a “Simon” electronic game (that produced a series of lights and musical tones) and a person playing peek-a-boo. Video clearly has an emotional impact even in infancy. Infants’ reactions to the live presentation were somewhat stronger, however, suggesting that the infants discriminated the videotaped events from the real ones.

In addition, infants can interpret the affective responses of others shown to them on television (Mumme & Fernald, 2003). One-year-olds were shown a videotape of an adult reacting either positively or negatively to a toy. When later given the opportunity to play with the same toy, infants who saw the adult’s negative reaction via video were less likely to play with the toy and showed more negative affect. They used the video as a source of specific social and emotional information.

In summary, it is clear that infants find video presentations meaningful. They extract information from video and learn from these presentations. Furthermore, they respond to video with the same kinds of emotions and manual behaviors that they produce in response to actual objects and events.

B. GRASPING THE NATURE OF PICTURES

1. Learning What to Do with Pictures

Why do infants grasp at pictures and video images, given that they can discriminate real objects from depicted ones? We believe infants are unsure about the nature of pictures, whether still or moving, and thus manually explore them. In many ways, a picture of an object looks like the object; in other ways, it does not. Infants can perceive the two-dimensionality of a depicted object, but they do not understand what two-dimensionality means—what actions are appropriate toward such entities. Because young infants do not really know what a picture is, they start investigating.

When the depicted object turns out not to be manipulable, the infants’ lack of affective reaction (none appeared upset or even surprised) indicates that they are not committed to the belief that pictured objects are just like real ones. Their manipulative behavior toward pictorial representations thus appears to be exploratory, the same kind of manual, investigative behavior that infants direct toward other aspects of the environment.

Infants presumably learn the significance of two-dimensionality through experience with pictures. Thus, one would expect that older infants would manually investigate less, because they have had more opportunities to interact
with and learn about pictures and video. We examined the developmental course of the investigation of both pictures (DeLoache et al., 1998) and video (Pierroutsakos & Troseth, 2003), comparing the behavior of three age groups: 9-, 15-, and 19-month-old infants.

The mean number of manual behaviors that children of different ages directed at the pictures is shown in Figure 4. Exactly the same pattern of results was found with video; however, 9-month-old children directed even more manual behaviors toward the video images than they did toward the static pictures. With age, the level of manual investigation decreased. The 9-month-olds frequently rubbed and grasped at the pictures and video images, just as the 9-month-olds did in the original studies. Older children were more likely to point at the objects in pictures and video instead of manually exploring the images. In fact, 19-month-olds

![Manual Investigation](image1)

![Pointing](image2)

*Fig. 4. Mean number of manual behaviors per child directed at pictured objects by 9-, 15-, and 19-month-old infants. The same pattern of results was found with video: With age, manual investigation decreases and pointing increases.*
almost never grasped at the pictured objects, but pointed and vocalized instead. The results for 15-month-olds were intermediate. Thus, the tendency to physically explore the picture surface is gradually replaced by communication about its referent. Through experience, infants learn that what is depicted is not a real object—it is not manipulable or eatable. They learn to point to and label objects in pictures as their parents do.

2. Pictures as Symbols

A crucial question with respect to very young children’s pictorial competence is their appreciation of pictures as symbols. A child who looks at a picture of a dog and says, “dog,” could be performing a referential mapping. That is, the child’s utterance could reveal an understanding that both the word and the picture refer to (are symbols for) a real entity in the world. Alternatively, the child could simply have learned an association between the picture and word as a result of repeatedly hearing “dog” while looking at pictures of dogs.

To examine this issue, Preissler and Carey (2004) employed a simple but powerful procedure. They taught 18- and 24-month-old children a new word—“whisk”—by repeatedly pairing the word with a small line drawing of a whisk. The children were then presented with the original picture paired with a real whisk and asked to indicate the whisk. The children almost always indicated either the real object alone or the real object and the picture of it. What they almost never did was indicate the picture alone.

This result rules out a purely associative mapping, because the word had actually been paired with the picture, but never with the object. The fact that the children picked the real object, either alone or in combination with its picture, tells us that they interpreted the picture referentially. When they heard the label repeatedly paired with the picture, they assumed that the label referred to the depicted object, not to the picture itself. Thus, by 18 months of age, children appreciate the symbolic nature of pictures—a crucial step toward pictorial competence.

C. SUMMARY

We thus see that young infants have not mastered the “three R’s” needed for pictorial competence. They can be characterized as “seeing through” a picture to its referent, and they can discriminate three-dimensional referents from two-dimensional representations. However, they do not know how the two are related. Infants must come to understand the representational nature of pictures and video, that is, that the representation is not equal to the referent and does not share all of its qualities. In other words, they must appreciate that pictures are symbols for what they depict. What infants lack is not so much perceptual abilities
as conceptual knowledge: They do not initially know what kind of thing a picture is, and they investigate in an attempt to find out.

III. Young Children’s Understanding of Picture-Referent Relations

After discovering that pictures serve more appropriately as subjects of discussion than as objects of action, there is still much for children to learn about how pictures are related to reality. We and other investigators have documented a number of ways that very young children do not fully understand this relation, three of which we discuss in this section.

A. PICTURE ORIENTATION

Nothing seems more natural to adults than that a picture has a correct orientation and that the proper way to view a picture is right side up, with the depicted entity oriented to the viewer as it would be in the world. Thus, a picture of a glass of milk should be oriented with the base of the glass at the bottom of the picture and the open rim at the top. Our examination of very young children’s sensitivity to picture orientation has led us to conclude that this very strong preference on the part of adults and older children seems to be a learned pictorial convention.

Our research started with casual observations and parental anecdotes of toddlers happily looking at their picture books upside down. We verified that very young children have at best a weak preference for pictures in their canonical orientation (DeLoache, Uttal, & Pierrouatsakos, 2000). If the adult—their own mother or an unfamiliar person—who is reading a picture book to them holds the book upside down, 18-month-old children rarely protest or try to turn it. Similarly, if handed an upside-down picture to look at, they typically study it in its inverted orientation, not bothering to turn it around. Offered two identical pictures, one upright and the other upside down, 18-month-olds choose randomly, and reorient their inverted choices less than 1/3 of the time. This absence of orientation preference for pictures occurs even though: (1) much younger infants can discriminate orientation and prefer looking at certain stimuli (like familiar faces) in their canonical orientation (Bornstein, 1979; Hayes & Watson, 1981; Held, 1989; Walker, 1982); and (2) 18-month-olds have had a great deal of experience with normally oriented pictures during picture book reading sessions, and relatively little, we assume, with inverted pictures.

Young children’s indifference to picture orientation extends beyond a lack of preference for viewing pictures in their usual orientation. In two studies (Pierrouatsakos, DeLoache, & Gound, 2003), 18-month-olds were asked to identify (point to) depicted objects in quite different kinds of pictures: one book
showed four photographs of single objects on a page, whereas the other showed a colored drawing of a complex scene including many objects. The children were equally accurate at pointing to the correct depicted object, regardless of the orientation of the book. Furthermore, their latency to point to the correct item did not differ for upright and inverted pictures.

Unconcerned as they were with picture orientation, 18-month-old children seemed to have a clear preference for upright objects. Although they chose randomly between identical upright and inverted objects, when their choice was of an upside down object, they almost always reoriented it (DeLoache, Uttal, & Pierroutsakos, 2000). In contrast, they never reoriented an upright object.

The 18-month-olds we studied in this research clearly had not yet acquired the cultural convention having to do with picture and book orientation. Although they knew that picture book interactions involve pointing to and talking about pictures, they did not yet appreciate that the picture or book is supposed to be in a particular orientation with respect to the viewer. By 30 months of age, children reliably prefer pictures in their canonical orientation. We think that this phenomenon may have to do with an immature picture concept. Perhaps the mental tag, “picture of,” that signifies to children that the depiction is not a real object also removes the constraints of orientation that children apply to real objects.

B. PICTURE-REFERENT RELATION

An important part of pictorial competence involves the ability to match pictures to the reality they represent. Harris, Kavanaugh, and Dowson (1997) report a dramatic failure by children below the age of 2 years to relate a picture to what it depicts. In one condition in that research, children between 18 and 44 months observed an experimenter perform a simple action such as squirting ketchup onto a toy pig. The children were then asked to select which one of three pictures (of a clean pig, a ketchupy pig, or a pig with a white spot on its neck) showed the outcome of the action. The toy remained in front of the child as the experimenter pointed to each of the pictures, asking in turn, “Does the pig look like this?” Despite the fact that the toy with the result of the experimenter’s action on it was fully visible, children below the age of two were not above chance at choosing the correct picture. They did not seem to understand the relation between the display and its depiction.

What accounts for these rather remarkable results? We think that young children learn very early on that pictures are basically removed from the fabric of everyday life; they “provide no immediate real-world information” (Ittelson, 1996, p. 173). Most photographs in magazines and programs on television depict people and events the child has never encountered. Mr. Rogers talked directly to the “boys and girls” watching, but he was never in the same room with them;
there was no relation between their behavior and his. Even family photographs and home videos typically are not related to the present, but to past events, such as birthday parties, grandparent visits, and holiday trips. Furthermore, children’s books and television are often pure fantasy—cartoons showing violations of physical and biological principles, with people flying through the air and dogs driving cars.

Having learned that pictures are decontextualized, young children often go too far. The tag “picture of” leads them to treat pictures as irrelevant to current reality. The mother of a 2-year-old related that her daughter had appeared confused when she saw her mother working out along with an exercise video. The child repeatedly looked back and forth between her mother and the screen, as if surprised to see a relation between the two. Perhaps the youngest children that Harris, Kavanaugh, and Dowson (1997) tested chose randomly among the pictures because they did not understand that they should select a depiction of a current reality.

Children’s lack of experience with pictures related to the present may explain an apparent difference between these results and those from Preissler and Carey’s (2004) research described earlier. In that study, 18- and 24-month-old children generalized a new word to a real, novel object after that label had been applied to a line drawing of the object. To do so, the children had to relate a picture to a matching object. Why were they able to connect a picture to what it depicted in this case, but not in the Harris, Kavanaugh, and Dowson study? One possibility is that the relation between a picture of a whisk and a real whisk is what DeLoache and Burns (1994) called a generic relation—similar to the relation between a picture of an apple in an alphabet book and apples in general. A picture as a generic representation of a kind of entity is relatively common in picture books. In contrast, the relation between the pig that Harris, Kavanaugh, and Dowson squirted with ketchup and the appropriate picture is a specific relation—the picture needed to match the outcome of a particular event performed on a particular toy pig. As mentioned previously, children’s pictorial experience includes little if any experience with pictures that depict specific, current reality.

Given the difficulty that young children often have relating pictures to their referents, it should be useful to examine further the general question of what very young children can learn from picture books. Young children, and increasingly even infants, receive a great deal of exposure to pictures and picture books. As mentioned earlier, very young children spend a substantial amount of time in picture book interactions with their parents, siblings, and teachers, and learning occurs in these interactions (Gelman et al., 1998; Ninio & Bruner, 1978; Snow & Goldfield, 1983; Whitehurst et al., 1988). However, there has been relatively little research on the process through which children learn words and other information from books.
In an initial effort to examine very young children’s learning from books, the focus was on learning a novel word for a novel object from a short picture book experience (Ganea & DeLoache, 2004). Two age groups—18- and 15-month-old children—were presented with a book composed of color photographs of individual objects. Most of the depicted objects were familiar, but two were novel. The novel objects appeared repeatedly in the book; one of them was given a nonsense name by the experimenter ("blicket") each time it appeared, but the other was never labeled. Then the child was given three test trials, each involving a pair of stimuli, and was asked to indicate which was the “blicket.”

The first trial, which paired the pictures of the two novel objects, simply tested whether the child had learned the label for the picture. Both age groups performed well: 88 and 75% correct for the 18- and 15-month-olds, respectively. On the second test trial, the experimenter presented the real novel objects that had been depicted in the book to see if the child would generalize the newly learned label from the picture to the real object. Again, both age groups were successful: 94 and 81% for the 18- and 15-month-olds, respectively, revealing that the children related picture and object, as would be expected from Preissler and Carey (2004). Finally, two new novel objects that differed from the original only in color were presented to see if the children would generalize to a new exemplar of the labeled object. In this test, the two groups diverged: The older children chose the new exemplar at a rate above chance (75%) but the younger group did not (50%).

This study thus establishes that children as young as 15 months of age can generalize a newly learned label from a picture of an object to the object itself. However, their generalization is limited to the identical object that was depicted. Among the many follow-up questions raised by this study is whether more extensive experience with the novel label for the novel object would lead to greater generalization.

C. SELF-REPRESENTATION

Very young children’s trouble with picture-referent relations even extends to representations of themselves. When Ayme Warren (personal communication, May 27, 1997) allowed 3- and 4-year-olds to see a video playback of themselves participating in a study, they sometimes made comments such as, “That boy has on shoes just like mine,” and, “That boy can’t do it, but I could.” Although the events they saw had occurred within the previous half hour, these children did not appear to realize that they were watching themselves. Parents of some of the 2- and 2½-year-old participants in our studies similarly report that their children often seem puzzled or confused and do not recognize themselves on home video.
Consistent with these casual observations, in several experiments, children did not use a picture as a source of information about themselves. Povinelli, Landau, and Perilloux (1996) showed 2- to 4 \( \frac{1}{2} \)-year-old children a Polaroid photograph or delayed (by 3 min) video of themselves with a large sticker on their heads—put there minutes before by the experimenter. Most of the 2- and 3-year-old children did not reach up to remove the sticker, as children of this age did who were watching a live video. Some of the younger children who saw themselves on delayed video referred to their own image in the third person, commenting, for example, that there was a sticker on “her head.” The 4-year-olds, in contrast, usually reached for the sticker on their heads after seeing the pictorial evidence. Similar results with delayed video and photographs have been reported by Suddendorf (1999) and by Zelazo, Sommerville, and Nichols (1999).

Very young children have similar difficulty performing a simple mapping between themselves and a self-representation. DeLoache, Anderson, and Smith (1995) conducted a series of studies in which a sticker was placed somewhere on a child’s body (shoulder, wrist, ankle). The child was then asked to put a smaller sticker on the “same place” on a self-representation—a same-gender doll or a picture (for instance, a simple line drawing of a doll, an enlarged Polaroid photograph of the child, or a tracing made around the child’s body as he or she lay on a large sheet of paper on the floor). In all cases, the children placed the sticker correctly less than half the time.

D. SUMMARY

As the research described in this section shows, aspects of picture-referent relations that seem transparent to adults are not obvious to young children, even when the picture depicts an array currently visible or even the child himself or herself. Young children do not even share the very strong, and natural-seeming, preference older individuals have for viewing pictures in an upright orientation. Thus, an important part of the development of pictorial competence is figuring out how pictures and the reality they represent are related.

IV. Using Video as a Source of Information

Along with learning the basic nature of pictorial media and coming to understand picture-referent relations, very young children must learn how such media are used, what function they serve in the culture at large. One important function of pictures, and of symbols in general, is as a source of information about the real world. Here, we describe what we have learned about young children’s use of information from video to solve a problem. We center our
discussion on kinetic pictures (video); however, we have obtained the same pattern of results with various kinds of static pictures.

Symbolic media such as video are an important source of information to Western adults. Much of what any of us knows of events in the world—wars and royal weddings, sensational court trials and sporting events—has not been the result of direct experience, but rather was obtained by viewing such events on video. Those who watched the astronauts on television “live from the surface of the moon” gained information about a place and a situation they did not experience directly. On the basis of what was shown on TV screens, viewers constructed a mental representation of real events happening hundreds of thousands of miles away.

Adults routinely use information obtained from video to act in the world. We learn to prepare tarte tatin by watching Jacques Pepin on a cooking show and to swing dance from an instructional video. A television newscast of a dangerous situation (a hurricane or terrorist attack) or even a traffic jam may move us to change travel plans or to phone relatives. Viewing an event by means of video equips us with much of the same knowledge we would obtain from experiencing the event directly. Our adult response to video is flexible, however: We assume that the medium can represent reality (even depicting actual, ongoing events), but that it does not always do so.

That young children do not share adults’ understanding of video–reality relations is clear from a multitude of anecdotes. For example, Jaglom and Gardner (1981) describe a 2-year-old going to fetch a paper towel after seeing an egg break on television. In the same vein, as a 2-year-old acquaintance was watching a home video of herself and her family building a tower of books and blocks, she retrieved a block and tried to hand it to the people on the set, saying, “Here.” Incidents such as these, hearkening back to Chloe’s confusion over her father’s photograph, suggest that toddlers have much to learn about the various possible relations between video and reality. We have been particularly interested in the question of whether young children, like adults, can use video as a source of information when this is appropriate.

To examine this issue, we have employed a general procedure used previously with pictures and other representations, such as scale models and maps (DeLoache, 1987, 1991; DeLoache & Burns, 1994; Marzolf & DeLoache, 1994). We put 2- and 2½-year-old children in a problem-solving situation in which necessary information is given by means of video. Specifically, a child watches a “live” video presentation of a toy being hidden in the room next door and then tries to retrieve the toy. To find it, the child must use what he or she has learned from the representation (the video image) to form an inference about a situation in the real world (the location of the toy in the next room).

Although apparently simple, this task actually requires children to use video in a way they have probably never done before. To find the toy, children must take
what they see on a television screen as a source of information about present reality. They need to form a mental image of a real, current situation (the location of the toy in the room) based on what they see on the video monitor. This novel use of video requires children to respond flexibly to a familiar medium.

In our initial experiments (Troseth & DeLoache, 1998), we made great efforts to convey to children that live video was a valid source of information about ongoing reality. During an extensive orientation, children saw themselves, their parents, the experimenter, the furniture in the room (hiding places), and the toy on the video screen. Most children loved seeing themselves on TV and many became very engaged in interacting with their own image on the screen.

Next, children participated in four retrieval trials. They watched as the assistant walked out the door into the next room (closing it) and then saw the assistant appear on the video screen, hide the toy, and return. During this presentation, the experimenter directed their attention to the events appearing on the monitor, narrating the assistant’s behavior without labeling the hiding place. Finally, the children were asked to go into the room and find the toy.

After watching the hiding of the toy via live video, the $2\frac{1}{2}$-year-olds usually knew where to search. They immediately retrieved the toy on 79% of trials (we counted as correct only errorless retrievals, searching first in the right location). The 2-year-olds, however, frequently did not make use of the information available from video to guide their search, finding the toy only 44% of the time (Figure 5, Standard Video). Only two of the twelve 2-year-olds were highly

![Fig. 5. Percentage of errorless retrievals achieved by 2-year-olds in the video studies. The children found it difficult to use video as a source of information about current reality (Standard Video); they did better when they thought they were watching the hiding event directly through a window (Video Window), or actually did watch the event directly (Real Window).](image-url)
successful at using information from video to find the toy. The younger children’s poor performance in this task has been replicated both by us (Troseth, 2003a,b; Troseth & DeLoache, 1998, Experiment 3) and independently by other researchers using very similar video tasks (Deocampo & Hudson, in press, Experiment 4; Schmitt & Anderson, 2002).

The same age difference has been found in a problem-solving task using pictures (DeLoache, 1987, 1991; DeLoache & Burns, 1994). When the correct location of a toy hidden in a room was pointed out on a photograph, 2½-year-olds usually found it (about 80% errorless retrievals), but 2-year-olds rarely did (only 6–27% correct). It is not surprising that 2-year-olds were somewhat less successful with pictures than with video, given that video contains added information (motion, depiction of the actual hiding event). Nevertheless, our young participants did not reliably use either pictorial medium as a source of information.

A. VIDEO: NOT EQUIVALENT TO REALITY

As we continued to explore young children’s use of video, we discovered another area of similarity with their use of pictures: It is extremely difficult to convince 2-year-olds that either medium could help them to solve a current problem. In a series of studies employing several kinds of still pictures, DeLoache and Burns (1994) tried by various means to improve 2-year-olds’ use of pictorial information, but their efforts had little impact on children’s performance. Two-year-olds in our initial video study were somewhat more successful than children of this age ever were in the picture task; therefore, we thought it possible that a small amount of additional training would help this age group use the familiar video medium in the novel way required by our task (as a source of information about a real event).

One study (Troseth, 2003a, Experiment 1) was designed to emphasize the correspondence between video and reality. During four training trials, a door between the room and the adjoining viewing area was left open, so that children (seated in the adjoining area) could watch the assistant hiding the toy in the room via the video monitor and directly through the doorway at the same time. The experimenter directed children’s attention to the two views of the hiding event. On the four training trials, when they could directly see the hiding of the toy, children almost always found it (91% correct). Immediately after this training, children participated in four standard video trials with the door closed so that the only source of information was video. On the video trials, their mean level of retrievals was as low (41%) as that of 2-year-olds who did not receive training.

In another study (Troseth, 2003a, Experiment 2), we actually showed children what to do. The child and experimenter watched on the video monitor as an
assistant hid two similar toys together someplace in the room. Then
the experimenter told the child to “watch on TV” as she found one of the toys. The child watched the experimenter go into the room (closing the door), appear
on the monitor, and retrieve one of the toys, then open the door and return, bringing the toy with her. The child was then encouraged to go find the other toy. Although the children saw two toys being hidden in the same place, and saw one of the toys being found in that place, they typically did not go to that location to retrieve the remaining toy (only 38% correct).

Deocampo and Hudson (1999, Experiment 4) independently obtained similar results using a similar procedure. In one condition of their experiment, 2-year-olds did not see a hiding event, but watched on a video monitor as an adult found a toy. They were then encouraged to do just what the adult did (i.e., go find the toy in the same place the adult had found it). The children usually did not retrieve the toy (only 23% errorless retrievals).

Despite elaborate training and assistance, most of the 2-year-old participants in our studies (and those of Deocampo and Hudson) did not readily rely on that what they saw on the video monitor to tell them where to find the toy in the room. Like the 2-year-olds in the picture studies (DeLoache & Burns, 1994), our young participants generally seemed quite resistant to using a pictorial symbol as a source of information about present reality.

B. POTENTIAL SOURCES OF DIFFICULTY

Why do most 2-year-old children infrequently find the hidden toy in the video (and picture) task? Perhaps, the memories of children this young are taxed by having to remember the location of a toy that they see hidden in a room. Or, they may not be motivated to search for the toy. Perhaps, the two-dimensional video image of a person hiding a toy is not meaningful to 2-year-olds. We examine these three possible explanations in turn.

Several pieces of evidence suggest that 2-year-olds’ poor performance with video does not involve problems of memory for the location of a hidden toy. In the training study described above, children had no difficulty finding the toy as long as the door was open and they could watch directly as it was hidden. In another study, 2-year-olds watched the hiding of the toy directly through a window that was the same size and location as the video monitor (Troseth & DeLoache, 1998, Experiment 2). Everything else about the procedure was the same as in the original experiment, except that children observed the hiding event directly through the window rather than on the video monitor. Children who watched through the window always retrieved the toy—100% correct performance (Figure 5, Real Window). Thus, they had excellent memories for the location of a toy hidden someplace in the room next door.
Similar results were reported by Deocampo (2003), who explored 2- and 2 1/2-year old children’s use of information from video to solve means-end problems. This task presented difficulties for both age groups. Children were trained to criterion to use three different tools to remove prizes from specific containers (e.g., using a key to unlock a transparent box). Then, with the tools in front of them, children watched either on a video screen or directly through a window as an adult in the next room baited one of the three containers. While watching, they were encouraged to pick the tool they needed to get the treat. Children picked the correct tool more frequently after watching through a window (younger, 78% correct; older, 96%) than after watching on a video screen (52 and 64% correct, respectively). In the video condition, only 3 younger and 5 older children (out of groups of 11) picked the correct tool at a rate that was significantly above chance. In the window condition, more than twice as many children of each age were highly successful.

The children in the training and “real window” studies also showed by their success that they were highly motivated to find the toy (or retrieve the prize). We produced further evidence that this factor was not a problem in the video studies by ensuring that children were highly motivated to search successfully. After adding some larger hiding places to the room, we asked parents to get into the act. Two-year-old children intently watched the live presentation on the video monitor as their parents hid in the adjoining room (e.g., crawled under a card table covered by a tablecloth, hid behind a curtain, etc.) All the children were extremely eager to find their parents and rejoiced when they finally (with assistance) found them. Nevertheless, the children looked first in the right place on only 31% of trials (Troseth & DeLoache, 2003).

The third proposed explanation for 2-year-olds’ poor performance concerns the meaningfulness of the video presentation. Do children not use video to solve the object-retrieval task because what they see in the two-dimensional video image is not meaningful to them? Several lines of research indicate that this is unlikely. First, 2- to 9-month-old infants make sense of video images: They apparently recognize images of their own moving legs (Rochat & Morgan, 1995a,b), and they respond to the image of another person much as they would to the actual person (Gusella, Muir, & Tronick, 1988; Hains & Muir, 1996; Hayes & Watson, 1981; Murray & Trevathan, 1985; Pierroux, Diener, & Roberts, 2003; see also Walker, 1982). Twelve-month-old children recognize the emotional expression a person on video directs toward a novel toy, and this information affects their response to the real toy (Mumme & Fernald, 2003). Children as young as 14 months of age imitate novel actions they see on video, although they imitate more frequently after a person directly models the actions (Barr & Hayne, 1999; Hayne, Herbert, & Simcock, 2003; McCall, Parke, & Kavanaugh, 1977; Meltzoff, 1988). In addition, a video presentation helps young children remember behaviors they learned 10–16 weeks earlier.
Hudson and Sheffield (1999) taught 18- and 24-month-old children eight novel actions (e.g., pressing a toy bear’s paw to make it talk). After an extended delay, children were shown a video presentation of a preschool child carrying out the actions. When tested the next day, children re-enacted the behaviors at a significantly higher rate than did children who had not received the video reminder. Also, children who participate in our video experiments frequently label the people and items they see on the monitor screen, indicating that they make sense of the video image. Finally, between their second and third birthdays, toddlers learn educational content from television shows such as Sesame Street (Hughes et al., 1999). It is therefore unlikely that the video presentation is not meaningful to the young participants in our research.

Evans, Crawley, and Anderson (2004), however, voiced a specific concern about the meaningfulness of the video image in the object retrieval task. Their question was whether young children had trouble making sense of a two-dimensional representation of a complex, three-dimensional space, such as a room full of furniture. Perhaps, 2-year-old children’s problem with video (and pictures) in the task is that the depiction of spatial relations on a flat surface is not meaningful to them. Hypothetically, this could hinder children’s ability to use information from video to find a toy hidden in the room. To test this account, Evans and her colleagues eliminated the complex spatial information by presenting 2-year-old children with a verbal cue rather than a pictorial one. Children did not see the experimenter on video hide a toy in the room; instead, she appeared on camera against a neutral background and simply told them where the toy was hidden. The prediction was that the task would be easy for 2-year-olds, now that they did not have to decipher the spatial relations. In another condition, the experimenter stood right in front of the child while giving the verbal information. Although the verbal video task did not require children to make sense of a flat depiction of spatial relations, they still did not use information from video to find the toy (only 20% correct). Children who directly saw and heard the experimenter give the verbal prompt were much more successful (64%). Thus, 2-year-olds had problems with a video presentation that did not convey complex spatial information. These results suggest that children’s problems in the video task do not center on deciphering spatial relations from a two-dimensional display.

C. REPRESENTING SYMBOLIC RELATIONS

Given that 2-year-old children’s difficulties in our video experiments do not stem from problems of memory, motivation, or understanding the meaning of something seen on video, what does make the object-retrieval task so difficult for them? We think the problem arises from the particular way the object-retrieval task requires children to use information from video.
To use a video presentation (or picture) to solve a current problem requires what DeLoache (1987, 1991, 2000, DeLoache, Miller, & Rosengren, 1997) terms dual representation. Children must mentally represent both the video event actually seen and, based on that information, the real event it stands for. In other words, they must recognize the “stands for” relation between the video picture and reality. Based on what they see on the video screen, they must construct a mental model of the real event happening in the next room, and must use this model to guide their search. Then, on subsequent trials, they must update their mental representation of current conditions in the room based on information from video. We think that the 2-year-olds’ problems in our object-retrieval task are attributable in large part to difficulty in achieving dual representation. Children watch and interpret the video event, but fail to relate it to the real event.

To test this claim, we attempted to remove the need for dual representation from the video task. To do this, we tried to convince children that they were watching hiding events directly through a window, when they were actually watching a video screen (Troseth & DeLoache, 1998, Experiment 3). If children did not know they were watching video, they would not need to represent the “stands for” relation between the video image and the actual event, and the task should therefore be easier for them. They would need to represent only what they saw—an event visible through a window. (The logic is similar to that in a study of older children’s understanding of a scale-model, DeLoache, Miller, & Rosengren, 1997).

The key to the “video window” study was that the child never saw the video camera or monitor. The experimenter took the child to the adjoining area to “watch through the window” as the assistant hid the toy. She opened the curtain covering the window and directed the child’s attention to the hiding event seen through the window. Then she closed the curtain. After a 10-sec delay, the child was asked to retrieve the toy. From the child’s perspective, the situation was the same as that in the real window study described above in which children watched the hiding events directly through a window (and always retrieved the toy).

The difference between the two studies occurred “behind the scenes.” As soon as the experimenter and child entered the adjoining area and closed the door before the first trial, the assistant rolled a cart containing the monitor and video camera out of a hiding place and positioned the monitor directly in front of the window. The video screen, but not the rest of the monitor, was visible through the window. When the monitor was in place (10 sec later) the experimenter opened the curtain. After the child watched the hiding event, the experimenter closed the curtain, and the assistant removed the cart before opening the door and inviting the child to search for the toy. This sequence was repeated for each trial, so the child never saw the monitor or video camera.

The children were watching a two-dimensional video image, just like in the other video studies, but this time they were told they were watching through a
window. We compared their performance to that of a new group of 2-year-olds in the standard video situation who knew they were watching a video monitor. The performance of the children who knew they were watching video (41%) was as inaccurate as in the original study (only 3 of 16 children were correct on every trial). When the source of the information was obscured, however, performance was more accurate (63%; Figure 5, Video Window), and significantly more children were successful (9 of 16 children were always correct). The results of this study thus support the dual representation hypothesis: More children made use of the information from video when they did not need to mentally represent the symbolic relation between the video image and the actual event.

D. PRIOR EXPERIENCE

Earlier, we pointed out that children’s pictorial experience is largely, if not entirely, with pictures and video images that are not related to the immediate present. We think young viewers decide that events occurring on the tube are not relevant to the current context: They cannot really pat a kitty or taste the food on TV, and a speeding car on the screen is not going to come through their living room. Due to their prior experience, children may discount the relevance of the video presentation in the lab to the real, immediate problem they are trying to solve (finding the hidden toy).

One kind of experience that might be expected to make the video-reality connection more apparent to children is live video of themselves. Previous research suggests that the relation between a live video image and children’s own motions may be central to self-recognition (e.g., Bahrick & Watson, 1985; Lewis & Brooks-Gunn, 1979; Povinelli, Landau, & Perilloux, 1996). Contingency between children’s own movement and what they see on the monitor also may convince them that events on a TV screen can be related to the real world and hence can be informative about it.

To determine the impact of such experience with live video at home prior to their lab visit, Troseth (2003b) had parents connect their camcorders to their television sets and children saw themselves and their parents, siblings, and pets “live” on TV for two weeks. During five 10-min sessions, as children played with toys (e.g., built a tower of blocks and knocked it over, played dress-up, sent a slinky down the stairs), their every movement and the consequences of their actions were pictured on the screen. When they came to the lab, children with this prior experience used information from live video to find a hidden toy; in fact, their performance (77% correct) equaled that of 2 1/2-year-olds in the original studies.

The children also performed impressively on a later “transfer” task with still pictures. After the experimenter pointed to a photograph of the hiding place
to indicate where the toy was hidden, the children found the toy 60% of the time (much more often than the 2-year-olds in the earlier picture research, DeLoache & Burns, 1994). A control group of children who did not get the live video experience performed inaccurately on both tasks (video: 23% correct; pictures: 15%).

Therefore, children with extensive video experience may have learned something general about the information potential of pictorial symbols. Experiencing repeated opportunities to see their own actions depicted on the video screen, children apparently came to recognize that a video picture could represent reality, even when they themselves did not appear on the screen (during the hiding events in the lab). Children’s experiences with live video, in turn, enabled them to detect the more difficult relation between a static picture and a real situation. These results demonstrate that experience helps very young children to learn an important function of pictures and video images—their role as sources of information about the world.

E. SUMMARY

As we have shown repeatedly in this section, 2-year-old children have a great deal of difficulty using an event they observe on video as a guide to reality. After watching on live video as an adult hides a toy in the room next door, they usually do not know where to find it. As is true for other symbolic media, young children have difficulty achieving dual representation; they do not readily form mental representations of both the event they see on the video screen and the corresponding real event in the world. However, given extensive experience that highlights the video-reality relation, young children can use video and pictures as sources of information about real situations.

V. The Development of the “Intelligent Eye”

In this chapter, we have described some early steps in the development of pictorial competence. As we mentioned in the beginning, developing an “intelligent eye” to interpret and understand pictures is a complex and protracted process. One factor that makes the process complex is the inherently dual nature of pictures. Children must learn to both “see” the surface of a picture (the representation itself) and “see through” the picture to its referent. They must also learn about the relation between representation and referent, as well as the many functions that pictures can serve.

We focused in our research on some of the hurdles infants and young children surmount in the development of pictorial competence. First on the list is
acquisition of the picture concept—the understanding that pictures are both similar to and different from what they depict. Having figured out how pictures differ from objects, young children then learn how they are related, that is, how people use pictures to represent reality. As we have shown, picture–reality relations that seem transparent to adults are not obvious to very young children. They have difficulty matching a realistic photograph with the simple scene it represents, and their lack of facility with picture-referent relations extends even to pictures of themselves. Young children also have difficulty using video images as a source of information about reality.

In the development of pictorial competence, infants and very young children turn both an intelligent and an innocent eye on the world. With respect to seeing through pictures, to perceiving their content, the eye is never innocent. Infants and young children bring to bear whatever they know about the world when perceiving pictures. As Goodman (1976) says:

The eye comes always ancient to its work … It selects, rejects, organizes, discriminates, associates, classifies, analyzes, constructs … Nothing is seen nakedly or naked (p. 8).

In contrast, with respect to seeing the picture itself, to understanding the relation between pictures and their referents, the young eye is indeed quite innocent and only gradually becomes intelligent. The development of the intelligent eye in turn enhances the development of the intelligent mind. As the quotation from Ittelson (1996) at the beginning of this chapter highlights, we gain an enormous amount of information from a variety of pictorial media. As children develop an “intelligent eye” to interpret and understand video and pictures, they become increasingly able to use these sources of information to supplement their direct experience. The intelligent eye sees a vastly expanded world.

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IV. CONCLUSION

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Conceptualizations of cognitive development of the early 21st century differ in the domains of thinking they study and the cognitive processes they emphasize. However, these conceptualizations tend to share a constructivist approach to cognitive development. In a constructivist approach, intellectual change, which is seen as actively constructed by the developing child, results from the interaction of maturation and experience. Although some constructivist theories focus on the internal or endogenous aspects of this process (e.g., Gelman & Williams, 1998) and other theories concentrate on the external or exogenous contributions to cognitive growth (e.g., Rogoff, 1998), these theories agree that understanding how biology contributes to cognitive development relies, in a central way, on understanding how experience also contributes to this process.

Since the 1990s there has been substantial progress in the examination of the biological underpinnings of cognitive development (e.g., see Johnson, 1997). Even though a fair amount of attention has also been directed toward
exogenous contributions to this process, a systematic and principled understanding of the ways in which experience supports, constrains, and directs cognitive development is yet to emerge. Research on experiential contributions to cognitive development, especially higher mental functions such as memory, conceptualization, and problem solving, has concentrated mainly on demographic factors, like social class or neighborhood features, family characteristics like the availability of cognitive resources in the home (e.g., the number of books, the regularity or manner of parent–child reading), and task-related factors such as the familiarity or complexity of an activity or its materials. These contributions are often studied with an eye toward application, for instance to determine how a particular experience may advance or constrain intellectual growth. Less common is research devoted to the formulation of broader theoretical understanding of the role that experience plays in the development of a particular cognitive capability or domain of understanding.

Contextual approaches to development seem ideally suited to addressing this topic. Bronfenbrenner’s (1979) ecological model is an important step in this direction; however, this model describes the contexts of development quite generally and is not specific to cognitive development. Subsequent efforts to understand how social experience, in particular, contributes to cognitive development are a stepping-stone toward understanding the exogenous contributions to mental functioning. This research has concentrated on direct social contributions to cognitive development, particularly the social interactions that children have with adults and peers (Gauvain, 2001; Rogoff, 1998). There has also been attention to other, less direct but still socially based experiences of childhood that contribute to cognitive development. This research has concentrated on the symbolic and material resources that support cognitive development, the selection and management of everyday activities in which learning and development occur, and social practices that organize intelligent action (e.g., Goncu, 1999; Goodnow, Miller, & Kessel, 1995; Rogoff, 2003; Saxe, 1991).

In this chapter, I argue that investigation of the cultural context of cognitive development offers one systematic way of examining social contributions to cognitive development. The purpose of this chapter is threefold. First, I discuss how a broad-based approach to cognitive development, one that embraces multiple perspectives and levels of analysis, is necessary to understand such a complex and dynamic process. Although this general point is well understood by researchers, it bears reiteration. Second, I discuss the utility of multiple perspectives by highlighting how examination of social influences on cognitive development, broadly construed, relates to mental growth. The main point I make in this section is that examination of social influences on cognitive development is, in part, examination of the role that culture plays in this development.
Third, I use research on the development of one cognitive skill, planning or the anticipation and solution of future-oriented problems, to illustrate how culture contributes to this development. My aim is to show how examination of cultural contributions to the development of planning provides a unique and generative set of observations about this area of intellectual growth. Finally, I hope that this illustration, along with similar research cited throughout the chapter, demonstrates the valuable contribution of the sociocultural perspective to the study of cognitive development.

I. Bringing Culture into Relief

An underlying assumption of this chapter is that multiple perspectives or vantagepoints are useful, in fact necessary, to understand cognitive development. As a general introduction to the utility of studying cognitive development from multiple perspectives, consider the maps of France shown in Figure 1. The map on the left is called a political map because it provides graphical information about the major political units of the country, called provinces, as well as the location of major cities and the capital. This type of map is a fairly common way of representing nations and it is useful for many purposes. In other words, it is a perfectly fine map.

The map to the right of the figure is also a map of France; however, it is not a political map but a relief map. This map depicts spatial dimensions and relations of the country and includes major topographic features such as mountains, borders, and rivers. Though familiar, this type of map is less common than a political map. A relief map is useful for many purposes; such as to gain insight into historical alliances and hostilities or to better understand particular events such as the grueling bicycle race called the Tour de France. Like a political map, a relief map is a perfectly fine map.

These two maps contain similar but not identical information about France. In fact, they differ in some important ways, with each map allowing one to see something that is not visible in the other map. In other words, these maps provide different views of the same place and neither map is useful for seeing or understanding everything of interest and importance about France. If someone wants to discover something about France, which is the better map? The better map is the one that contains the information that the person wants to know. Whereas one map may be ideally suited to one set of questions, it may be almost useless for another set of questions. Anyone who has gone on a mountain hike and relied on a landmark or political map rather than a topographical map that magnifies the contours of the immediate terrain understands this point all too well.
Fig. 1. Political (left panel) and relief (right panel) maps of France.
These two types of maps can serve as a metaphor for discussing the utility of multiple perspectives for examining cognitive development. Just as research on developmental biology, neuroscience, and maturational constraints (e.g., Gelman & Williams, 1998; Gottlieb, 1992; Johnson, 1997) concentrates on the biological system and thereby aids understanding of this aspect of cognitive development, sociocultural approaches concentrate on the experiential aspects of cognitive development. Examination of social and cultural experiences can provide information about cognitive development that is not available in other approaches to the field. In addition, because this approach has at its center a focus on experiential contributions, it may, in the long run, help lead to a broader and more principled understanding of the role of exogenous factors in intellectual growth (Bugental & Goodnow, 1998).

Researchers working from a sociocultural perspective have identified various aspects of the social and cultural context that contribute to cognitive development. These aspects include cultural practices (Goncu, 1999; Goodnow, Miller, & Kessel, 1995), belief systems (Harkness & Super, 1996; Sigel, McGillicuddy-DeLisi & Goodnow, 1992), values (Greenfield & Cocking, 1994; Harkness, Raeff, & Super, 2000), activity structure (Saxe, 1991), and symbolic and material artifacts (Cole, 1996; Nelson, 1996). Because research examining these contributions is still relatively new, it is not yet clear how this information can be brought together in a coherent fashion to advance theories of cognitive development. This chapter has a more modest goal. It simply attempts to use one particular framework for characterizing sociocultural contributions to cognitive development to describe how consideration of culture can provide insights into one area of intellectual growth, the development of planning skills. Perhaps, over time, as research on the sociocultural contributions to different areas of cognitive development is conducted, this research will improve theory about the experiential contributions to development more broadly.

Before discussing how the sociocultural context relates to cognitive development in the area of planning, several assumptions that underlie the ideas presented in this chapter are important to lay out. Culture is seen as a necessary and defining feature of human psychological development. Cole (1996) states this point clearly when he characterizes human biology and culture as the dual legacy or inheritance of our species. These processes co-evolved and their mutually constitutive nature is not a mere side story of human history. Rather, they were critical to each other over the evolutionary course and their connection was mediated by cognitive processes (Donald, 1991). Our evolutionary ancestors were relatively weak in the environments they inhabited. One way they survived was by being smarter than their natural predators and by being able to use this intelligence in socially organized ways. Psychological capabilities critical to this process included the ability to understand the self and others, the ability to understand and use the accumulated knowledge of the social
group, and the ability to transmit this knowledge to subsequent generations (Tomasello, 1999). These ideas suggest that the study of human psychological development is in many ways the study of culture. Humans possess the ability to adopt and adapt historically formulated courses of intelligent action, the products of culture, to local and immediate needs. Transmission and refinement of these processes compose a good portion of the experiential contributions to cognitive development, at least from a sociocultural perspective. This is because cognitive development occurs in practical situations in which courses of action in that situation (i.e., ways of thinking and solving problems) that have been successful in the past and remain of value to the group are transmitted to and used by children.

What questions about psychological development can be derived from these assumptions? The main psychological question is the following: How is culture manifested at the local level? The main cognitive developmental question, an offshoot of the broader psychological question, is: How do the situations in which children develop cognitive skills reflect and transmit cultural ways of thinking? Because cultural ways of thinking are transmitted by experienced cultural members, these questions direct attention to both the social and cultural context of cognitive development.

II. Integrating the Social and Cultural Context of Development

Examination of the social context of cognitive development may improve understanding of the role that experience plays in intellectual growth for one simple reason. Most of the social contributions to cognitive development are not random but patterned. This is not to say that the pattern is transparent or simple. But there is a pattern, nonetheless, and in tracing out this pattern developmentalists may obtain better understanding of the experiential contributions to cognitive development.

In general, two types of experiences contribute to brain development: experiences that are unique to an individual, referred to as experience-dependent processes, and experiences that are common to all members of a group, such as a species or population, referred to as experience-expectant processes (Greenough, Black, & Wallace, 1987). Accordingly, the pattern present in children’s social-cognitive experiences comes from two sources. Some aspects of this pattern reflect unique social and emotional characteristics of the individual or dyad that are involved in cognitive activity. For example, in addition to the demographic, family, and task-related contributions mentioned already, individual characteristics such as attachment status (Colman & Thompson, 2002; Matas, Arend, & Sroufe, 1978), child noncompliance (Gauvain & DeMent, 1991), and maternal depression (Goldsmith & Rogoff, 1995) have been shown to regulate joint
cognitive activity in systematic ways, as well as influence the cognitive opportunities and learning that occur in these interactions. Other than the patterned variation in the social context of cognitive development that is due to individual characteristics of the participants, systematic variation also reflects the practices or behaviors that are shared by a group. Shared behaviors, such as values, beliefs, child rearing practices, socialization goals, and ways of doing things, also influence the cognitive opportunities that emerge in social situations. These shared behaviors, which reflect species-related needs, are instantiated in individual activity and they are presented to children in the form of cultural experience. Thus, to understand how social experience contributes to cognitive development, it is necessary to examine how culture helps guide intelligent action and its development.

Examination of culture as a set of values, beliefs, child rearing practices, socialization goals, and ways of behaving is consistent with contemporary definitions offered by psychological anthropologists and cultural psychologists that emphasize the socially organized and symbolic nature of culture (Bruner, 1990; Cole, 1996; D’Andrade, 1990; Geertz, 1973). Although this focus represents only one of the many different conceptions of culture that exist (Bock, 1999), an emphasis on behavior and shared meaning and their transmission across generations is consistent with the interests of developmental psychologists, particularly those who study cognitive development.

The goal of cognitive development from the perspective of the child, stated most broadly, is to become competent in the context in which the child will eventually have to function on his or her own. To accomplish this goal, knowledge acquisition must be tailored to the types of problems and demands that children encounter in their everyday lives. Thus, cognitive development is a process of socialization to the context of development so that the content, skills, and uses of knowledge that a child acquires will make sense in that context. This accomplishment would be daunting, to say the least, without the assistance of the various types of social support that children encounter regularly and provide the experiences and tools necessary for “contextualizing” cognitive development for the child. This support primarily exists in the direct social experiences children have every day with adults and other children. These various social encounters are a particularly fertile source for socialization because they are rich in culturally specific information and they are related to or connected with one another. In other words, children not only have social experiences that guide them in the development and use of cognitive skills; there is a commonality or redundancy across many of the social encounters that involve these skills. This commonality, which is rooted in culture, further enhances the opportunities for children to develop and practice valued cognitive skills.

In short, human social organization in the form of culture, defined as a system of shared meaning and action transmitted over generations, provides
the framework that unites children’s social experiences across situations and helps structure the content and process of cognitive socialization (Goodnow, 1990). Routine practices, not surprisingly, play a key role in this process. Children use the behavioral regularities in their environment to help them understand the world in which they live, to define the boundaries for expected and accepted behaviors in settings, and to represent and provide practice with the competencies that they will eventually be expected to have when they mature (Rogoff, 2003; Weisner, 1996).

The underlying cognitive base of this learning is not understood, but ideas in the developmental literature are interesting to contemplate in this regard. For instance, Tomasello, Kruger, and Ratner (1993) discuss three types of social-cultural learning—imitative learning, instructed learning, and collaborative learning—each of which has a rich history of study in developmental psychology. Other cognitive processes may also play important roles. For example, Klahr and Wallace (1976) suggest that the human cognitive system modifies itself by regularly reviewing the experiences an individual has and determining if any features are repeated. Detection and organization of regular features may then lead to generalizations, and perhaps rule-based understanding, about situations. Given that children’s participation in the repeated or regular experiences of culture forms the foundation of cultural learning (Rogoff, 2003), a cognitive process that involves some form of regularity detection may be critical to this accomplishment. Siegler’s (1996) strategy choice model may also provide insight into the cognitive processes that underlie learning in cultural context. This model emphasizes how intelligent performance often entails choosing among the alternative actions available the one best suited to a particular problem context. However, when children are young, their knowledge of the choices available and their ability to obtain a particular choice are restricted. Therefore, children can often only identify and access a choice through the assistance of another person. Across development, collaboration with adults and peers takes on different forms, but social partners continue to aid children in the selection and enactment of choices for action. Even during adolescence, when new relations with peers emerge, these social partners play an important role in mediating strategic behavior. Thus, throughout development, other people, and the cultural values and practices these people represent, help support and guide children in strategy selection and intelligent action.

In sum, better understanding of the role that culture plays in cognitive development may offer unique insights about the relation between individual maturational processes and experiences that are common to members of a cultural community and that support and direct intellectual growth. In the next section, I briefly describe a framework that specifies aspects of culture that may contribute to cognitive development in social context. This is followed by
discussion of the cultural contributions to the development of children’s planning skills using this framework.

### III. A Framework for Examining the Cultural Contributions to Cognitive Development

In general, three directions of anthropological and psychological research have described ways of thinking about culture and human intelligence that are useful for examining the cultural contributions to cognitive development. One such direction is a cultural practice view of cognition (Chaiklin & Lave, 1996; Goodnow, Miller, & Kessel, 1995). Research based on this perspective includes studies of situated learning, everyday cognition, and practical intelligence. This research takes as a starting point the idea that people learn to think in specific contexts in which human activity is directed toward practical goals. An important contribution of this perspective to the study of cognitive development is attention to the coordination between a thinker and the practical and culturally defined actions he or she performs. A main limitation is that this approach concentrates more on learning than it does on development.

A second approach to the study of culture that is directly relevant to the study of cognitive development in cultural context is the sociohistorical or socio-cultural tradition (Cole, 1996; Rogoff, 1998; Vygotsky, 1978; Wertsch, 1985). This approach emphasizes the role of material, symbolic, and social resources in organizing and supporting mental growth. The primary contribution of this approach is attention to the opportunities and constraints for cognitive development that are provided by the cultural community in which growth occurs. A practical limitation of this approach for guiding research on cognitive development is that this idea, to date, has been broad in conception. That is, systematic use of this approach to examine development in particular areas of intellectual functioning is limited. In addition, rarely are research findings based on a sociocultural perspective integrated with findings from studies on these same areas of cognitive development but influenced by other theoretical perspectives.

Super and Harkness (1986) introduced a third research approach useful for thinking about culture and cognitive development in the concept of the developmental niche. The central idea of the developmental niche is that it is not only the organism that provides structure and direction to growth but culture also possesses structure and direction and it is through the conjoining of these two organized systems that human development unfolds. Super and Harkness proposed three subsystems of the developmental niche, physical and social settings, customs of child care, and the psychology of the caregiver, that support socioemotional development. Research related to physical and social settings include the influence of adult–child and peer interaction on development;
investigations of the role of the family, the neighborhood, and the classroom in organizing and directing development; research on daily household practices such as sleeping, work, and play arrangements; and patterns of gender-segregation in children’s peer groups. Child care customs are the focus of research that examines the consequences of home-based versus out-of-home care for young children; the influence of maternal employment on child development; and practices of infant caregiving, such as carrying, exercise, and visual experience. The psychology of the caregiver is studied in research on parental belief systems, parenting styles, maternal guidance, and the role of parents in helping children regulate their emotions.

Using ideas from a cultural practice approach, the sociohistorical tradition, and the concept of the developmental niche, Gauvain (1995a) proposed three processes of culture, or subsystems of the developmental niche, that organize and direct intellectual growth. These three subsystems are the activity goals and values of a culture and its members; historical means for satisfying cultural goals and values, especially the material and symbolic tools that support thinking and its development; and higher-level structures that instantiate cultural goals and values in everyday practice and through which children participate in and learn about the intellectual life of their community. Research on activity goals and values of a culture include studies of everyday activities, such as mathematical practices, spatial problem solving, and the organization of work, and the broader cultural goals and values that define the nature, course, and importance of these activities. Historical means for satisfying cultural goals and values are represented in the tools, both symbolic and material, that support mental activity and include language, literacy, mathematical notation, navigational aids, and technology that supports thinking, such as calculators and computers. Higher-level structures and organized cultural practices connect members of a community to each other in a shared system of meaning, and include ways of organizing and presenting knowledge, such as scripts, frames, and directional systems, as well as formal (e.g., school, apprenticeships) and informal (e.g., clubs, playgroups, homework) settings in which instruction and learning take place.

An important component of this framework is the range of human intellectual experience represented in these three subsystems. These subsystems include specific behavioral features of individual activities, that is the immediate goals that structure action, as well as the broader and organized systems of meaning in which actions are embedded. Thus, implicit in this framework is the idea that culture penetrates human intellectual functioning and its development at many levels and that it does so through organized individual and social practices.

In the following sections, I use each of these three cultural processes or cognitive subsystems of the developmental niche to describe research on the development of children’s planning skills. The aim is to illustrate the type of research questions and findings that are possible when cultural contributions to
the development of one particular cognitive skill are examined. The three aspects of culture defined in these subsystems are not the only parts of culture that may be important to cognitive development. This framework is used as a set of working ideas or as a heuristic device. In addition, it is important to stress that these three subsystems of culture help organize and direct cognitive development; they do not determine it. Both maturation and experience determine the nature and course of the development of thinking in children. Because substantial discussion of the maturational contributions to the development of planning exists in the literature (see Friedman & Scholnick, 1997; Friedman, Scholnick, & Cocking, 1987; Haith et al., 1994), this research will not be reviewed here. My discussion concentrates solely on experiential contributions to the development of this ability that are related to the cultural context of development.

A. ACTIVITY GOALS AND VALUES OF A CULTURE

Human behavior and thinking occur in meaningful contexts as people conduct purposeful, goal-directed activities. In their analysis of goal-directed behavior, Carver and Scheier (1998) distinguish different types of goals, including goals that are unique to the individual and goals that are socially shared. A sociocultural approach to cognitive development concentrates on the latter, emphasizing the connection between activity structure (i.e., the means and goals that define human action, the cultural context from which they stem) and their combined contribution to cognitive development (Saxe, 1991). Research in several areas of cognitive development, including children’s mathematics (Carraher, Carraher, & Schliemann, 1985) and spatial reasoning (Gauvain, 1998), indicates that understanding of the development of these capabilities improves (a) when they are considered in relation to the goals that guide people’s actions and (b) these goals are connected with the cultural context of performance.

Although deciding on or setting a goal is critical to planning, its development is not well understood. Most of the emphasis in developmental research has been on other aspects of the planning process, such as the determination and sequencing of action steps. Limited understanding of goal formulation, as well as the development of this ability, is also an artifact of laboratory research on planning, which has tended to use structured planning tasks with specified goals (Das, Kar, & Parrilla, 1996). This method standardizes planning tasks across research participants and, therefore, is useful for studying some features of the planning process. However, it impedes the study of goal formulation, as well as limits the generalization of laboratory-based findings to real-life planning situations. Planning in everyday life tends to be ill structured, often having vague or multiple goals states (Newman, Griffin, & Cole, 1989) and typically entails complex social
processes (Heath, 1998). In addition, both explicit and implicit goals may influence the nature and extent of planning that occurs.

1. Explicit Planning Goals

When planning goals are made explicit for participants in a study, research has consistently shown that the goal of the activity influences how children and adults plan. For example, children who were given a goal that stressed accuracy while solving maze problems engaged in more advance planning than did children who were given a goal that emphasized speed of performance (Gardner & Rogoff, 1990). Adolescents who were asked to devise a plan to reach a specific and challenging goal, such as saving $3000 to buy a car by summer, planned more than adolescents who were asked to devise a plan for a vague and less immediate goal, such as saving for college (Locke et al., 1997).

Different goals for a joint planning activity may also create different learning opportunities for children when working with adults (Gauvain, 1995b). Mothers and their 3- to 5-year-old children were observed as they planned a series of errands in a model grocery store. Two experimental conditions were compared: Some dyads were told prior to the interaction that there would be a subsequent individual posttest for the child and some dyads were not forewarned of the posttest. During the interaction, the planning responsibility and the way in which the partners in these two conditions coordinated planning responsibility differed. Dyads who were aware of the posttest shared more responsibility during joint planning, a behavior that enhances children’s learning (Gauvain & Rogoff, 1989), than their counterparts who were not aware of the posttest. Furthermore, for the parts of the task when the partners did not share responsibility, mothers who were not aware of the posttest did more of the planning on their own. In contrast, mothers who were aware of the posttest gave their children more opportunities to plan on their own as the mother watched them. These results are consistent with other research findings that show that participants organize their social-cognitive behaviors in relation to the goal of the activity (Renshaw & Gardner, 1990). They also suggest that guided participation (Rogoff, 1990), and therefore opportunities to learn from joint activity, may be enhanced when particular activity goals are operative.

Children’s daily activities and the goals that structure them are often arranged by others, such as parents and the community. Research indicates that the goal of the activity influences how children plan on their own as well as how responsibility is shared when adults and children plan together. Oftentimes, planning goals are made explicit, however sometimes the goals that influence the occurrence and extent of planning reflect implicit values of a culture.

2. Implicit Planning Goals

Research also suggests a link between activity goals and the broader, more implicit goals of the cultural context in which an activity is conducted.
For example, common goals among workers and employers in industrialized settings are efficiency and timeliness. In recently industrialized nations, adult workers have been observed to change how they plan out their work days, from less temporally precise plans to ones that are more efficient and concerned with the timing of their daily activities (Inkeles & Smith, 1974). Along similar lines, workers in a milk-processing plant in the US relied on their extensive spatial knowledge of the plant to plan their evening work assignment of loading trucks for the next day’s deliveries so that the job was handled as efficiently as possible (Scribner, Gauvain, & Fahrmeier, 1984). These plans resulted in an average saving of 5 miles of walking per night for the dairy workers.

A unique contribution that a sociocultural perspective can make to understanding planning and its development is by directing attention to the connection between planning goals and the more implicit cultural values that may define these goals and how someone should go about attaining them. In some cases, the implicit goals underlying a plan may be tied clearly to cultural values. For example, in cultures in which social involvement is a central value that guides much of activity (e.g., Native Hawaiian and some Native American communities), children organize and plan their behavior at home and even in school, a setting that emphasizes individual goals, with social values in mind. Sometimes this consideration means that the plans these children devise are less efficient or effective than one would expect at their age (Philips, 1983; Tharp & Gallimore, 1988). Children from cultural groups that do not emphasize cooperative learning norms, such as middle-class European–American children and children from urban regions in Mexico, often perceive helping one another in the classroom, even during peer collaborative sessions, as “illegal” (Ellis & Gauvain, 1992). These children sometimes devise plans during cooperative activities that are less effective than one would expect from children of their age because they make plans that undermine the assigned social goal. The children apparently do not want to share too much information with classmates with whom they usually compete, even though this choice interferes with optimal performance in this task situation (Madsen & Shapira, 1970).

Planning may also be organized around tacit cultural understanding of what an appropriate goal is and what a good performance looks like (Goodnow, 1990). Certain features of intelligent performance, such as the generalization or completeness of a plan, the idea that a good plan is made entirely in advance of action, and that steps in a plan should not be repeated, may reflect the goals and values of a culture (Goodnow, 1976). For instance, the propensity among Western thinkers to generalize information may hinge on cultural values that regard a search for universals or principles across events as important and worthy of pursuit (Cole, 1996).

In sum, activities and the goals that guide them are often expressions of culture. Better understanding of the cultural origin of goals that organize and guide
planning will provide insight into the planning process as well as to the development of this skill. Regardless of whether the goal is explicitly or implicitly linked to cultural values, to understand planning and how this ability develops, it is important to study the goals that guide people as they plan. This point has implications for both theory and methods of research. Theoretically, a complete account of planning and its development will not be obtained without an understanding of the goals that organize, direct, and give meaning to this cognitive process. To understand goal formulation it will be necessary to sort out when and how cultural values—instantiated in everyday activities and the planning of these activities—play a role in the development and expression of planning skills. In terms of methods, better understanding of goal formulation and planning will help researchers distinguish instances in which children plan poorly due to limited competence and when planning reflects goals other than those presented by the investigator. As shown in the classroom research cited previously, social goals may override individual performance goals in a planning situation. Unless one is knowledgeable of cultural values, such as an emphasis on social coordination, children may be identified as poor planners when their plans may actually be organized around a cultural goal.

B. MATERIAL AND SYMBOLIC TOOLS FOR SATISFYING CULTURAL GOALS AND VALUES

Material and symbolic tools or artifacts are developed and used by cultural communities to guide and support mental activity. Such tools not only enhance thinking, they can transform it and, in so doing, they channel cognitive development in unique ways (Vygotsky, 1981). There has been extensive analysis of the connection between material and symbolic tools of a culture and human intelligence (e.g., Ascher, 2002; Goody, 1977). Historical analyses have taken this topic in fascinating directions by documenting how the tides of history have turned dramatically as a result of the introduction and use of particular material and symbolic tools (e.g., Crosby, 1997; Maier et al., 2003).

Acquiring competence at using cultural tools that support cognitive activity is an important developmental achievement with critical consequences for the development of thinking. For example, if a person knows how to use a map or other navigational tool, extensive travel will not only be more successful; it is also more likely. Recall the Puluwat navigators studied by Gladwin (1971) and Hutchins (1996). The great distances these seafarers travel using star paths and a traditional navigation system are a prime example of tool-aided intelligent action.

Researchers have examined the influence of a variety of tools, both material and symbolic, on cognitive development. For example, research on the development of map-reading skills shows that even preschoolers can acquire
some integrated knowledge about the relative positions of locations from a map and this knowledge can aid subsequent travel (Uttal & Wellman, 1989). In this case, an external, symbolic representation, a map, mediates and enhances cognitive activity. This finding suggests that the success or failure by a child on a map and wayfinding task not only reflects the child’s spatial and representational skills. It also reflects the child’s experience with a system of representation or tool available within a particular cultural context.

An important aspect of the integration of material and symbolic tools and human intelligence pertains to tools for planning and how children come to understand and use these artifacts. Psychological research suggests that involvement with more experienced cultural members who demonstrate and convey the use of such tools may be a critical part of the development of planning skills (Cole, 1996; Olson, 1994; Wertsch, 1998). Through the use of these “tools for thinking” a child’s mental functioning acquires an organized link to sociohistorically formulated means of planning transmitted through these tools. To illustrate this point, I discuss research on how children use a cultural tool specific to planning.

1. Cultural Tools for Planning

Cultures create many forms of external representations. These representations store and communicate valued information, especially information that is difficult to remember or generate spontaneously, and they are used to guide intelligent action. Established plans are one type of external cultural representation. Such plans are ubiquitous in literate cultures and they appear in many forms: step-by-step diagrams for making objects; recipes for cooking; patterns for sewing and construction; directions for playing games and using equipment; maps for travel. There is evidence that children have experience early in life with established plans. Heath (1983) observed these types of artifacts in both communities in the southern US that she studied. She found that these artifacts were given privileged status in the home, that is, they were well taken care of, and placed in secure locations. Moreover, Heath discovered that most of what children knew about these artifacts came from social interaction with more experienced people, especially parents. As these observations suggest, the sociocultural contribution to the development of skill at using established plans comes in two forms: through the provision of the plans themselves and through social interaction with more experienced partners who provide children with opportunities to learn about and practice using these plans under their tutelage.

Most research on the development of planning has examined spontaneous planning, that is, the generation of a novel plan. Additionally, this research has largely concentrated on how children plan when they work on their own.
The development of skill at generating novel plans is an important part of mental growth and research has made substantial progress in describing this development (e.g., Friedman & Scholnick, 1997; Haith et al., 1994). However, skill at using established plans is also a significant developmental achievement. Moreover, these two abilities may be related to and influence the development of each other. After all, generating novel plans and using established plans rely on some of the same underlying knowledge. They both require the understanding that future behaviors can be planned in advance of action, that an activity can be decomposed into a set of actions or operations, and that these actions can be organized in an ordered sequence to achieve a goal.

To study how children understand and use established plans to guide action, as well as how more experienced cultural members help children learn about these artifacts, we videotaped 32 mother–child dyads, in which children ranged from 4 to 7 years of age, as they used a pictorial, multi-step plan to construct a toy (Gauvain, de la Ossa, & Hurtado, 2001). Before and after the children interacted with their mothers, children worked on a similar activity on their own. Our observations focused on the participants’ use of the plan. We observed how often they made verbal and nonverbal references to the plan, how long these references were, and whether they occurred before, during, or following an action. Performance was measured by identifying whether the toy was constructed according to plan and whether pieces were omitted when the task was completed.

Even before the children worked with their mothers, they used the plan to construct the toy. During the initial solitary task, no children ignored the plan, not even the 4-year-olds. However, on this pretest, older children, especially the 6- and 7-year-olds, showed more extensive and effective use of the plans than younger children did. Older children looked at the plan more often and their looks were longer than the looks made by younger children. Older children also performed better, that is, they followed the sequence represented in the plan more faithfully and they were less likely to have pieces left out when they were done.

During the interaction, maternal instruction reflected these age-related differences. Younger children received more information from mothers at the outset of the interaction about what a plan is, as illustrated in the following comment made by a mother of a 4-year-old:

“OK, look, look, look. Look at the picture. See, this is what we want to make, right? And so this is where we have to start. So we have to lay this down like that, OK … with me? OK, get one of these. Here, you do the screws. Here, I’ll hold it.”

None of the mothers of 7-year-olds and only two of the mothers of 6-year-olds provided any introductory remarks about the plan. And when such information was provided to older children, it assumed more knowledge of plans on the
child’s part than was evident in the remarks made by mothers of younger children. Contrast the detail in the introductory comment just presented with the following introductory comment a mother made to her 6-year-old:

“We look at the instructions, number one, right? (Pointing to Step 1). This is what it is going to look like. What pieces do we need?”

In addition to these types of introductory comments, mothers also made comments about the plan during the interaction, and the information provided for younger and older children differed. Younger children received very specific information about how to use the plan. For example, one mother and her 5-year-old had the following exchange.

Mother: Let’s see. So what piece do you need for number four? What new piece do you need? (Child holds up a piece) OK … now what? Can you see where it goes? (Child points) Mmm. We need to get it in the same spot as this one. So where do you think it needs to go?
Child: I don’t know.
Mother: What does it look like here in the picture? (Child points) Yeah, those go through, but what does it go through? See what’s in the picture? (Child looks at picture) OK, good.

In contrast, mothers communicated more general information about plans and how to use them to older children. This information included the importance of aligning the plan with the object under construction and particular conventions of representation, like expansion or detail drawings. In the following excerpt a mother tells her 6-year-old what a detail drawing is:

Mother: Well, let’s see what you got. Umm … look. It shows that it goes around, and they show those. See this little circle? (Referring to an inset detail drawing).
Child: Yeah.
Mother: This kind of blows up, shows up close what this is … what you want to do is put the square thing on one side and this thing on another side. Then this thing. Then the screw. See how they blow it up here? That’s just showing you.

After interacting with their mothers, children worked on their own again on a task that involved making another toy using a plan. As on the pretest, older children referred to the plan more often both before and during action and their looks at the plan were longer than those made by younger children. All these behaviors were related to more accurate performance, with the greatest change from the pre- to the posttest observed among 6-year-olds.

This research suggests that by the early school years, children understand both the function and use of this type of artifact. Also, between 4 and 7 years of age, children are developing skill at using this type of cultural tool to guide goal-directed action. Age-related understanding of plans was also evident in how mothers instructed their children, which reflects Vygotsky’s (1978) notion of the zone of proximal development. Finally, this type of guided social interaction was
particularly beneficial for 6-year-old children, suggesting that this age may be a
growth point for the development of this type of planning-related skill.

By documenting age-related change in children’s understanding and use of a
type of cultural tool that aids thinking, this research illustrates one of the unique
contributions of a sociocultural approach to cognitive development. Another
related contribution might be better understanding of the connection between
cognitive skill at using a particular artifact and similar cognitive abilities that do
not involve the use of these tools. In other words, after changes in children’s
understanding and use of cultural tools in an area of cognitive development are
understood, attention can turn toward the broader cultural developmental
question: How do these two types of competence (e.g., planning that relies on
these artifacts and planning that does not rely on them) relate to each other?

To examine this connection in the area of planning, Vygotsky’s (1981) ideas
about the development of scientific and spontaneous concepts are useful. For
Vygotsky, scientific concepts do not solely pertain to scientific material. Rather
scientific concepts include any understanding that is hierarchical, systematic, and
logical. Vygotsky argued that scientific concepts are cultural products and
therefore children learn about them through formal instruction and through less
formal social interaction with knowledgeable and supportive partners. According
to this definition, understanding an established plan is a scientific concept. In
contrast, spontaneous concepts emerge from children’s immediate everyday
experiences and their reflections on them, which may or may not be guided by
experience with others. For Vygotsky, spontaneous concepts are not organized
systematically; however, Vygotsky’s notion of systematicity was rooted in the
creation of hierarchical taxonomies (Nelson, 1995). Understanding hierarchical
relations entails learning abstract relations of inclusion. Thus, one of the main
reasons that the concepts Vygotsky called scientific result from experience with
other people is because the linguistic system that specifies these abstract relations
is needed to organize this knowledge, and this system is learned from experiences
with others. Thus, according to Vygotsky’s characterization, the plans that
children generate on their own are examples of a spontaneous concept.

Vygotsky did not consider either of these types of concepts more important or
“natural” than the other. Even though spontaneous concepts derive from
everyday experience, scientific concepts also stem from natural aspects of
children’s lives, namely experience with cultural institutions and more
experienced partners. Vygotsky considered these concepts related in a bootstrap
fashion, that is, the child needs some experience with a spontaneous concept to
learn the related scientific concept. However, after a child begins to learn the
scientific concept, it can be learned more rapidly than the related spontaneous
concept because supports for this learning are provided by the social context.

Applying this framework to the development of planning, one could
hypothesize that children’s spontaneous planning should emerge earlier than
competence at using established plans because children’s developing interests, their opportunities to act on these interests, and the emergence of future-oriented thinking would direct children toward anticipating and planning their own behaviors. However, after children are able to understand the nature of established plans, especially the actions they represent and how to deploy these actions effectively to reach a goal, the ability to use such plans should proceed more rapidly than spontaneous planning abilities. This is because, as external tools of representation, established plans alleviate the need for the child to do all aspects of the planning on his or her own. In other words, these artifacts take on some of the cognitive requirements of planning that may overtax young or inexperienced children by helping them remember the steps of the plan or identify easily overlooked steps that are critical for reaching the goal.

Our observations are consistent with this interpretation. Preschoolers’ basic knowledge of planning, which has been demonstrated in laboratory research (see Haith et al., 1994), helped them understand established plans. By age 7, children appeared to have substantial competence at using such plans and they were able to carry out a more elaborate plan using the artifact than they would be able to generate on their own at this age. The assistance that children received from mothers in these interactions was tailored to the children’s developing abilities in this area of cognition. Social experiences like this, which are a part of cognitive socialization, may aid children as they learn to enact pre-set plans. And, as Vygotsky suggests, they may also help children understand the planning process more generally.

2. Cognitive Socialization to Cultural Tools

Interactions involving cultural tools reflect a specialized aspect of cognitive socialization—a process that sensitizes the child to these artifacts, the representational conventions they contain, their utility, and their value. By examining the role of representational tools in adult–child cognitive activity, research can describe one way in which culture is integrated with intelligent social activity and may become part of individual cognition. Experience with cultural tools is abundant in childhood (e.g., see Liben, 2003, on the development and understanding of photographs as spatial and expressive representations). Many aspects of cognitive development involve some type of external representation. Researchers working in these areas may benefit by attending to the ways in which cultural tools are integrated with intelligent action over the course of development. Guidance from more experienced partners plays a critical role in introducing and refining children’s use of cultural artifacts. However, to be effective, this guidance must be tailored to the developmental needs and interests of the child (Vygotsky, 1978).

There has been little systematic investigation of how children are brought into this representational aspect of culture, yet we know that they are. More
specifically, despite several decades of research on the development of planning, there is little understanding of how this process is aided and perhaps constrained by external representations of plans. And not only is little known about how children’s understanding of these artifacts develops and integrates with thinking and action, even less is understood about how the existence of plans in a culture may affect when and how we plan. According to Vygotsky (1981), the introduction of a cultural tool transforms human activity, and in so doing it changes the social community. In other words, tools, what Vygotsky called mediational means (Wertsch, 1998), transform how people understand and interact with the world.

In the analysis of tools of thinking and the development of skill at using such tools, it is important to remember that these tools do not create the cognitive process. That is, the presence of established plans in a culture does not create planning. The human mind is able to organize future actions and much of planning is done mentally. However, plans are sometimes represented externally, and it is these external instantiations of plans and their relation to human action and cognitive development that is the focus of our discussion. Olson’s (1994) analysis of the influence of literacy on memory suggests that cultural tools that aid thinking may have profound effects on cognitive processes and their development. Moreover, these influences may stretch beyond the actual practices that employ these materials, a provocative idea indeed. Although established plans may not transform human cognition as extensively as some of other cultural tools that have been studied (e.g., literacy and mathematical notation and representation), plans nonetheless impact human action in many ways. For example, the fact that an established plan exists may make an otherwise untenable course of action possible, like assembling a child’s bicycle at midnight on December 24. It remains an open question as to how the existence of plans in a cultural community transforms intelligent action more generally and how the presence of such artifacts impacts the development of this particular skill.

Sociocultural research on artifacts, both symbolic and material, introduces new lines of inquiry to the study of cognitive development. More explicit and systematic research on the development and use of artifacts that support and organize intelligent action is needed. This research will provide a glimpse of the social and cultural foundation of cognitive development that is not found in other approaches in the field. In other words, the developmental side of Norman’s (1993) analysis of “things that make us smart” has yet to occur.

Attention to the impact of computers on children’s thinking is an interesting case to the contrary and both the benefits and limitations of this technology on children’s thinking and learning have been shown (Packard Foundation, 2000). The interactive features of computers can help create environments in which children learn by doing, receive feedback on their current understanding and skill, provide rich and integrative access to information, and foster the
development of new knowledge (Bransford, Brown, & Cocking, 1999). However, computer use, both in and outside the classroom, is more limited than is generally assumed and when it does occur, it usually does not reflect either the pedagogical or imaginative potential of the technology (Cuban, 2001).

A cautionary comment regarding cultural tools and the development of thinking is in order. The introduction of a new tool to aid thinking, especially one with such pervasive uses and implications like the computer, may temporarily bring issues about thinking and cultural tools to the foreground. However, after tools of thinking become institutionalized or entrenched in a community, concern with the connection between the tool and the mind tends to fade and the actions that rely on these tools become increasingly identified as “the way” of doing something. For researchers, this process of cultural absorption may make the relation between established cultural tools and cognitive development easy to overlook and, therefore, difficult to study.

The final challenge left to researchers in this type of analysis is to understand the relation between cultural tools and mental development without adopting a materialistic view in which the tool itself wholly determines thought and action. Awareness that cultural tools influence the development of the mind does not mean that these tools specify the mind. As history has shown, humans are active agents in the construction, reconstruction, and rejection of tools of thinking.

C. HIGHER LEVEL STRUCTURES AND CULTURAL PRACTICES

Organized institutions and social practices are developed by cultures and occur in tangible and intangible forms. Tangible forms include kinship structures, formal institutions like schooling and government, and organized social behaviors such as routines and rituals. Intangible forms include belief systems, as well as conventions of speech and behavior, such as scripts and etiquette. These higher-level structures and cultural practices allow people to share their knowledge and traditions with one another. They also help connect members of a community to each other and to a shared system of meaning. Examples of the connection between cognitive development and cultural ways of organizing and communicating knowledge exist in the developmental literature in research on belief systems, schooling, family structure, scripts and other pragmatic conventions, and children’s participation in routine, everyday activities.

1. Participation in Routine Activities

Interest in children’s everyday experiences and the cultural values and practices that give them shape has increased since the 1990s (Goncu, 1999; Goodnow, Miller, & Kessel, 1995). The goal of this research is to describe how cognitive development is connected to children’s participation in the activities in
their community (Rogoff, 2003). One of the most difficult aspects of examining planning in real-life situations and in cultural context is that for a good portion of every day people participate in routine and highly practiced activities. The routine nature of these activities appears to alleviate the need to plan. However, as Randall (1987) points out, even when someone is carrying out a highly routinized activity, some planning is typically required. Two situations are rarely identical and even a well-practiced routine needs to be monitored and updated along the way to ensure that the goal will be reached. And, quite often, social or environmental conditions arise that necessitate a change of routine or, in other words, a new plan.

Both anthropological and developmental research suggest that the use of routine plans is a conscious problem-solving process that involves the selection and execution of future-oriented behaviors, and that the ability to engage in these behaviors effectively is a developmental achievement (Randall, 1987; Rogoff, Gauvain & Gardner, 1987). Developmental change is evident in how children select a routine among those available for a given circumstance, how well they carry out this routine, and how effectively and efficiently they alter the routine if needed. Thus, planning within the context of everyday activities occurs before and during action. Research that examines the connection between scripts and plans and how children learn to coordinate these effectively in their actions shows developmental change from the pre- to early school years in this ability (Hudson, Sosa, & Shapiro, 1997).

The idea that even routine activities involve planning is not all that unusual if one recalls that the development of skill at selecting and carrying out routine plans is often used to evaluate child competence. Many child assessments ask about the child’s ability to carry out routine actions specific to the child’s age group. Also, consider how proud parents are when they can say that their child knows how to do a particular routine, such as getting ready for school in the morning.

Connecting routine plans to the cultural context of development is an interesting part of this story. Some research describes children’s learning of routine plans that are valued in their cultural community. Bril and colleagues (Bril, 1986; Bril & Roux, 1993; cited in Schliemann, Carraher, & Ceci, 1997) examined how young girls in a Mali village learned to do goal-directed tasks, such as crushing and pounding condiments or cereals that involve multiple steps. Although explicit instruction in these practices by mothers was not observed, by age 5, girls in this community displayed skill at these activities, which included the temporal organization of the operations of which they are composed. Observations also indicated that some planning was involved in the collection of the materials children needed to do these activities and that, with increasing age, the children’s plans reflected efforts to optimize their actions to reach the goal. In other words, the children created action plans for routine activities so that they became more efficient over time.
This example is interesting in that it describes the development of knowledge about and execution of routine plans and the connection between cultural values and these routines. Incidentally, these age-related findings are consistent with laboratory results. Whereas preschoolers can devise and execute simple plans in advance of action (Wellman, Fabricius, & Sophian, 1985), by 5 years of age children are able to solve problems that require arranging four to five moves in advance of action (Klahr & Robinson, 1981) and they consider more alternatives and correct planning errors more readily than preschoolers do (Fabricius, 1988). Perhaps, the development of skill at creating more efficient plans within the context of routine performance, at least on work-related tasks, is consistent across cultures or universal.

2. Planning Everyday Activities in Middle Childhood

One way to understand how higher-level institutions and cultural practices may contribute to the development of planning skills is to examine some of the everyday practices of parents and children. Research may determine if and how these practices provide opportunities for the development of planning, as well as whether these opportunities and their related outcomes vary across cultural communities. In our laboratory, we have investigated this process during the period of middle childhood (Gauvain & Perez, 2004). We are interested in planning during this period because, at this time, children’s activities are still managed to a large degree by their parents. However, the expectations of adolescence, which include substantial responsibility for planning and managing everyday experience, loom large on the horizon. Our research concentrates on family practices that may help prepare children for these impending expectations. More specifically, we are interested in whether children have opportunity to develop and practice planning skills in their everyday experience outside of school, how parents are involved in this process, and whether these practices are similar in European–American and Latino-American families, communities that hold differing views on the timing of child independence (Delgado-Gaitan, 1994).

These questions reflect theoretical interest in the connection between cultural values, children’s everyday activities, and cognitive development. They also reflect practical concerns about how children learn to manage their own time outside of school. This practical concern is fueled by research that indicates that children’s lives outside of school during middle childhood are harried and stressful (e.g., Belle, 1999; Elkind, 1981; The Packard Foundation Report, 1999). Children’s after-school time, at least in the US in the middle of the 20th century, had been reserved for leisure and homework (Wartella & Mazzarella, 1990). Reality shifted dramatically in US middle class homes by the end of the 20th century however: Now children’s after-school hours tend to be heavily scheduled. Children shift from activity to activity with few breaks in between and many of these activities emphasize performance and achievement.
Furthermore, much of children’s time outside of school is controlled and supervised by adults. In addition, research has shown that opportunities for children to plan and make decisions about their activities at school are greatly restricted during these years (Eccles & Midgley, 1990). This pattern, which is the result of many societal changes, is of great concern to researchers, educators, policy makers, parents, and even politicians. We are interested in the relation between this social pattern and the development of planning skills. It appears that children during the formative years of middle childhood may have little opportunity to develop and practice planning either at home or at school.

To pursue this topic, our research focuses on what children do after school and the roles of parents and children in European–American and Latino-American families in deciding on this participation. Parents differ in their support and encouragement for development during middle childhood (Jacob & Eccles, 2000). Some of these differences are rooted in culturally based expectations that parents have about the pace of development, and these expectations influence how parents interact with their children (Sigel, McGillicuddy-DeLisi, & Goodnow, 1992). Research has shown cultural variation in parental expectations about development in a wide range of abilities (Goodnow et al., 1984; Gutierrez & Sameroff, 1990). This research suggests that parental expectations may influence the opportunities children have to develop and practice planning in the family.

We examined the expectations that parents in two cultural communities have about when in childhood children are capable of planning on their own. We also studied how these parental expectations relate to the opportunities that parents provide for children to plan their own after-school activities. Latino-American parents expect that children’s competence at planning will emerge at older ages than European–American parents do (Savage & Gauvain, 1998). However, acculturation to middle class values and practices in the US, which includes greater emphasis on children’s independence, results in a lowering of the age at which Latino-American parents expect children to be able to plan their own activities. We hypothesized that the opportunities that parents in these two communities provide for their children to develop and practice planning skills outside of school would relate to their cultural expectations regarding these developing abilities. We also predicted variation within the Latino-American community, with the acculturation status of parents contributing to this process (Delgado-Gaitan, 1994).

European- and Latino-American children and their parents (79 European–American, 61 Latino-American) visited the laboratory once a year for three years, beginning when the children were 7 years of age. Among the Latino-American parents, English was the primary or sole language spoken at home for about 60% of the mothers, who we considered more acculturated, and Spanish was the
primary language for the remaining 40%. Each year mothers and children were asked about the children’s after-school activities and who decided on these activities, the parent, the child, or both parent and child. Mothers were also asked about their beliefs about the development of planning. Specifically, they were asked about the age at which they expected most children to be able to decide on or plan various organized (e.g., music lessons, sports teams) and informal activities (e.g., decide what to watch on TV or what toy to play with) that are typical for this age group.

Throughout middle childhood, parents and children in both communities were involved in planning children’s organized after-school activities. Shared planning may have dominated for organized activities because these activities tend to involve a time or monetary commitment from parents and children. Parental involvement in this decision-making may have served as a scaffold for the development of children’s planning for these types of activities. In contrast, children had more opportunities to plan their own informal activities, and these opportunities increased and parental planning of these activities decreased over the three years of the study. For example, when children were 7 years of age parents were often involved in arranging play dates for their children and even deciding on the children’s play activities. By 9 years of age, most children were making these types of decisions on their own or in collaboration with peers. Apparently, over middle childhood responsibility for planning informal activities shifts from parent to child, as evidenced by changing patterns of participation by parents and children over this period.

Cultural differences in the timing of this shift appeared. Consistent with the European–American value on child independence, child-only planning occurred at an earlier age for children in these families than it did for children in Latino-American families. In the Latino-American families, children in more acculturated families engaged in child-only planning at a younger age than children in less acculturated families did. Finally, parental expectations were linked to parenting practices. The age at which parents expected children to be able to plan on their own was related to the timing of the opportunities that parents provided for children to practice these skills at home regarding their own informal activities. Latino-American parents, who as a group expected children to develop planning skills later in middle childhood than European–American parents did, were more likely over the years of the study to plan their children’s after-school activities for them or to help their children plan these activities. In contrast, European–American parents often let their children make these plans on their own.

These results indicate that opportunities for children to learn about and practice planning outside of school change over middle childhood. This research also demonstrates that support for the development of planning exists in the family context and that variability in opportunities for the development of these skills in
the home are explained, in part, by cultural expectations or beliefs about the development of child competence at planning.

This study illustrates how consideration of the role of higher-level structures and cultural practices can broaden the scope of research in cognitive development as well as improve understanding of the organization of children’s everyday experiences in relation to learning and intellectual growth. Parental expectations about child development are one type of higher-level structure or cultural practice that may affect cognitive development. Higher-level structures and cultural practices provide children with an introduction to the ways of thinking and behaving that are available in and important to their community. These structures and practices help children learn about cultural ways of thinking and behaving through their participation in them. The changing roles and responsibilities that appear in children’s participation can serve as an index of development in these areas of growth (Rogoff, 2003). In addition, because these activities typically occur in social settings, they also provide children with opportunities to be instructed by and observe more experienced individuals as they engage in these behaviors.

IV. Conclusion

In some ways this chapter covers familiar ground. Several of the key ideas on which it is based have been in the developmental literature for a while, such as a sociocultural perspective, the Vygotskian approach, and collaborative learning. New to this chapter is an effort to use these ideas in conjunction with research findings in one area of cognitive development to illustrate how a cultural contribution may advance understanding of the development of this particular cognitive capability.

The framework that was used to characterize cultural contributions to intellectual development does not capture all the aspects of culture that are important to examine. Several other approaches within the sociocultural tradition also shed light on this connection. For instance, some research examines how universal tasks of human development—specifically relationship formation, knowledge acquisition, and the balance of autonomy and relatedness in reaching maturity—provide cultural pathways to development, including cognitive development (Greenfield et al., 2003). Other research examines cultural influences on children’s participation in school-related cognitive activities, such as mathematics, but outside the school setting (Guberman, 1999; Saxe, 1991; Schliemann, Carraher, & Ceci, 1997). Still other research emphasizes the ways that children learn by actively observing and “listening-in” on ongoing activities in their cultural community (Rogoff et al., 2003). Finally, observation of children as they engage in collective, collaborative activities in sustained
nonschool settings with a focus on the creation and transmission of shared knowledge represents a particularly innovative approach to studying cultural contributions to cognitive development (Nicolopoulou & Cole, 1993). The main message conveyed in this body of research is that it is possible to specify dimensions of culture that are relevant to cognitive development and that, by so doing generate unique questions, observations, and insights about the course of intellectual growth.

In a general sense, a sociocultural approach to cognitive development relies on a simple yet powerful assertion of cultural psychology: Culture is an inextricable and necessary part of human history that exists and is maintained through the psychology of its members. If this assertion is true—and there is no reason to think it is not—then those who study cognitive development should be able to find culture in the processes that they investigate. The tricky part of this endeavor is knowing what aspects of culture to bring into relief. Also challenging is the fact that when cultural contributions to cognitive development are studied, no definitive test or experiment is possible. Because of the complex nature of human cognition, the embeddedness of mental processes in the shared activities and meaning of culture, and the intricate and complex relation between the thinking of the investigator and the thinking that is the object of study, no “true experiment” can be conducted that will clearly and definitively describe the connection between culture and cognitive development (Greenfield, 1997). What is important to stress is that all the extant evidence points in the same direction: Culture contributes in meaningful ways to the content, process, and timing of cognitive change.

Understanding the connection between culture and cognitive development will accrue slowly, over many studies and areas of focus. Over time, a general pattern will be revealed. To this end, sociocultural research could benefit from research that combines rich descriptions of cognitive processes in cultural context with empirical investigations of basic assumptions of this approach (Campione et al., 1984). Determining which assumptions need to be examined in any particular area of research will not be easy. In cognitive terms, culture operates largely as a set of unexamined or tacit assumptions about the way things are done.

Developmental psychologists, like other social scientists, cannot ignore the contributions of culture in their research. Ignoring the contribution of culture to cognitive development may exact a huge price, similar to the price a hiker pays when he or she does not use a topographic map but goes on the mountain hike anyway. Sometimes, usually with a little luck, the hike works out fine. Other times, one may end up courting disaster. Similarly, in research on cognitive development, it is important from the outset that the investigator consider what role biology and what role culture may play in the processes under study (Li, 2003).
Along these lines, it is also important to remember that even though this chapter concentrated on the contribution of culture to the development of planning skills, biological contributions are also an important part of this story. Two particular maturational changes play significant roles in the development of planning in the age ranges touched on in this chapter, and these biological changes connect with experiences in a reciprocal fashion over the course of development (Gottlieb, 1997). Maturational changes that occur between 5 and 7 years of age (i.e., the 5–7 shift), particularly changes in the prefrontal cortex, contribute substantially to the development of planning at this period (Pennington, 1994). Also, biological changes associated with puberty contribute to changes in planning abilities in the early years of adolescence (Spear, 2000). What is interesting in relation to our discussion is evidence of universal recognition and adaptation to these maturational changes in relation to planning. That is, cultures exhibit similarity in the type and magnitude of future-oriented behaviors for which children are expected to assume responsibility during these transitional periods (Rogoff et al., 1975; Schlegel & Barry, 1991).

The increased complexity in reasoning skills, including problem solving and planning, that appears between 5 and 7 years of age has direct consequences for the responsibilities children are expected to assume in the household and the community at this time, including infant and toddler caretaking, running errands, gathering and distributing food, and learning valued skills at home and at school (Weisner, 1996). At the transition to adolescence, anthropologists have observed that in both industrialized and nonindustrialized societies there is ordinarily some delay between puberty and adult responsibilities (Schlegel & Barry, 1991). During this time, youth are given opportunities to learn about, practice, and display under the watchful eyes of more experienced adults, the types of responsible behaviors they will be expected to have as adults, such as the accumulation, protection, and distribution of resources. After these responsibilities seem well in hand, adulthood commences (e.g., by identifying a youth as of marriageable age). These observations suggest that transition points of development, and the changes in expectations and performance that accompany them, may be especially fruitful for examining the coordinated role of biological and cultural contributions to cognitive development. An interesting, related question that stems from our research on children’s everyday activities is how a particular maturational transition and the responsibilities that accompany it are coordinated with parental expectations regarding child development. Perhaps, parental expectations, which reflect cultural values and beliefs about development, help regulate the manner and duration of adult supervision during these transitional periods.

In closing, a general limitation about cultural analysis is worth remembering. Although it is customary to consider culture as having a coherent pattern or structure, D’Andrade (1995) points out that this idea is really “an article of faith”
(p. 249)—there has never been an empirical demonstration of any culture’s structure, much less of the coherence of that structure. For D’Andrade, what has been demonstrated in research by cognitive anthropologists is that one aspect of culture is related to another aspect of culture in some way. This point is relevant to our discussion because in developmental research culture is also assumed to function as a coherent and integrated set of forces. However, the coherent and integrated nature of culture and its influence on development is yet to be demonstrated. On first thought, this observation is disturbing and it might even cause an investigator to throw up his or her hands and retreat from the study of culture altogether. However, it is important to remember that our understanding of the connection between culture and cognitive development is in the formative stages. Moreover, this realization is no less disturbing than one that resides at the heart of scientific psychology; namely, that normal human behavior is organized, coherent, and predictable. Although psychological research clearly has demonstrated that certain aspects of human behavior are related to other aspects of behavior in organized and predictable ways, no definitive empirical demonstration that all the behaviors of an individual cohere in a unified structure exists. The lack of such demonstration has not stopped psychological inquiry, nor should it. In fact, this issue raises interesting questions about how much of a system, psychological or cultural, needs to adhere to a particular pattern for the system to be considered coherent and, therefore, supportive of psychological development or amenable to scientific inquiry.

Much can be learned about cognitive development by relating patterned aspects of individual behavior to patterned aspects of experience, such as those provided by culture. At present, it seems best to put D’Andrade’s (1995) caution aside but not entirely out of the mind. In this spirit, in this chapter, I have attempted to show how some organized contributions of culture might provide leverage for studying the link between the social world and cognitive development in one specific area of growth. Such study may improve understanding of some of the ways in which experiences common to a cultural community support and constrain cognitive development. From this type of research, as well as from other types of sociocultural research cited throughout this chapter, a principled description of the culturally based, experiential contributions to intellectual development may eventually emerge.

REFERENCES


I. INTRODUCTION

II. DUAL-PROCESS THEORIES OF COGNITION

III. DEVELOPMENTAL EVIDENCE FOR TWO PROCESSING SYSTEMS

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I. Introduction

The last 20 years of research on adolescent development in the 20th century witnessed two disconcerting trends. First, research on cognitive development and research on social development became increasingly independent. One result of this increased independence has been theories of social development that attribute psychological adjustment and age-related changes in social development primarily to forces in adolescents’ environments (e.g., family, peers) and that give lip service, at best, to the role of cognition. Second, inspection of programs from prestigious conferences, such as those held by the Society for
Research in Child Development and the Society for Research on Adolescence, indicates that, if research on adolescent cognitive development was being conducted, it was being presented far less frequently than research on social development. Adolescent textbooks reflected both of these trends. On the one hand, the sole cognitive theory presented in most texts that is a truly developmental was Piaget’s theory of formal operations. On the other hand, chapters on adolescent social behavior did not typically go far in integrating recent theories of and findings concerning adolescent cognition.

In this present chapter, I present evidence for a dual-process theory of cognitive and social-cognitive development. The theory is potentially applicable to all age groups, but most of the relevant research has involved comparisons between children and adolescents or has focused solely on adolescents. Although the adolescent focus of dual-process research necessarily limits the extent to which generalizations about the mechanisms underlying cognitive development can be made to other age groups, this focus also provides a foundation for the construction of bridges between adolescent cognitive and social development. In part, then, I hope to build a bridge that connects aspects of social, cognitive, and social-cognitive development that currently exist as isolated islands. As a prelude to my discussion, I believe that the model advanced here has implications for understanding decision making, in-group and out-group biases, stereotyping, reasoning, and the self. The more specific goals of this chapter are to discuss research on “belief-biased reasoning,” decision making, conditional reasoning, and identity formation. The current running through and tying together these discussions is the belief that dual-process theories can provide useful accounts of developments in each area.

The chapter is divided into the following sections: First, in Section II, I present a brief overview of a dual-process theory of cognitive and social-cognitive development. This theory, which has much in common with similar theories in social and cognitive psychology, operates under the assumption that cognition is guided by processing in two independent systems. Following this introduction to dual-process theories, in Section III I briefly review of some of the research that supports the value of adopting a dual-process approach. This section is followed by a discussion, in Section IV, of recent research on the development of conditional reasoning. In Section V, I present results from a series of investigations into children’s and adolescents’ decision making. In Section VI, I focus on a model of belief-biased reasoning, an outline of relevant research, and the relation between biased reasoning and “thinking dispositions.” In Section VII, I outline new research exploring the relations among belief-biased reasoning, epistemological development, and adolescent identity formation. I conclude, in Section VIII, by discussing the question of how adolescent cognition differs from that of children and of how dual-process theories can be usefully employed in framing future research on adolescent social and cognitive development.
II. Dual-Process Theories of Cognition

In literature on adult reasoning and decision making, perhaps the most striking finding of research conducted between 1972 and 2004 is that, on a variety of tasks and under a wide range of conditions, performance falls well short of traditional prescriptions for normative responding (Kahneman & Tversky, 1996; Piatelli-Palmarini, 1994). The large discrepancy between how people “should” respond and how they actually respond has been referred to as the “normative/descriptive gap” (see Baron, 1988; Stanovich & West, 2000). Although the interpretation that these findings are indicative of basic shortcomings in adult reasoning and decision making competence has been challenged on a number of grounds (e.g., Cohen, 1981; Gigerenzer, 1996; Hilton, 1995), the list of purported “biases” in human reasoning is impressive. Research in the so-called “heuristics and biases” literature shows that adults frequently commit the “conjunction fallacy,” ignore base rate information, make unrealistically optimistic judgments, overemphasize the usefulness of vivid, episodic memories in making judgments, are unduly biased by prior beliefs, make systematic errors on simple ratio problems, and are prone to numerous other errors (for reviews, see Evans & Over, 1996; Kahneman, Slovic, & Tversky, 1982; Stanovich, 1999).

To illustrate the normative descriptive gap, consider the following “conjunction” problem (a variant of the original “Linda” problem used by Tversky and Kahneman, 1983):

Linda is 31 years old, single, wears glasses, and wears dresses that are out of fashion. Although her hair is somewhat long, she usually keeps it in a tight bun. Linda enjoys listening to music and reading books. As a college student, she was deeply concerned with social issues, such as discrimination, poverty, and social justice. She also participated in a number of political demonstrations.

After reading this description, participants rank the following statements in order of the likelihood that they accurately describe Linda.

a. Linda is a teacher in an elementary school.
b. Linda is a bank teller.
c. Linda works in a bookstore and takes Yoga classes.
d. Linda is active in the feminist movement.
e. Linda is a member of the League of Women Voters.
f. Linda is a bank teller and is active in the feminist movement.

The “conjunction fallacy” occurs when the probability that Linda is both a bank teller and a feminist is ranked higher than the probability that Linda is a bank teller. In the “strong” version of the fallacy (see Klaczynski, 2001a), the conjunctive description (f) is ranked higher than both of its components (b and d). However, in any conjunction, $p(AB)$ cannot exceed
p (A: bank teller) or p (B: feminist) because the individual categories (A and B) necessarily include all subcategories (e.g., bank tellers who are feminists must be members of the superordinate category, “bank tellers”). Although the conjunction task involves little more than class inclusion, most adults indicate that option “f” is more likely than option “b” and a significant minority believe that “f” is more likely than both “b” and “d.”

Debates over the normative response to this and other problems (e.g., the normative response to Wason’s (1966) selection task has been subjected to similar scrutiny) have been fierce (for review, see Stanovich, 1999) because, if responses traditionally judged as normative are accepted as such, then it would appear that most college-educated adults are poor decision makers and reasoners and, therefore, are fundamentally irrational (see Piatelli-Palmarini, 1994). Among the most prominent arguments supporting the case for “fundamental irrationality” is that, because humans have limited information processing capacity (and, in particular, because the size of working memory is limited), they must “satisfice” (Simon, 1993) in their decision making. That is, because information processing capacities are easily overwhelmed by problem complexity, people do the best they can with their limited resources.

As appealing as this “bounded rationality” argument is to many cognitive scientists, it has been criticized on the grounds that it does not explain why people sometimes make decisions that are in almost direct opposition to the decisions that are normatively prescribed and it cannot account for some of the developmental evidence described subsequently. Bounded rationality arguments also cannot explain why people often make errors on simple ratio problems that impose few demands on cognitive resources (Reyna, 2000). Furthermore, these arguments seem to ignore the distinction between competence and performance. People may well possess the capacity to make normative judgments and decisions on a variety of tasks in the heuristics and biases literature, but may not often evince that competence in performance.

Dual-process theories of cognition have arisen as alternatives to traditional information processing theories to account for these perplexing findings—that is, dual-process theories hope to explain why college students perform poorly on decision making and reasoning tasks that, at least on the surface, should be solved easily. Specifically, surface characteristics of problems may not necessarily overwhelm information processing capacities, as assumed by bounded rationality theorists. Instead, task characteristics may determine which of two independently functioning information processing systems is predominant on that task. One system—here called the “analytic” system—has been the traditional focus of both cognitive psychologists and cognitive developmentalists. When it is predominant, college students’ solutions to many heuristics and biases tasks are often normative. However, under most circumstances a different system—here labeled the “experiential” system—is predominant. Because this system relies more heavily
on procedural and episodic memory than on active computation of choices, alternatives, and reasons, solutions produced under the predominance of this system are sometimes at odds with normative prescriptions.\(^1\)

The experiential system involves the preconscious activation of procedural and episodic memories that can be used to guide judgments and decisions (Chen & Chaiken, 1999; Epstein, 1994; Epstein & Pacini, 1999). Consider the “Linda” problem. Most people believe that Linda is a bank teller and a feminist because problem content cues stereotypes of both categories. Rather than relying on logical processing, computation of probabilities, or construction of Venn diagrams, people instead base their judgments on strongly activated memories. On problems such as this one, people are believed to rely on heuristic short-cuts in making their judgments. Thus, the “representativeness” heuristic—the belief that a target is prototypical of a particular category—is activated when the information about Linda is presented (see Kahneman, Slovic, & Tversky, 1982, for a discussion of other tasks that involve the representativeness heuristic).

In general, experiential processing is fast and operates automatically, at the “periphery” of consciousness (Epstein, 1994). This system facilitates information mapping onto and assimilation into existing knowledge categories, operates to convert conscious strategies and tactics into automatic procedures and strategies and aids the activation of decision-making heuristics and other memories (e.g., beliefs, vivid episodic memories) that bias judgments and interfere with attempts to reason “objectively.” Because it likely evolved before the analytic processing system and, more importantly, because it requires little cognitive effort and expends few cognitive resources, experiential processing is often considered the overall system’s default (Brainerd & Reyna, 2001; Epstein, 1994; Stanovich, 1999).\(^2\)

Thus, experiential processing depends on the activation of heuristic short-cuts, most of which are acquired through experience. Developmentally, this means that

\(^1\)In previous publications (e.g., Klaczynski, 2001a; 2001b), I have referred to the experiential system as the “heuristic” system. The unfortunate outcome of that labeling has been that the heuristic system, which is a mode of processing information, was sometimes confused with the use of heuristics, which are strategies for making judgments and decisions. To reduce this confusion, I now have adopted Epstein’s (1994) term for this system.

\(^2\)Although a great deal of information processing takes places at the “truly” unconscious level, experiential processing may involve various degrees of consciousness. Despite vagaries surrounding definitions of unconscious, minimally conscious, and peripherally conscious processing, experiential processing produces responses with little, if any, effort. Obviously, additional theoretical clarity is needed if two-process theories are to progress. For the present, however, I use the term “unconscious” to mean “minimally conscious” or “on the periphery” of consciousness. This usage is consistent with the belief of some two-process theorists (e.g., Epstein, 1994) that experiential processing is “felt” at some level. Attention to these intuitive feelings may bring the products of experiential processing fully into consciousness, where they may be evaluated analytically.
individuals’ repertoire of heuristics should become increasingly diverse and increasingly easily activated with age. The implication of this conclusion is not that adults will use heuristics more than children, but instead that—when experiential processing is predominant—adults’ judgments and decisions will reflect more variability in the types of heuristics they use. If children have not yet acquired the heuristics adults typically use on a task, the (possibly mistaken) conclusion that adults rely on experiential processing more than children may be drawn. However, simply because adults have more heuristics available than children does not mean that they will use these heuristics more often. Indeed, knowing that an increasingly diverse repertoire of heuristics is acquired from childhood through adolescence and adulthood suffices to explain neither the frequency with which heuristics are applied to judgment and decision situations nor occasions on which heuristics, although activated, are not exercised. As discussed subsequently, because a particular heuristic is stored in procedural memory does not mean that it will be used when it is activated. The experiential processing system, functioning with little or no conscious awareness on the decision maker’s part, continuously assimilates information and matches internal and external cues to memory procedures; this matching process, in turn, activates and makes available specific heuristics for utilization.

However, the experiential processing system co-develops with the analytic processing system. Indeed, if not for the co-development of the more deliberate analytic system, judgments might well be dominated by “off-the-cuff,” automatically activated and employed heuristics and biases. The analytic processing system comprises consciously controlled, effortful thinking, and the numerous competencies that have traditionally been considered essential to cognitive development and normative decision making (Evans & Over, 1996; Stanovich, 1999). Unlike experiential processing, analytic processing is directed toward breaking down problems into their component elements, examining these elements, and, from this analysis, deriving a problem solution, judgment, decision, or argument. In further contrast to experiential processing, analytic processing operates on “decontextualized” representations. The process of decontextualization, in turn, is essential if other analytic competencies are to be engaged consistently and effectively (Stanovich, 1999; Stanovich & West, 1997). Decontextualized task representations—wherein the underlying structure (e.g., logical components) of a problem is decoupled from superficial contents (e.g., counterfactual information)—provide a working memory structure on which logico-computational processing can operate (Stanovich & West, 1997; see also Donaldson, 1978). However, the ability to consciously decontextualize task structure and requirements from superficial task contents and misleading memories depends largely on the development of the metacognitive and executive function abilities (e.g., planning, impulse control, ability to inhibit memory-based interference). In Table I (adapted from Epstein, 1994; Evans, 2002;
and Stanovich, 1999), a brief list of the attributes of the two processing systems is presented.

Because the instantiation of analytic competencies in performance is often highly effortful, if they are to benefit developing individuals, their acquisition must be accompanied by increases in the tendency to consciously employ them. As several discussions of metacognitive development (e.g., Kuhn, 2000; Moshman, 1990, 1999) and “thinking dispositions” (e.g., Stanovich & West, 2000) highlight, for everyday reasoning and decision making to approach normative ideals, development must proceed beyond the abilities to inhibit memory-based interference, reflect on the processes of reasoning and decision making, and evaluate the quality of decision options. Specifically, developments in analytic competence must be coupled with the acquisition of the dispositions (i.e., personal qualities, such as the “Need for Cognition,” the tendency to seek and enjoy intellectual challenges; see Cacioppo et al., 1996) that increase individuals’ inclinations to use these abilities.

As noted previously, development is in part characterized by the acquisition of judgment and decision heuristics. Although some of these heuristics may be learned explicitly, by and large they are acquired through implicit cognitive processes (see Reber, 1992). Once acquired, judgment and decision heuristics are activated automatically by situational cues. Many people also employ these heuristics automatically not only because they are “fast and frugal” (Gigerenzer, 1996), but also because they often lead to outcomes beneficial, or at least not harmful, to the decision-maker. Also, because people have only a fleeting

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<th>Characteristics of the Experiential and Analytic Processing Systems</th>
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<tr>
<td><strong>Experiential processing</strong></td>
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<tr>
<td>Evolved early</td>
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<td>Fast</td>
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<td>Automatic</td>
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<td>Unconscious or minimally conscious</td>
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<td>Operates on contextualized representations</td>
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<td>Involves activation of memories such as heuristics and stereotypes</td>
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<td>Relies on cursory situation analyses</td>
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<td>Frees attentional resources for analytic processing</td>
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<td>Operates independently from general intelligence</td>
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awareness that they have been activated, and because their activation elicits intuitions or "gut" feelings that they are "right" for the immediate situation, decision heuristics are often used in situations for which their relevance is dubitable. Yet, although heuristic activation is effortless and automatic, once activated, it is likely that some (but perhaps not all) heuristics are at least momentarily available in working memory. This availability affords reasoners the opportunity to consciously reflect on the value of the heuristic and actively decide whether to use the heuristic or not. As the adult literature indicates, either most people do not engage in this type of conscious reflection or, if they do, most people decide that the heuristic is in fact worth using.

The first point of this discussion is that experiential processing tends to predominate people's thinking. Second, experiential processing predominance can be overridden by analytic processing (Stanovich, 1999). The process of overriding experiential processing is conscious, likely requires advanced executive function and metacognitive abilities, and therefore is likely to be achieved more effectively by adolescents than by children. However, the third point of the foregoing discussion is that most adolescents (and most adults) are not predisposed to override the experiential system functioning; that is, there appear to be wide individual differences in the tendency to inhibit the utilization of automatically activated heuristics, engage in logical analysis, and construct decontextualized task representations (Stanovich & West, 2000).

This final point leads to an important distinction between metacognitive abilities and metacognitive dispositions. The former comprises a cluster of competencies that involve the ability to effectively reflect on what one knows, how one knows, and how accurate one's knowledge is; the ability to track the course of one's reasoning and monitor it for consistency and quality; and the ability to reflect on one's arsenal of decision and reasoning strategies to determine the most optimal strategy for a given situation. Metacognitive dispositions, by contrast, are motivational in nature and generally reflect beliefs about the value of engaging in effortful, logical analysis and of being aware of the reasoning process. This distinction recalls again the competence/performance distinction: Two individuals may possess similar degrees of metacognitive competence and may, therefore, be similarly able to inhibit experiential system predominance. But one of these individuals may be more disposed to expending the effort required to achieve the precision enabled by this intercession.

The role of metacognitive intercession in regulating analytic processing and in interactions between the analytic and experiential systems is illustrated in Figure 1. The top box in the figure is intended to illustrate that there exist individual differences in the tendency to rely on experiential or analytic processing. However, this box could also include situational factors (e.g., the need to generate quick responses, the need to generate precise responses) that could trigger experiential or analytic predominance. The boxes in the two
columns indicate the processing steps and outcomes that occur when analytic processing is predominant (left column) or experiential processing is predominant (right column). The key to the figure, however, is the box situated between the two columns, “metacognitive intercession.” The arrow from analytic processing to this box is meant to show that metacognitive intercession is an aspect of analytic processing. Unlike the boxes listed directly under the “analytic processing” box, metacognitive intercession is not a necessary part of analytic processing. As research discussed throughout this chapter illustrates, adolescents may well have the abilities to metacognitively intercede in their reasoning and decision making, but they do not often use these abilities. The arrows leading from the “metacognitive intercession” box indicate points in both analytic and experiential processing where a person could engage in intercession. The bold lines to points in analytic processing indicate that such intercession is more likely when analytic processing is predominant than when experiential processing is predominant. Again, however, these lines indicate possibilities for intercession, rather than necessary steps in representing a problem or deciding whether or not to apply a solution. Because of the intuitive and speeded nature of experiential processing, intercession is much less frequent than when the analytic system is
predominant. However, like outcomes of analytic processing, outcomes of experiential processing (e.g., contextualized task representations) are at least momentarily available in working memory. This availability, together with the dual-process assumption that the analytic system is active (although subordinate) during experiential predominance, affords for the possibility of metacognitive intercession at each step of experiential processing.

### III. Developmental Evidence for Two Processing Systems

The assumptions of dual-processes approaches contrast starkly to those of traditional approaches to cognitive development. Traditional approaches assume various sorts of unidirectional developmental trajectories—that developmental progressions occur in a single processing system (as in information processing theories) or within a sequence of qualitatively distinct stages toward a predetermined endpoint (as in Piagetian and Neo-Piagetian theories)—and that early development is characterized by a predominance of intuitive processing which eventually shifts toward predominantly analytic processing. A key difference between the dual-process approach advocated here and traditional theories is that dual-process theories assume independent developmental progressions in analytic and experiential processing. For example, as in most traditional (and most contemporary) theories, reasoning, problem solving, and metacognitive abilities improve with age and many of the improvements in these abilities occur at predictable points in development (e.g., theory of mind abilities improve dramatically between 3 and 4 years of age; certain reasoning abilities improve dramatically during early adolescence, etc.). However, individuals also have increased access to automatic procedures, heuristics, stereotypes, empirically unverified (and sometimes unverifiable) beliefs (e.g., in a God figure). Thus, development occurs along two trajectories—one directed toward increases in computational processing and in the capacity to decontextualize reasoning from problem content; the second directed toward heuristic, highly contextualized processing (Stanovich, 1999). The emergence of two-process theories thus poses serious challenges to views of development as a unidirectional progression from intuitive processing to logico-mathematical processing (e.g., Piaget & Inhelder, 1951). In my view, the potential to respond to problem situations without engaging in extensive conscious processing increases with age. However, these developments are accompanied by gains in the potentials to engage in metacognitive intercession and by increases in the capacity to make logical judgments and decisions.

The dual-process approach I have been endorsing does not assume that one processing system becomes more predominant than the other with age. It is
overly simplistic to assume that development is characterized by domain-general shifts from one processing system to the other. Instead, throughout much of development (i.e., from at least 7 years on), the experiential system is predominant over the analytic system in the sense that the former system is the default system. Despite this, there may be age-related changes in the extent to which the experiential system is the predominant system. Determining whether there are shifts in the extent of experiential predominance remains an interesting avenue for empirical exploration.

The little available empirical evidence (Klaczynski, 2001b; Klaczynski & Narasimham, 1998a) suggests that preadolescents, adolescents, and adults are highly reliant on experiential processing, although analytic abilities improve with age. As I discuss subsequently, what may improve from childhood to adolescence is the ability to override experiential processing with analytic processing. As already noted, this type of “intercession” is largely a function of metacognitive development and the development of reflective thinking dispositions (see Kuhn, 2001; Stanovich, 1999; Stanovich & West, 1997, 2000).

Unfortunately, these thoughts are rather speculative. Although dual-process theories have found considerable favor among cognitive and social psychologists, to date their impact on developmental psychology has been relatively small. Although researchers interested in memory development have increasingly recognized the importance of examining differences between implicit and explicit memory (e.g., Hayes & Hennessy, 1996; Lie & Newcombe, 1999; Newcombe & Fox, 1994; Schneider & Bjorklund, 1998), the roles of experiential and analytic processing in the development of reasoning and decision making have generally been ignored. Considerable empirical work remains to be done to answer many fundamental questions: How do the two systems develop? How, if at all, does system predominance change with age? How do the systems interact to determine responses under different conditions? How does the nature of the interactions between systems change with age?

Even with these unanswered questions, there is mounting evidence that unidirectional, single processing system approaches to cognitive development are inadequate to explain the numerous counterintuitive age trends in reasoning and decision making that have been reported during the 1990s. For instance, Jacobs and Potenza (1991) found that reliance on statistical evidence on asocial decision tasks increased with age (presumably because of increased analytic competence). On logically isomorphic social problems, however, the opposite trend was observed: With increasing age, children relied more on the “representativeness heuristic” (i.e., the extent to which individual cases conform to existing schemata) and less on statistical evidence (presumably because of increased reliance on experiential processing). In their frequently cited study, Jacobs and Potenza presented first, third, and fifth grade students (and college students) statistical reasoning problems that either did or did not involve social stereotypes.
The following example illustrates a statistical reasoning problem in the “object”
domain:

Jim is buying a bicycle. Before buying it he gets information on different brands. A
bicycle magazine says that most of their readers say the Zippo (Pathfinder) bike is best;
however, Jim speaks to his neighbor and she says that the Whammo (Trailblazer) bike
is best. Which bike should Jim buy?

For the problem above, the base rate (i.e., statistical) decision is to buy the
Zippo bike instead of the Whammo bike because a larger sample of bike riders
attested to its superiority. On such problems, the tendency to make decisions
based on base rate information increased with age. An example of a problem in
the “social” domain (i.e., that involved base rate information and information
likely to activate a social stereotype) is:

In Juanita’s class, 10 girls are trying out to be cheerleaders and 20 are trying out for the
band. Juanita is very popular and very pretty. She is always telling jokes and loves to be
around people. Do you think Juanita is trying out to be a cheerleader or for the band?

Despite its similarity to problems in the “object” domain, on problems such as
this, the tendency to ignore base rate information and to rely instead
on stereotypical information increased with age. Although the age trends found
on the object problems are hardly surprising, those found on the social problems
are difficult to explain without reference to two processing systems. According to
Jacobs and Potenza (1991), this study illustrates both that basic statistical
reasoning abilities improve with age and heuristic use (in this case, the
representativeness heuristic), under some conditions, also increases with age.
Davidson (1995) similarly reported that, under certain conditions, older children
commit the conjunction fallacy more than younger children—a finding also
attributed to increased reliance on representativeness.

Similar counterintuitive age trends have been reported across disparate
methodological paradigms and a variety of aspects of cognitive development. In a
study of conditional reasoning, Klaczynski and Narasimham (1998b) found that,
on problems involving such major and minor premises as, “If a person exercises a
lot, then she will be in good shape. Joan is in good shape. Does Joan exercise a
lot?” adolescents committed the “fallacy” of affirming the consequent (i.e., by
responding “yes”) more often than children. However, on problems such as, “If a
person is driving a car, then he must be at least 16 years old. Mark is 18 years old.
Is Mark driving a car?” adolescents were more likely than children to give
responses indicating uncertainty, which has traditionally been considered the
logically appropriate response.

In brief, despite knowledge of normative computational strategies, age (under
certain conditions) is positively associated with (a) making probability judgments
based on simple, cognitively economical strategies (e.g., ignoring denominators
in ratio problems; Brainerd, 1981), (b) changing decisions as a function of the “framing” of logically identical problems (Reyna & Ellis, 1994), (c) making nonlogical “transitive” inferences regarding social relationships (e.g., “A is a friend of B. B is a friend of C. Therefore, A and C are friends”; Markovits and Dumas, 1999; a “friends of friends are friends” heuristic), (d) committing deductive reasoning fallacies (Klaczynski & Narasimham, 1998a; Wildman & Fletcher, 1977), (e) imputing false beliefs to others (Mitchell, Robinson, Isaacs, & Nye, 1996), and (f) rejecting evidence on the basis of non-logical heuristics (Klaczynski, 2000).

Because they are systematic and yet violate formal rules of inference, these developmental trends must arise from a cognitive system that does not rely on logico-mathematical processing. Although none of these studies in itself provides definitive evidence for two processing systems, taken as a whole—and in combination with a multitude of studies of adult cognition (see Chaiken & Trope, 1999; Evans & Over, 1996; Stanovich, 1999)—these findings beg for an explanation that relies on two processing systems. In the following sections, I review in more detail evidence from studies of reasoning, belief biases, and decision making that further illustrate the usefulness of dual-process approaches to cognitive and social-cognitive development.

IV. The Development of Conditional Reasoning

One area that has recently been subjected to dual-process theoretic analyses is conditional reasoning (i.e., reasoning about if \( p \), then \( q \) premises). Traditionally, research on conditional reasoning has focused on four basic logical “forms.” The modus ponens (MP) form involves the minor premise that \( p \) is true. For modus tollens (MT), \( q \) is not true is the minor premise. The affirmation of the consequent (AC) form involves the minor premise, \( q \) is true, and the denial of the antecedent has the minor premise, \( p \) is not true. In standard logic, the correct conclusion to MP is that \( q \) is true; for MT, the correct conclusion is that \( p \) is not true. MP and MT are considered determinate forms because these conclusions are logically necessary and can be drawn with certainty. By contrast, AC and DA are considered indeterminate forms because no conclusions (e.g., about the truth of \( p \) in the case of AC) can be drawn with certainty.

Research with children indicates that, on problems involving MP and MT, inferences in accord with standard logic are often drawn by 4- and 5-year-old children (e.g., Hawkins et al., 1984; Harris & Nunez, 1996; Chao & Cheng, 2000). On AC and DA problems, under certain conditions 6- and 7-year-olds
draw indeterminate conclusions (Markovits & Barrouillet, 2002). The precocious responding of young children is in distinct contrast to findings that adults often make invalid inferences on all four logical forms (e.g., Cummins, 1995; see Evans, 2002, for review and discussion). Adults’ performance is not simply a function of variations in the familiarity of problems. Performance is sometimes better under conditions of greater familiarity (Ward & Overton, 1990) and sometimes worse when problems are more familiar (Janveau-Brennan & Markovits, 1999; Klaczynski, Schuneman, & Daniel, 2004). For example, despite having the same consequent, the conditional statement, “If a person eats too much, then she will gain weight” is more familiar than, “If a person grows taller, then she will gain weight” (Klaczynski et al., 2004). However, on AC and DA problems, performance is in accord with standard logic more often on the latter conditional than on the former conditional.

Evans (2002) has argued that the variability often seen in adults’ performance can be explained by assuming that adults can interpret conditional problems either as tasks for which they are supposed to think logically (i.e., by adopting the experimenter’s view of the task) or as everyday problems that they are free to use their intuitions to solve. Because task instructions are often vague (e.g., participants are often not instructed to think logically), the tendency of most participants is to rely on intuitive (i.e., experiential) processing and natural language interpretations.

The inferences “invited” by natural language or “pragmatic” interpretations of conditionals are sometimes different from the inferences called for by logic. Specifically, under a natural language interpretation of a conditional problem, the AC premise (e.g., Alice gained weight) leads to the invited inference that “Alice ate too much.” The invited inference for DA problems (e.g., “Alice did not eat too much”) is similarly determinate (“Therefore, Alice did not gain weight”). By contrast, the logical inferences and the invited inferences for MP and MT problems are the same (e.g., for MP—“Alice ate too much. Did Alice gain weight?”—both the logical response and the invited response are “yes”). Thus, natural language interpretations invite determinate inferences for all four logical forms; logical interpretations should lead to indeterminate responses for AC and DA and determinate responses for MP and MT.

For the AC and DA forms, one important determinant of how a conditional is represented is the number and strength of alternative antecedents (i.e., p₁, p₂, p₃…) to a conditional’s consequent (see Janveau-Brennan & Markovits, 1999; Markovits & Barrouillet, 2002). The conditional, “If a person eats too much, then she will gain weight” has few alternatives that are strongly associated with the consequent and is, therefore, more likely to be interpreted as a biconditional than “If a person grows taller, then she will gain weight.” Because in general adolescents and adults are more likely to have access to alternative antecedents
than children, they are more likely to respond to these forms in ways consistent with formal logic.

If the acceptance of invited inferences arises from predominantly experiential processing and indeterminate inferences arise from predominantly analytic processing, then different sets of developmental predictions can be forwarded for the two determinate logical forms and the two indeterminate forms. For MP and MT, because the invited and logical inferences are the same and because experiential processing is more cognitively economical than analytic processing, then—regardless of age—the experiential system should predominate on these forms. By contrast, because children have access to fewer alternative antecedents and less developed executive function and metacognitive abilities, they might be expected to use contextualized, pragmatic interpretations and experiential processing to solve AC and DA problems. With their more developed metacognitive skills and access to more alternative antecedents, adolescents and adults might be expected to rely on decontextualized interpretations and analytic processing on AC and DA problems.

These speculations lead to three predictions. First, on MP and MT problems, most individuals should make determinate (and logically correct) inferences and there should be no age-related increases or decreases in this tendency. Second, on AC and DA problems, children should make determinate inferences and adolescents should be more likely to make indeterminate inferences. Third, and perhaps most importantly, patterns of correlations between the two determinate forms and the two indeterminate forms should differ for preadolescents and adolescents. Specifically, if experiential processing is predominant for preadolescents, then determinate inferences should correlate positively across the four forms. For adolescents, if experiential processing is predominant for MP and MT, but analytic processing is predominant for AC and DA, then inferences on the former forms should be statistically independent from inferences on the latter forms.

My colleagues and I (Klaczynski et al., 2004) tested these predictions in a study of children (8- and 10-year-olds), adolescents (12- and 14-year-olds), and college student adults. Each participant was presented a series of conditional statements, the consequents of which had either few strongly associated alternative antecedents or at least one strongly associated alternative. Consistent with expectations, on MP and MT problems, most participants made determinate responses and no development effects were found. On AC and DA problems, determinate responses declined with age. Only by adolescence were indeterminate responses given at above chance levels. Each of these findings is consistent with the suggestion that children tend to respond experientially to all four forms, whereas adolescents respond experientially to MP and MT problems, but analytically to AC and DA problems.
Additional support for this speculation was found in analyses of the correlations between forms. Across ages, MP and MT were positively related, as were AC and DA. However, among children determinate responses across all four forms were positively and significantly related (rs ranged from 0.26 to 0.38, ps < 0.01). Among adolescents and adults, these correlations were considerably smaller (largest r = 0.13) and none were significant.

We did not interpret these findings to mean that any sort of domain-general general shift from predominantly experiential to predominantly analytic processing occurs at the beginning of adolescence. Rather, the MP and MT data, as well as the findings discussed in the next sections, imply that experiential processing dominates the thinking of both children and adolescents under at least some, and perhaps most, task conditions. However, age-related shifts from predominantly experiential to predominantly analytic processing are found under certain conditions and on some tasks. Thus, within the same cognitive domain (conditional reasoning), experiential processing governs responding across ages in some circumstances and age-related shifts in processing system predominance occur under other conditions. The findings thus illustrate how a dual-process approach can serve as a useful guide for understanding occasions in which development effects are and are not found.

V. The Development of Decision Making Heuristics and Decision Making Competencies

Another focus of my research has been the development of children’s and adolescents’ decision making propensities and, specifically, on the relations among age, performance on a variety of judgment and decision making tasks (largely adapted from the adult literature), and conditions intended to cue either analytic or experiential processing. In the first of these studies (Klaczynski, 2001a), adolescents were given a set of problems derived from the “heuristics and biases literature.” Among other tasks, participants were presented versions of Wason’s (1966) selection task, several conjunction fallacy problems (similar to the “Linda” problem described earlier), covariation detection problems, statistical judgment problems, and problems involving the gambler’s fallacy, outcome bias, and hindsight bias.

Several findings were noteworthy: First, normative reasoning, judgments, and decisions were, with few exceptions, more common among middle adolescents than among early adolescents. Second, despite these age trends, most responses across age groups were non-normative. Even though, according to traditional prescriptions for sound judgments and decisions, older adolescents were more accurate than younger adolescents, on most tasks most responses were not in accord with these prescriptions. For example, most older adolescents committed
the gambler’s and conjunction fallacies, relied on vivid personal testimonies rather than on more reliable (but also more pallid) statistical evidence, were guilty of hindsight bias, and ignored denominators when they analyzed covariation patterns. On one of the statistical judgment tasks, many participants based their judgments on vivid personal arguments, but then (on the same problems) rated arguments based on statistical evidence as “more intelligent.”

Third, the associations between normative responding and a measure of general intellectual ability were not uniformly positive or significant. For example, although statistical judgments and covariation judgments were related positively to ability, neither the tendency for outcomes to bias judgments nor hindsight biases were linked to ability. Fourth, principle components analyses revealed two readily interpretable factors. The “analytic” factor comprised statistical reasoning, deductive reasoning, covariation judgments, and the metacognitive abilities involved in assessing the accuracy of one’s judgments. The “heuristic” factor comprised a host of non-normative biases (e.g., outcome bias, hindsight bias, the conjunction fallacy). Whereas the analytic factor was positively related to age and ability, the heuristic factor was related negatively to age \((r = -0.20, p < 0.05)\) but was not related to ability \((r = 0.03)\).

Stanovich and West (1998, 2000) have argued that individual differences in ability are related to performance on heuristics and biases tasks primarily when the experiential and analytic systems “pull” for different solutions. However, solutions to problems that loaded on the heuristic factors were not related to ability, even though the two systems should have pulled for different solutions. Thus, applying the Stanovich and West argument to these problems is difficult. Instead, it could be argued that the variables that loaded on the heuristic factor did so because the “attraction” (i.e., the intuitive appeal) of experiential processing was so strong on these problems that any cues that analytic processing might lead to different responses were overwhelmed. Because heuristics were more strongly activated on these problems than on problems that loaded on the analytic factor, even for the highest ability participants, analytic processing was never fully engaged. Consider the previously mentioned example of “statistical reasoning conflict,” a response pattern wherein participants responded using vivid personal testimony to make their judgments, but then rated simultaneously presented statistical evidence as more intelligent. An adapted version of a problem on which “statistical reasoning conflict” was found is presented below.

Ken and Toni are teachers who are arguing over whether students enjoy the new computer-based teaching method that is used in some math classes.

Ken’s argument is, “Each of the three years that we’ve had the computer-based learning class, about 60 students have taken it. At the end of each year, they have written essays on why they liked or didn’t like the class. Over 85% of the students say that they have liked it. That’s more than 130 out of 150 students who liked the computer class!”
Toni’s argument is, “I don’t think you’re right. Stephanie and John—the two best students in the school, both are high honors students—have come to me and complained about how much they hate the computer-based learning class and how much more they like regular math classes. They say that a computer just can’t replace a good teacher, who is a real person.”

If you had to decide on which course to take, what would you do?

a. Take the lecture-based class
b. Take the computer-based class

If Ken wanted to take the computer-based class and Toni wanted to take the lecture-based class, who do you think would be acting more intelligently?

a. Ken would be acting more intelligently
b. Toni would be acting more intelligently

On this problem, participants who displayed statistical conflict opted to take the lecture-based class, but indicated that that the decision to take the computer-based class was more intelligent. Although both responses were related to intellectual ability (negatively in the first case, positively in the second case), the tendency to make conflicting judgments was not. However, conflicting judgments, like several other variables that loaded on the heuristic factor, were less prevalent among older than among younger adolescents.

Results such as this indicate that age is not merely a proxy for the abilities measured on traditional intelligence tests. Rather, “something more” is indexed by age. In this case, one possibility is that heuristic responses declined with age not because of improvements in basic intellectual abilities, but instead because the metacognitive abilities involved in inhibiting experientially activated judgments improved with age. As discussed earlier, when heuristics are activated automatically, they may be available briefly in working memory. During this time, individuals may evaluate these heuristics to determine their appropriateness. Both this study and numerous studies of adult decision making (for review, Evans & Over, 1996; Kahneman, Slovic, & Tversky, 1982; Stanovich, 1999) suggest that these reflective abilities are not utilized often, possibly because heuristics are so intuitively appealing that no subjective need for evaluation arises. Nonetheless, when post-activation heuristic evaluation does occur, it is more common among older adolescents and adults than among younger adolescents and children. To effectively evaluate a heuristic, people must first re-examine the problem, decontextualize the structure of the problem from misleading content, and search for a decision principle that is appropriate for the task (see also Reyna, Lloyd, and Brainerd, in press).

In a second study (Klaczynski, 2001b) that also illustrated the importance of metacognitive engagement, early adolescents, middle adolescents, and college students were presented three tasks drawn from the adult judgment and decision
making literature. Specifically, tasks involving sunk costs, ratio bias, and counterfactual thinking were presented to each participant under two conditions (based on Epstein et al., 1992). In one condition, designed to elicit responses from participants’ default processing mode, the instructions were to think about the problems “as you usually would.” In the condition intended to elicit more analytic responding, participants were instructed to adopt the perspective of a “perfectly logical person.” Half of the participants received the “usual” instructions first and half received the “logical” instructions first.

The sunk cost problems involved deciding whether to continue pursuing actions in which investments of time or money had been made, but that were not leading to the intended outcomes (e.g., watching a bad movie for which a non-refundable ticket has been purchased), or to adopt different actions more likely to bear fruit (e.g., leave the movie and have coffee with a friend). The dilemma in such problems arises because, to adopt the new action, the investments made in the current course of action have to be ignored. Ignoring these investments is difficult because doing so has the feeling of “wasting” investments (e.g., “throwing money down the toilet”) in a prior decision. The sunk cost fallacy is committed when people decide to “honor” sunk costs (e.g., continue watching the bad movie) to avoid losing out on their investments—a tendency that has been attributed to a “waste not” heuristic (see Arkes and Ayton, 1999). The normative decision is to abandon the investment. Consider a college student who, despite having no possibility of passing a course, continues attending classes (when time could be better spend working to improve grades in other classes) because “I’ve already put three quarters of a semester into it.”

On the ratio bias problems, participants were presented with lottery-type problems and asked which, if either, of two logically identical lotteries they would participate in. For example, in one problem, participants had three choices—to participate in a lottery with 1 winner in 10 tickets, a lottery with 10 winners in 100 tickets, or claim that, because the lotteries were identical, they had no preference for one or the other lottery.

The third type of problem involved a type of counterfactual thinking referred to as the “if-only” fallacy. The if-only fallacy occurs when behaviors are judged more negatively when it appears that a negative consequence could have been easily anticipated, and therefore avoided, in one of two logically identical and equally unpredictable situations. Consider the example below (adapted from Epstein et al., 1992):

Tom parked his new car in a parking lot that was half empty. His wife asked him to park in a spot closer to where she wanted to shop, but he parked, instead, in a spot closer to where he wanted to shop. As luck would have it, when he backed out after shopping, the car behind him backed out at the same time, and both cars sustained about $1000 worth of damage.
Robert parked his car in the same parking lot when there was only one parking place, so he took it. As luck would have it, when he backed out after shopping, the car behind him backed out at the same time, and both cars sustained about $1000 worth of damage.

Participants indicated which, if either, of the two involved parties acted “more foolishly.” In both cases, the accidents were not actually under the control of the involved parties. Yet representations based on contextualized representations (e.g., Tom had control, Robert had no control) may activate heuristics that link control to fault (i.e., similar to the “fundamental attribution error”—the tendency for observers to overestimate the role of dispositional factors when assessing a person’s actions). Tom, whose accident appeared avoidable (“if only he had heeded his wife”), is thought by most young adults to have made a worse decision than Robert (Denes-Raj & Epstein, 1994; Epstein et al., 1992)—whose decision was “forced” on him by uncontrollable circumstances.

This study was revealing in several ways. First, in both the “usual” and the “logic” frames, normative judgments were infrequent. For instance, on the most straightforward problems (the ratio problems), only 21% of adults’ responses were normative in the “usual” frame (despite identical odds of winning in the other lottery, participants overwhelmingly opted for the lottery that had the greatest absolute number of winning tickets). Second, in both frames, normative responding increased with age on all three tasks. Third, and perhaps most importantly, normative responses were more frequent in the “logic” condition than in the “usual” condition, regardless of age and task. Even in the logic frame, however, responding was far from perfect and in some cases remained close to or only slightly above chance. These findings, collapsed over the three types of decision tasks, which are presented in Figure 2.

If participants had the analytic competence to respond normatively, then the frequency of non-normative responses in both frames suggests that experiential processing was predominant—although experiential predominance was clearly stronger in the “usual” frame. In contrast, the powerful effects of the framing instructions—approximately twice as many normative decisions were made in the “logic” frame than in the “usual” frame—suggests that shifting from predominantly experiential processing to predominantly analytic processing was accomplished easily by many participants.

In the logic frame, to shift successfully from experiential to analytic processing, adolescents must inhibit the “prepotent” response to a problem, construct decontextualized task representations, evaluate the quality/appropriateness of the prepotent response against this representation, and consider alternative solutions. Despite this shift, performance remained poor in the logic frame. At least in the case of the ratio problems, this poor performance is probably not attributable to lack of analytic competencies, as even preadolescents are capable of solving ratio problems and comparing ratios against
one another (Krietler & Krietler, 1986). Therefore, poor performance more likely resulted because participants had trouble defining and decontextualizing the logical task, because the “logic” instructions were insufficient to induce an experiential to analytic shift (e.g., because in both frames participants may have believed that they were responding logically and thus did not respond differently in the two conditions), because (in the case of the counterfactual and sunk cost tasks) participants lacked knowledge of the relevant logical principles, and/or because the heuristics activated by the tasks were too compelling for participants to dismiss easily. Recall that a key metacognitive competence is the ability to recognize the appropriateness of a strategy to a decision situation; thus, insufficiently developed analytic and metaprocedural competence could also explain poor performance in the logic frame. Indeed, at least in the case of the sunk cost problems, subsequent research lends some credence to this possibility.

Specifically, in another investigation (Klaczyński, 2002), I tried to determine, first, how often children and adolescents use heuristics to respond to different decision tasks and, second, to examine the effects of arguments—either for the normative decision or for the heuristic decision—on adolescents’ post-argument decisions. This latter goal was particularly important because of its relevance to the analytic-experiential theory outlined earlier and questions of adolescent decision making competence. The results of the two previously discussed investigations illustrated that under conditions with no instructions to engage in analytic processing (Klaczyński, 2001a) or minimal instructions to think analytically (Klaczyński, 2001b), adolescents’ decisions are often non-normative.
and appear to rely heavily on heuristics. However, perhaps if adolescents were instructed to closely inspect arguments for heuristically based responses, they would reject these arguments. In subsequent decisions, adolescents might then rely more heavily on responses produced through analytic processing and thus show evidence of more decision making and metacognitive competence than the two previous studies suggested. Alternatively, after making a decision in line with traditional normative standards, adolescents exposed to non-normative, heuristically appealing arguments might make subsequent decisions on the basis of these arguments. Such a finding would suggest that adolescents’ understanding of normative principles is unreliable and susceptible to situational influences (e.g., nonlogical arguments from peers).

Decision tasks involving sunk costs and precedent setting were presented to 8-, 11-, and 14-year-olds in one study and to 9-, 12-, and 15-year-olds in a second study. In the precedent setting problems, each scenario contained information about a publicly established rule (e.g., for classroom behavior, household chores), a rule infraction committed by a particular child, and the circumstances surrounding the rule infraction. The task was to decide whether to enforce the punishment associated with the rule or to “make an exception.” In the first study, the circumstances surrounding infractions either appeared extenuating or more clearly fell under the purview of the rule. An example of a “no-mitigating circumstance” problem (adapted from Baron et al., 1993) is:

Mr. Miller, the coach of the basketball team, says that every person on the team has to go to all of the team’s practices if they want to play in the games. If a person misses a practice, then he will not be allowed to play in the next game. Bill is the best player on the team. He missed three practices in a row, just because he wanted to watch TV instead. Bill is so good that the team will probably win if he gets to play, but the team will probably lose if Bill doesn’t get to play.

Now, it’s the day before the game. What should Mr. Miller do?

The normative principle in cases such as this appears straightforward: Unless there are mitigating conditions, failure to enforce the rule establishes a negative precedent for future violations. Thus, if Mr. Miller does not enforce the rule, the rule may well lose its moral force and open the door for Bill (and his teammates) to question the rule in the future (see Moshman, 1998). When positive precedents are established by enforcing rules, future violations should be deterred. By contrast, negative precedents provide grounds for arguing for the permissibility of violations.

However, under some conditions even clearly stated rules can be violated without establishing negative precedents. Specifically, if the conditions surrounding a violation were not anticipated when the rule was created (or, if they were anticipated, they were not communicated to potential violators), then the question of whether the violation establishes a negative precedent is more
ambiguous. For example, in the “mitigating circumstance” version of the above problem, the mid-sentences of the problem read:

Bill is the best player on the team. He missed three practices in a row because he had promised to do charity work at a hospital instead. Bill is so good that the team will probably win if he gets to play, but the team will probably lose the game if Bill doesn’t get to play.

The results shed light on an aspect of adolescent decision making (i.e., decisions involving precedents) that hitherto had been investigated only by Baron et al. (1993). Specifically, 9-year-olds responded at chance on both the mitigating and the no-mitigating circumstance problems. By contrast, on the no-mitigating circumstance problems, the 11- and 14-year-olds usually opted for rule enforcement (the normative decision). On the mitigating circumstance problems, decisions to “make exceptions” (arguably, the normative decision) increased with age (see Figure 3). Thus, both early and early-middle adolescents evinced more flexibility in their decision making than children. Only the adolescents appeared to consider the role of context in their decisions. Children vacillated between

![Fig. 3. Age trends in children's and adolescents' decisions involving precedents (from Klaczynski, 2002).](image)
rule enforcement and making exceptions—regardless of the contextual variations that profoundly affected adolescents’ decisions.

Adolescents’ ability to coordinate social contextual considerations with apparently context-independent rules argues for a developmental progression in the same types of skills involved in coordinating beliefs and evidence that Kuhn and her colleagues have studied extensively (e.g., Kuhn et al., 1995). As Kuhn (2001) has argued, this coordination can only occur when advanced metacognitive skills have developed.

Despite the attainment of a certain degree of metacognitive competence, adolescents’ decision making remained characterized by substantial variability. To illustrate this variability, and again highlight the importance of metacognition in decision making, consider developmental trends in sunk cost decisions. An example of a sunk cost problem is presented below:

On parents’ day at Julie’s school, there will be a contest where all the students’ paintings will be shown. Julie has spent the last 14 days working really hard on a drawing.

She wants to win a prize pretty badly and thinks her drawing has a chance to win. Now, at long last, the drawing is almost finished.

Then, just four days before the contest, Julie had an idea for a totally different drawing. She was positive that she could draw the new picture in four days, just in time for the contest. Not only that, but Julie thinks that the new drawing would be a lot better than the one she’s been working on. The problem is that Julie has only one drawing board. That means that if she wants to draw the new picture, she will have to completely erase the picture she’s been working on.

In a both studies, children and adolescents demonstrated clear use of a non-normative rule. As illustrated in Figure 4, the majority honored sunk costs, presumably because of over-reliance on a “waste not” heuristic (see Arkes & Ayton, 1999).

These data, although generally congruent with age trends found on the precedent setting problems, illustrate two additional qualities of decision making and its development. First, on some decision tasks children, like adults and adolescents, do not reply randomly; rather, they systematically use non-normative heuristics (see also Davidson, 1995; Jacobs & Potenza, 1991). Second, despite age-related improvements, non-normative rule use typified decisions at all three ages. In contrast to precedent setting, these data, as well as those from Klaczynski (2001b), suggest that most adolescents are either not competent at making decisions involving sunk costs or rely so heavily on a non-normative heuristic that the abilities required to understand the value of avoiding sunk costs are not activated.

To determine when the competencies to understand sunk costs and precedents are acquired and the ages at which people can distinguish between normative decision principles and non-normative heuristics, in a subsequent
study (Klaczynski, 2002, Study 2) participants evaluated arguments that favored either the normative principle or a non-normative heuristic. More so than simple instructions to respond logically, this task was likely to elicit analytic processing predominance. Arguments for heuristics may function to keep automatically activated heuristics in working memory. Once in working memory, the metacognitive abilities involved in evaluating the appropriateness of strategies can be engaged to determine the value of the heuristics and contrast this value to the value of the normative principle. If participants embrace the normative rule more often than the non-normative rule and then apply the normative rule to subsequent decisions, then the case can be made that the requisite competence has developed (Stanovich & West, 1999, describe this methodology and its usefulness in helping sort out arguments over adult rationality in greater detail).

Participants made decisions on a set of baseline problems that involved either sunk costs or precedent setting (results for the baseline problems are shown in Figures 3 and 4). After decisions were made on the baseline problems, detailed arguments were presented. Thus, for each baseline problem, an argument for the normative decision, an argument for the non-normative decision, or arguments for the normative decision and the non-normative decision were presented together. Examples of these arguments are presented in Table II.

Subsequent to argument presentation, the original problems were re-presented and a set a transfer problems was administered. If non-normative responses were given on the baseline problems, and if at least some initial level of competence for understanding a particular decision principle had

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Fig. 4. Age trends in children’s and adolescents’ decisions involving sunk costs (from Klaczynski, 2002).
developed, then exposure to normative arguments should have resulted in more normative responding on problem re-presentation and on the transfer problems. Furthermore, if responses on the baseline problems were normative and if the relevant competence was developed (to some extent), then exposure to non-normative, intuitively appealing arguments should not have had a negative impact (for a detailed discussion of methodology used in this study and the “understanding/acceptance” principle, see Stanovich & West, 1999).

Importantly, the effects of both types of arguments were qualified by age and decision task. For the precedent setting arguments, regardless of age, normative arguments—both when these were presented by themselves and when presented alongside non-normative arguments—led to more normative decisions when the original problems were re-presented; this effect carried over to the transfer problems only for the adolescent groups, however. Interestingly, when presented by themselves (i.e., without the normative arguments), non-normative arguments

### TABLE II
Sample Normative and Non-normative Sunk Cost and Precedent Setting Arguments from Klaczynski (2002)

<table>
<thead>
<tr>
<th>Normative arguments</th>
<th>Non-normative arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sunk costs</strong></td>
<td></td>
</tr>
<tr>
<td>Amy thinks that Julie should erase the old picture and draw the new one because: “All the time that Julie put into the old picture doesn’t make any difference. She wants to win, so she should use the new picture. She shouldn’t worry about what she’s already done. The work she put into the old one is in the past—she can’t let that affect her now. Because she really wants to win, she’s got to go with the best picture, even if she has to throw out a picture she worked hard on.”</td>
<td>Tara thinks that Julie should keep working on the picture that she’s spent three weeks on because: “Julie’s worked on this picture for 3 weeks. Even if the new picture would be better, all of her imagination and effort were in the old picture. She should show a picture that really means something to her. She worked really hard on that picture. If she doesn’t use the one she worked so hard on, all of that time and effort will be wasted. If she doesn’t use the old picture, she’ll just be throwing away three weeks of work.”</td>
</tr>
<tr>
<td><strong>Precedent setting</strong></td>
<td></td>
</tr>
<tr>
<td>Mr. Ward thinks that Bill should not be allowed to play because: “If Mr. Miller lets Bill play, other players might start breaking rules. He can’t make an exception just because Bill is the best player. If Mr. Miller lets Bill break rules, the rest of the team could lose respect for him and might not listen to him if Bill gets away with skipping practice. It’d be better to lose a game than to make an exception.”</td>
<td>Mr. Jones thinks that Bill should be allowed to play because: “Bill has got to play or the team will lose. It’s true that Mr. Miller set a rule, but in this case he has to make an exception. The rest of the team will understand—they probably want Mr. Miller to let Bill play. Nobody wants to lose, so for the good of the team, Mr. Miller should let Bill play.”</td>
</tr>
</tbody>
</table>
led to declines in normative decisions at problem re-presentation and on the transfer problems for all three age groups.

A different picture emerged for sunk cost decisions. First, after receiving normative arguments, normative decisions by the 12- and 15-year-olds, but not the 9-year-olds, increased when the problems were re-presented and on the transfer problems. When normative arguments were presented alongside non-normative arguments, however, only the 15-year-olds accepted and understood the superiority for the former type of argument type over the latter. Second, the 15-year-olds were unaffected by exposure to non-normative arguments when these arguments were presented without the normative arguments. By contrast, when the problems were re-presented, both the 9- and the 12-year-olds made more decisions in the non-normative direction.

Findings such as these speak to the complexity involved in both making and disentangling arguments about age-related attainments in cognitive and decision making competencies. In this case, it would appear (despite recent arguments to the contrary; e.g., Arkes and Ayton, 1999) that an understanding of sunk costs and the reasons for avoiding them does not develop prior to adolescence. Even so, at 12 years this understanding seems somewhat fragile (given 12-year-olds’ susceptibility to non-normative arguments) and may not emerge “in full” until later in adolescence. But even at 15 years and beyond, in the absence of clear cues to engage in analytic processing, people typically rely on a “waste not” heuristic. By contrast, children’s responses to normative precedent setting arguments appear to suggest some competence at 9 years and a greater degree (as indicated by positive transfer) by adolescence; yet, across ages non-normative arguments lowered the frequency of normative decisions. This latter finding illustrates that, once a competence has developed, its utilization is sometimes overridden by situational factors that activate intuitively appealing heuristics. More broadly, this series of studies shows that decision making competencies do not develop in an all-or-none fashion and that these competencies are not displayed under all apparently relevant conditions.

In combination with the findings from Klaczynski (2001b), these findings indicate that (a) experiential processing predominates adolescent decision making under most conditions, and (b) many adult-like heuristics are acquired by late childhood. These studies also show that (c) just as experiential processing can be overridden by analytic processing (at least by early adolescents and older individuals), children and adolescents can be persuaded to accept simple heuristics as superior to normative decision principles. However, (d) there is substantial variation in the ages at which individuals can be persuaded into adopting different heuristics (e.g., arguments for the “waste not” heuristic were accepted by only 9- and 12-year-olds, but not by 15-year-olds; “make an exception” arguments were accepted by all three age groups, but only when these were presented without the opposing arguments for normative decisions).
All told, as in the studies of belief-biased reasoning discussed next, investigations of children’s and adolescents’ decision making illustrate that variability is a fundamental characteristic of everyday cognition and that “swings” of decision strategies can best be explained by adopting a dual-process approach to cognition.

VI. Development and the Belief-motivation-reasoning Interface

Belief-motivated reasoning occurs when individuals reason about evidence relevant to their beliefs in ways that preserve and perpetuate those beliefs (Kunda, 1990). As any observer of political or religious discussions is likely to see, people typically accept evidence that supports their views and reject evidence that contravenes their views. What makes studies of belief-biased reasoning especially pertinent to the present discussion is that they can be used to illustrate variability or “shifts” between analytic and experiential processing, the mechanisms that underlie the resilience of beliefs to change, individual differences in experiential processing predominance, and the relations among motivation, beliefs, judgment heuristics, and analytic competence.

In investigations of belief-biased reasoning, my colleagues and I (e.g., Klaczynski & Aneja, 2002; Klaczynski & Gordon, 1996a,b; Klaczynski & Narasimham, 1998a) have studied how children and adolescents process “everyday” arguments and “scientific” evidence. The basic tactic in these studies has been to present logically flawed arguments or methodologically flawed “scientific” investigations, the contents of which are relevant to strongly held beliefs. The conclusions drawn by the “arguers” or “scientists” in these scenarios are either consistent, inconsistent, or neutral with respect to these beliefs. In each scenario, information provided by participants concerning their beliefs and/or groups to which they belonged (e.g., concerning their religious affiliations) was inserted to make the scenarios as personally meaningful as possible. Consider the following scenario (adapted from Klaczynski & Narasimham, 1998a), designed for an adolescent who believed that being a Baptist makes a person morally superior to members of other religious affiliations:

Dr. Robison is a psychologist interested in finding out whether sexual harassment is more likely to occur in some religious groups than in others. To conduct his research, he conducted a study of Baptists, Catholics, Methodists, Hindus, Muslims, and Lutherans. In each religious group, he asked 40 people to be in the study. To measure sexual harassment, Dr. Robison observed people in each group at church meetings and picnics and counted the number of times each person told jokes with sexual content. At the end of his study, Dr. Robison found that the average Baptist told 6.5 sexual jokes per month. Members of the other religions…told an average of only 2.0 sexual jokes per month…. Based on this, Dr. Robison concluded that Baptists are involved in more sexual harassment than…members of other religions.
This conclusion contrasts rather clearly with the adolescent’s expressed beliefs. Like most adults, adolescents process such belief-threatening information with considerably more care than information that is either belief-neutral or belief-supportive. Specifically, the evidence is processed analytically and scrutinized closely for flaws; problem representations are based on decontextualizations of the logical structure of the evidence/arguments. On the basis of this processing, the evidence is rejected. The rejection of belief-threatening evidence is often accomplished by invoking normative principles of logic, argumentation, and scientific reasoning. For the scenario above, the adolescent is likely to display sophisticated reasoning by, for example, arguing that the operationalization of sexual harassment lacks construct validity, “The amount of jokes about sex a person tells hasn’t got anything to do with sexual harassment. Plus, you don’t know who they’re telling the jokes to.” In studies of belief-biased reasoning, other problems—involving sample size, selection, and experimental confounds—are also more likely to be detected when evidence threatens beliefs than when evidence is supportive or neutral.

When evidence supports beliefs or is belief-neutral, experiential processing is usually predominant. Specifically, the evidence is processed at a relatively cursory level, and representations are highly contextualized (i.e., based on superficial contents that support relevant beliefs). Justifications for evidence acceptance derive from personal experiences, category exemplars, positive stereotypes of in-groups, negative stereotypes of comparison out-groups, and simple assertions concerning the validity of the evidence.

The purpose of presenting neutral evidence (in the example, Baptists would be excluded from the scenario and other religious groups would be compared) is to establish participants’ default mode of processing. If reasoning on such problems is as complex as reasoning on belief-threatening problems, and more complex than reasoning on supportive problems, then one might conclude that participants typically reason analytically and that they suppress analytic reasoning on supportive problems. However, results from several studies (Klaczynski & Gordon, 1996a, Experiment 2; Klaczynski & Narasimham, 1998a) indicate that reasoning on neutral problems is similar in complexity to reasoning on supportive problems and that reasoning on both types of problems is less complex than reasoning on threatening problems. It thus appears that people typically reason experientially, do not change processing modes when presented neutral problems, and shift to analytic processing only when motivated by evidence that threatens their beliefs. Note that this conclusion is consistent with the previously discussed decision making findings, where clear cues for analytic processing (i.e., arguments) were needed to provoke analytic predominance.

Studies of belief-biased reasoning are usually conducted with within-subjects designs. Thus, participants are presented sequences of belief-threatening, supportive, and neutral evidence. The advantage of this approach is that it
provides the opportunity to examine problem-to-problem variability in processing. Of particular importance is the surprising finding that the extent to which children, adolescents, and adults vacillate between experiential processing on supportive and neutral problems and analytic processing on belief-threatening problems is very similar. In other words, the degree of belief bias participants show is unrelated to age. This vacillation suggests that, for most participants, the metacognitive skills (specifically, “metamonitoring” abilities) required to track the course of reasoning for consistency had not fully developed. However, an alternative possibility is that these skills had indeed developed, but consistency may not have been an important intellectual value or, more generally, the metacognitive dispositions needed to motivate metacognitive engagement were absent. As discussed shortly, some evidence supports this alternative possibility.3

To fully understand age-related effects in these investigations, some consideration of how biases and reasoning have been operationalized is warranted. Typically, participants rate (e.g., on 9-point scales) the quality of belief-threatening and belief-supportive evidence and provide verbal justifications for their ratings. These justifications are scored both for the presence of heuristics and the quality of reasoning. In the previous example, on a 0–2 scale, the justification given by the hypothetical adolescent would have received a “2.” This same adolescent may have given the evidence a “3” rating for quality. A second, younger adolescent may have given a less sophisticated justification, rated as a “1,” and may have rated the evidence with a “5.” Thus, on both indicators, the first adolescent would have displayed more complex reasoning (lower ratings are considered indicative of more complexity because the evidence used in the arguments is, in fact, quite flawed).

At this point, neither adolescent could be said to be biased. Bias is demonstrated by comparing the above scores with scores on belief-supportive problems. Suppose the first, older adolescent gave a belief-supportive argument a rating of “6” and had a justification complexity score of “1.” The same scores for the younger adolescent might be “8” and “0,” respectively. Again, the older adolescent shows evidence of better reasoning. However, because biases are computed as the differences between scores, the two adolescents have shown

3However, the age ranges in these studies have generally been restricted to early, middle, and late adolescence. In studies of adult development (Klaczynski & Robinson, 2000) and young children’s biases (Klaczynski & Aneja, 2002), age differences in biases have been found. The relation between motivated reasoning biases and age is complex, however. During adolescence, no age differences have been reported. However, at least in certain domains (e.g., gender) biases seem to decline from early childhood to late childhood (Klaczynski & Aneja, 2002), and appear to increase from early adulthood to late adulthood (Klaczynski & Robinson, 2000). Whether these are general age-related trends or specific to particular domains remains to be determined.
the same degree of bias (in both cases, biases in ratings equal “3” and biases in justifications equal “1”). The point here is that some age-related developments have been found in studies of belief-biased reasoning. That is, older adolescents evidence more analytic reasoning competence than younger adolescents on both belief-threatening and belief-supportive problems. However, bias in the use of reasoning skills—and, by implication, the degree of experiential processing interference in analytic processing and the amount of metacognitive intercession involved—has been unrelated to age.

Age is also related to belief-biased reasoning in at least one other way. Specifically, although the amount of experiential processing interference in reasoning varies little with age, the types of heuristics adolescents use to justify their evidence ratings is age-related. For instance, in a study of biases in beliefs about occupational goals, Klaczynski and Fauth (1997) found that older participants referenced personal experiences more than younger adolescents to justify accepting supportive evidence; younger participants relied more on stereotypical beliefs about their intended occupations. Klaczynski (2000) found that older adolescents were more likely than younger adolescents to invoke an “implausibility heuristic” (i.e., claim that an argument should be rejected because it didn’t make sense) to reject certain belief-threatening arguments. Because the amount of experiential interference was similar on these tasks, these findings reinforce the point made earlier that the use of different heuristics by children and adolescents does not necessarily reflect age differences in reliance on experiential processing. This research also shows that analytic and experiential processing are interactive: Regardless of evidence type and age, elements of both analytic and heuristic processing are often apparent in individuals’ justifications. It is the predominance of processing systems—rather than the complete “switching off” of one system or the other—that changes with evidence type.

Two additional sets of evidence further illustrate the roles of metacognition and experiential processing in belief-biased reasoning. First, in two studies we examined the effects of extrinsic “accuracy” motivation on belief-biased reasoning. In these studies (Klaczynski & Gordon, 1996b; Klaczynski & Narasimham, 1998b), adolescents were instructed that if they gave thoughtless or inaccurate responses, they would be required to meet with the experimenters to justify their responses. The effect of these instructions was considerable in that reasoning across all problems (i.e., belief-threatening, neutral, and supportive) was more complex than in the control conditions; thus, more analytic competence was apparent than in the control condition. However, what did not change was the amount of bias in reasoning. Although reasoning overall improved (i.e., justification complexity scores increased and rating scores decreased), differences between reasoning on belief-threatening and supportive problems were as large in the accuracy conditions as in the control conditions. This suggests that participants could not consciously control the biases in their reasoning.
From the improvements in reasoning complexity observed in the accuracy conditions, participants were clearly making conscious efforts to reason more “objectively” than control participants. Despite these efforts, biases did not diminish. Moreover, these effects were similar across levels of intellectual ability. Thus, in contrast to the previously discussed studies of decision making (Klaczynski, 2001b, 2002), these studies show that, under some conditions, the effects of experiential processing on analytic processing cannot be removed through metacognitive intercession (or that participants did not know the appropriate metacognitive procedures for reducing experiential interference).

Second, despite holding beliefs as strong as those of their more biased peers, in each of the aforementioned studies some participants were not biased (see also Stanovich & West, 1997; for detailed discussions of individual differences in rational thought, see Baron, 1985; Stanovich, 1999; Stanovich & West, 1998, 2000). Perhaps the most obvious individual difference variable that could explain differences in reasoning biases is general intelligence. However, in several investigations, intellectual ability has explained virtually no variance in biases (e.g., Kardash & Scholes, 1997; Klaczynski, 1997, 2000; Klaczynski & Gordon, 1996a,b). Thus, traditional measures of intelligence (as well as measures of formal operational ability) either do not index the metacognitive skills required to monitor reasoning for consistency or do not tap the metacognitive dispositions that motivate the use of these monitoring skills.

In light of these data, Klaczynski (2000) and Klaczynski and Fauth (1997) (see also Kardash & Scholes, 1996; Klaczynski, Gordon, & Fauth, 1997, Exps. 3 and 4; Stanovich & West, 1997) explored whether individual differences in “thinking dispositions” (e.g., “I believe in following my heart more than my head,” “It is more important for me than to most people to behave in a logical way”; from Epstein et al., 1995) could explain between-subject variability in biases. These dispositions did, in fact, account for significant variance in biases. Thus, individual differences in reasoning biases are evident at the dispositional level, rather than at the level of “raw” intellectual ability. If this supposition is correct, then differences in reliance on analytic and experiential processing—at least among adolescents and adults—arise mainly from intellectual motivations. Specifically, dispositions to “be metacognitive” and to utilize one’s executive function abilities apparently are better predictors of reasoning biases, and of individual differences in experiential system predominance, than intelligence.

VII. Identity Formation, Belief-biased Reasoning, and Metacognitive Dispositions

Among the possible outcomes of belief-biased reasoning are the strengthening of stereotypes, the perpetuation of mistaken beliefs, and the heightening of
intergroup conflicts and prejudices. Belief-biased reasoning may also have implications for important aspects of adolescent self-development. Perhaps more importantly, researchers concerned with self-development are likely to benefit from adopting a dual-process approach. Although a number of reasons can be given for this claim, one primary reason is that theories of self-development, and theories of identity development in particular, has long suffered from under-specification of the cognitive mechanisms underlying developmental changes in self-understanding. Because self and identity development can be conceived, at least to some extent, as involving processes of decision making (e.g., “Who am I?”) and reasoning about self-relevant evidence (e.g., “Is it really the case that I’m not cut out to be an architect?”), then the mechanisms I have proposed to account for decision making and belief-biased reasoning in general may well apply to the more specific case of identity formation.

Identity was originally conceptualized as the outcome of an adolescent’s attempt to discover unique aspects of the self that psychologically separate the self from others, particularly parents (Blos, 1967; Erikson, 1968). These efforts were believed to involve the goal of creating a sense of continuity among the past self, the present self, and the future self and intense exploration of one’s personal qualities and of the future person that the adolescent wished to become (Erikson, 1968). Erikson identified outcomes of adolescents’ identity strivings along a continuum from identity confusion (the adolescent feels “lost,” is unable to identify a “real” self, and cannot create a coherent self that links past, present, and future) and identity achievement (the adolescent has successfully resolved the identity “crisis” by developing an integrated and purposeful sense of self and has committed to a set of personal goals).

Similarly, most contemporary theorists (e.g., Berzonsky, 1994; Waterman & Archer, 1990) have focused on exploration of the self, possible futures, and the “fit” between the self as currently conceived and future possibilities. As this description should make evident, formal operational abilities were considered essential to the task of identity formation. Particularly influential among identity theorists has been the work of Marcia (1980), who argued that Erikson’s beliefs that identity outcomes existed along a simple confusion-achievement continuum lacked the specificity needed to identify the full range of identity outcomes. Instead, Marcia’s work has shown that adolescents can be classified into four basic identity “statuses” and various mixes of these statuses. Using Erikson’s ideas that self-exploration and commitment to a future self are central ingredients for successful identity achievement, Marcia argued for a classification system that rested on the extent to which adolescents progressed along these two dimensions. The resulting 2(exploration: high or low) × 2(commitment: high or low) matrix yields the four statuses.

The least well-developed status is identity diffusion. In brief, adolescents in this category have neither initiated exploration into possible selves nor made
commitments to sets of religious, social, political, philosophical, or occupational goals. Such adolescents are believed to live for the present, to be hedonistic, and to avoid thinking about the future. By contrast, adolescents in the foreclosed status are very goal oriented and have made extensive commitments to a life path. However, they have made these commitments without engaging in extensive self-exploration and without exploration into alternative life possibilities. Instead, these adolescents adopt goals borrowed from others (often a parent or authority). In the moratorium status, adolescents are believed to be progressing toward an achieved identity because they are in the process of self-exploration and are actively attempting to determine which of many possible life paths would best fit them. However, such adolescents have not yet committed to a future self and sets of life goals. Finally, adolescents in the achieved status have attained the Eriksonian ideal: These adolescents have explored themselves and possible futures and have committed to life plans.

Importantly, identity development does not occur in an all-or-none fashion. That is, adolescents may make considerable progress in self-development in some domains, but may progress more slowly, or not at all, in other domains. For instance, the pressures of deciding on a career that entry into college brings are likely to encourage self-exploration and commitment in the occupational domain, but may have little impact on religious identity. Similarly, an adolescent who attends a college with an ethnically and philosophically diverse student body may well make more progress in terms of religious identity than an adolescent who attends a college with a relatively homogenous student population. Thus, measurements of identity status should focus not only on domain-general identity (i.e., the extent to which identities in different domains are at similar levels and have been integrated), but also on domain-specific developments.

For the present, the main questions are, first, how do identity statuses relate to belief-biased reasoning? and, second, how do these statuses relate to individual differences in reliance on experiential and analytic processing? Prior research on identity has linked the statuses to differences in thinking styles. For instance, Adams et al. (1985) reported that foreclosed adolescents were more cognitively rigid than other statuses. Read, Adams, and Dobson (1984) found that adolescents in the achieved and moratorium statuses were more analytical in their thinking than those in the diffused and foreclosed statuses. Klaczynski, Fauth, and Swanger (1998) found that foreclosure was positively linked with absolutism, dogmatism, and the tendency to believe that beliefs—even without supportive evidence—should be defended and negatively associated with open-mindedness. After controlling for variance associated with cognitive ability, Klaczynski et al. found that identity achievement was positively linked to scores on a composite “critical thinking” values scale. Foreclosure and diffusion were negatively linked to this composite.
These investigations suggest an association between identity statuses and the types of thinking dispositions I (Klaczynski, 2000; Klaczynski & Fauth, 1997; Klaczynski et al., 1997) previously found were correlated with belief-biased reasoning. More importantly, the Klaczynski et al. (1998) findings not only suggest that the foreclosed and diffused statuses rely more heavily on experiential processing than the moratorium and achieved statuses, but also that the beliefs adolescents in the different statuses have about the nature of knowledge in general and of self-knowledge in particular—that is, their personal epistemologies—differ (Boytes & Chandler, 1992).

In general, foreclosed adolescents appear to have an absolutist epistemic “stance” (Boytes & Chandler, 1992). In brief, absolutists believe that knowledge is a direct copy of experience and that “facts” can be claimed with certainty. Facts, in other words, are the “truth” and as such are not open to question. In principle, the “correspondence” epistemology of absolutists is based on the assumption that differences in understandings of “facts” can be resolved through empirical observation or appeal to authority (e.g., scientists, priests, God). However, having attained knowledge from experience and respected authorities, absolutists often fail to recognize the fallibility of knowledge, particularly of those “truths” they personally accept as true. Thus, absolutists often rely non-logical tactics (e.g., heuristics, such as “authorities know best”) to deny the possibility that their “truths” can be repudiated (Kuhn & Weinstock, 2002; Moshman, 1999).

The thinking dispositions reported by moratorium adolescents, by contrast, suggest a “subjectivist” epistemic stance. Subjectivists are, in essence, relativists who believe that no knowledge can be held with certainty. This relativism leads to the belief that even personal “truths” are tenuous and that the known, as well as the knower, are susceptible to moment-to-moment change. No single point of view is considered right or wrong in an absolute sense. The individual considers “perspective”—as co-constructed, for example, with immediate situational factors or larger cultural forces—as the primary influence on the individualization of knowledge. In addition, however, moratorium adolescents are very curious intellectually and value logical analysis more highly than intuitive reactions. Thus, moratorium adolescents are not “pure” subjectivists, but also appear to value certain aspects of the “rationalist” epistemic stance described later.

Achieved adolescents, who have committed to a set of goals and a set of personal belief systems, appear to fall into what Moshman (1999) has called the “rationalist” epistemic stance. Like subjectivists, rationalists acknowledge that all knowledge is inherently uncertain and thus they are open to changing their beliefs. However, the rationalist uses logic and evidence to allow him or her to judge whether some “truths” are better supported than others. For the sake of effective discourse, cooperative enterprises, and social progress, and to avoid “epistemic confusion” (Boytes & Chandler, 1992), rationalists believe that “ideas
and viewpoints can be meaningfully evaluated, criticized, and justified” (Moshman, 1999, p. 28). Justifiable beliefs should be adhered to more closely than beliefs for which less evidence exists or weaker reasons can be provided (see also Kuhn & Weinstock, 2002). A “truth” or belief is maintained as a basis for action until its justifiability is called into question or a more justifiable claim is discovered.

Although this description may imply that epistemic stances are domain-general, the research of Kuhn and her colleagues (e.g., Kuhn, Cheney, & Weinstock, 2000) suggests that epistemological development is characterized by a considerable degree of domain-specificity. Thus, an adolescent or adult may be a rationalist in some domains (e.g., politics), an absolutist in other domains (e.g., religion), and a subjectivist in still other domains (e.g., aesthetics). However, in domains that are particularly meaningful to an adolescent’s identity, epistemic beliefs are likely to be similar across domains. Therefore, for the present purposes these stances will be treated as though they are domain-general. (For more complete descriptions of epistemic stances, developments in these stances, and the relation between domain-specific and domain-general epistemological development, see Hofer & Pintrich, 2002; Kuhn & Weinstock, 2002; Moshman, 1999).

I (Klaczynski, 2003) have argued for associations among epistemological beliefs, identity statuses, and belief-biased reasoning. The gist of the model that I developed is presented in Figure 5. The model posits that the degree of bias an adolescent shows in his or her thinking is influenced by three factors—the

Fig. 5. The relations among thinking dispositions, beliefs, epistemic stances, reasoning bias, and identity.
strength of beliefs in a specific domain, epistemological beliefs (which are important indicators of metacognitive development; i.e., thoughts about the nature of knowing), and thinking dispositions, which are important to motivate different types of metacognitive activity (e.g., monitoring for consistency). The absolutist belief that beliefs are immutable truths is, for example, more likely to give rise to biases than the belief that all knowledge, including beliefs, is uncertain. However, although in principle the latter two influences can be independent, in practice their measurement has often been confounded.

Biases, in turn, affect identity development in specific domains. This is because, on the one hand, the absence of biases is likely to encourage belief exploration and revision. When an adolescent is unbiased, he or she is likely to closely and critically inspect the foundations for his or her current beliefs and endeavor to determine whether information that contravenes current beliefs is well-founded. On the other hand, the presence of biases is likely to encourage the maintenance of beliefs that may not be well-grounded in arguments or evidence and to discourage exploration into alternative beliefs. Through the processes of introspection and reflection and through experiences that encourage self-integration, domain-specific identities eventually become linked in a more all-encompassing self-structure. Although my research was concerned primarily with predicting domain-specific and domain-general identity, many of the proposed influences are bi-directional and the model is not intended to describe all possible causal paths. Of particular note, domain-specific identity status is likely to influence reasoning about evidence in relevant domains and the strength of beliefs in those domains.

A more specific variant of the model, intended to describe the processing biases characteristic of the foreclosed status, is presented in Figure 6. The absolutist and close-minded nature of foreclosed adolescents, in combination with their typically strongly held beliefs and tendency to lack intellectual curiosity, suggested the hypothesis that these adolescents would be more biased in reasoning about identity-relevant evidence than either achieved or moratorium adolescents. Specifically, foreclosed adolescents were expected to evince the pattern of belief-biased reasoning that was discussed earlier. As shown in the figure, sophisticated analytic strategies were expected to be invoked to dismiss identity-threatening evidence, and experiential processing was expected to predominate on identity-supportive evidence. Subsequent to evaluating identity-relevant evidence, foreclosed adolescents might be expected to hold their beliefs even more strongly than prior to evidence evaluation. This phenomenon, known as “belief polarization” (Lord, Ross, & Lepper, 1979), has been found to be more characteristic of absolutist adolescents than of subjectivist and rationalist adolescents (Klaczynski, 2000).

Less biased reasoning was expected of the moratorium and achieved statuses because adolescents in these statuses are generally open-minded and because,
particularly for the moratorium status, they are still searching for a self and appropriate beliefs for the self. Thus, when presented with either identity-supportive or identity-threatening evidence, adolescents in these statuses were expected to engage in predominantly analytic processing. The typical thinking dispositions of adolescents in these statuses suggested that the goal of determining the quality of the evidence would outweigh the goal of preserving prior beliefs. Unlike foreclosed adolescents, the outcome of evidence evaluation for moratorium adolescents is likely to be either continued abstinence from

Fig. 6. Hypothesized biases in processing information relevant to information self-belief for the foreclosed identity status.
strong commitment (if both threatening and supportive evidence is weak), an increased tendency toward commitment (if the supportive evidence is particularly strong) or belief revision (if threatening evidence is particularly strong and supportive evidence is weak). Achieved adolescents, who presumably have previously engaged in extensive analysis of their beliefs and already decided that the best available evidence supports their beliefs, are therefore more likely to hold stronger initial beliefs than moratorium adolescents. Hence, achieved adolescents could be expected, at least under some conditions, to be more biased than moratorium adolescents. However, because they are motivated to be intellectual careful, rationalists in the iR epistemologies, and predisposed toward analytic processing, in general achieved adolescents should process both self-threatening and self-supportive evidence analytically. The outcome of this processing could be either belief maintenance (and, possibly, polarization) or belief revision. Excluding diffused adolescents, belief revision should be most likely for the moratorium status, somewhat less likely (but still common) for the achieved status, and unlikely for the foreclosed status.

To test the model, 182 junior and senior high school adolescents were presented self-relevant problems in two important domains, religion and vocation. As in prior research (Klaczynski & Fauth, 1997; Klaczynski & Gordon, 1996a), problems involved arguments based on small samples of evidence and pertained to either adolescents’ vocational beliefs or their religious beliefs. Arguments either supported the adolescents’ (religious or vocational) beliefs or devalued these beliefs. An example of a threatening argument, created for an adolescent whose goal was to become a psychologist, is:

A journalist wrote a column about his experiences with psychology. …the journalist wrote, “I’ve got a friend who’s a psychologist, but I wouldn’t let want my children near him with a 10-foot pole! I went to visit him the other day…and what did I find? The psychologist wasn’t exactly working—he was on a couch taking a nap! What am I supposed to think? I don’t think there’s a lazier group of people than psychologists!”

Participants rated argument quality and provided justifications for their ratings. Biases were calculated in the manner discussed previously. Participants were also administered questionnaires that assessed domain-general identity, religious and vocational identity, the strength of religious and vocational beliefs, and epistemic beliefs/thinking dispositions. Unfortunately, the domain-specific identity scales in this study were designed to yield single scores: At one extreme were foreclosed adolescents; at the other extreme were moratorium/achieved adolescents. Thus, hypotheses about specific statuses could not be tested. Furthermore, because thinking dispositions and epistemic stances were not measured independently, their contributions could not be disentangled. Nonetheless, the results of a path analysis, depicted in Figure 7, provide strong support for the model.
Fig. 7. Results from path analysis indicating links from epistemic beliefs to reasoning biases and identity.
In particular, the epistemic beliefs/thinking disposition measure predicted vocational, but not religious beliefs. In both the religion and the vocational domains, belief strength and epistemic beliefs predicted biases (results from a composite rating and justification measure are presented because results were similar for the two types of bias). In turn, biases in each domain predicted domain-specific identity (more biased reasoning was found for adolescents toward the foreclosed end of the scales). Finally, both measures of domain-specific identity were linked to domain-general identity.

These results are important for two reasons. First, they provide some evidence concerning the thought processes underlying the different identity statuses. Although other researchers (specifically, Berzonsky, 1994; Berzonsky & Neimeyer, 1994) have linked identity status to “information processing styles,” that research relied on self-reports of thought processes rather than on actual measures of reasoning. Furthermore, although other work has linked both epistemological beliefs (e.g., Boyes & Chandler, 1992) and thinking dispositions (e.g., Klaczynski et al., 1998) to the identity statuses, the mechanisms that tie these constructs together have been highly speculative. The research presented here suggests that the links of epistemic beliefs and thinking dispositions to domain-specific identity are mediated by the processes involved in dealing with self-relevant information and, specifically, by the degree of bias adolescents introduce into this processing. Both biases and domain-specific identity, in turn, mediate links between initial beliefs, thinking dispositions, and epistemic statuses.

Second, the results represent an important extension of dual-process accounts of development to identity formation. Theorists have long sought to determine the cognitive underpinnings of identity formation, but have met with mixed success (Fauth, 1995). Indeed, many researchers have begun focusing more on social contextual correlates of identity and appear to have abandoned attempts to determine how cognition relates to identity (an exception is the work of Chandler and his colleagues, e.g., Boyes and Chandler, 1992). The results suggest that, at least when reasoning about self-relevant information, foreclosed adolescents place a greater premium on experiential processing and a lower premium on metacognitively monitoring their reasoning for consistency than moratorium and achieved adolescents. It remains for future research to determine whether these differences between identity statuses extend to other social-cognitive domains, such as judgments and decision making. The findings also suggest the need to microgenetic analyses of identity development. Specifically, our findings imply that changes in domain-specific and domain-general identity occur over a series of encounters with belief-relevant evidence (and, as numerous researchers [e.g., Waterman and Archer, 1982] have pointed out, in contexts that pose consistent threats to prior beliefs).
VIII. Conclusions: What Develops?

In this chapter, I introduced a variant of the dual-process models of cognition that are influential in social and cognitive psychology. Although this model has a great deal in common with other models (e.g., Epstein, 1994; Evans & Over, 1996; Sloman, 1996; Stanovich, 1999), it differs from those models in its emphasis on the role of “metacognitive intercession.” Also in contrast to other models, I have argued that heuristics that are automatically activated by experiential processing are at least momentarily available in working memory. This availability affords reasoners the opportunity to intercede in experiential processing before these heuristics are actually applied. Thus, individuals can evaluate heuristics for their appropriateness and make contrasts to various analytic tactics. Individuals do not always (or even often) take this opportunity for a number of reasons. For instance, the intuitive appeal of heuristics is sometimes so strong as to overwhelm cues for analytic processing. On other occasions, the need for speeded and economical responses takes precedence over a more logical, deliberate approach.

The research I have presented on decision making, conditional reasoning, belief-biased reasoning, and identity illustrates the diversity of domains in which dual-process models of thinking are useful. Thus, my hope is that future researchers—many of whom currently appear to be disenchanted with cognitive approaches to adolescent development and uninterested in examining the cognitive underpinnings of social development—will use dual-process accounts in investigations of adolescent social development. The work presented here also shows that it is unlikely that simple unidirectional, unitrajectory characterizations of development from childhood to adolescence, and from adolescence to adulthood, will be especially valuable. As numerous theorists (e.g., Kuhn et al., 1995; Siegler, 1996) have pointed out, everyday cognition is more often characterized by variability than by consistency.

The same can be said of development: Analytic competencies, including metacognitive abilities, do not emerge in an all- or none fashion. Rather, different abilities emerge at different points in development and, when they do emerge, are not evident in all domains simultaneously. As research on decision making shows, everyday cognition is frequently characterized by simple, cognitively economical heuristics, the use of which sometimes masks underlying analytic competencies. Furthermore, as illustrated by work on how adolescents evaluate normative and non-normative arguments for different decisions, some decision competencies develop before others. For instance, the competence to evaluate arguments for avoiding negative precedents appears to develop prior to the competence to accurately assess arguments for avoiding sunk cost decisions. Similarly, there is age variability in children’s and adolescents’ susceptibility to
different types of non-normative arguments. Thus, both children and adolescents can be convinced, under some conditions, to adopt non-normative heuristics (e.g., to “make exceptions” in the case of precedents), even though they are aware of and had previously used normative principles. By contrast, older, but not younger, adolescents are able to resist the intuitive appeal of heuristic arguments on other tasks (e.g., on sunk cost problems).

These findings suggest that decision researchers, as well as policy makers, should exert considerable care in making generalizations about adolescents’ decision making abilities. Specifically, there does not appear to be a single decision making competence that emerges at a specific age. Furthermore, even when a competence does emerge, our research shows: (a) that competence is generally not used often because heuristics tend to predominate everyday thinking and (b) adolescents remain susceptible to arguments (e.g., from peers, advertisers) that can convince them to act against their better judgment (see also Cauffman & Steinberg, 2000; Denes-Raj & Epstein, 1994).

Do any abilities, then, distinguish adolescents from children? As numerous researches have shown (for reviews, see Moshman, 1998, 1999), many basic analytic competencies are better developed in adolescents than in children. For instance, conditional reasoning abilities, particularly those required to make, understand, and argue for indeterminate inferences, are more clearly developed in early adolescence than in late childhood. Although there are conditions under which young children show these abilities, these conditions tend to be those that allow children to rely on semantic memory more than on actual reasoning (i.e., “thinking through”) (see Markovits and Barrouillet, 2002). Thus, one way in which adolescents differ from children is the range of situations to which they apply their abilities; that is, even when children and adolescents attain a similar level of development for a particular skill, adolescents use this skill more often (although, as has been a theme throughout this chapter, this use is fairly infrequent) because they recognize a wider range of situations to which the skill can be applied.

Adolescents also differ from children in the types of heuristics they use in reasoning and decision making situations. For instance, more so than early adolescents, older adolescents rely on claims that belief-threatening evidence—despite being logically identical to belief-supportive evidence—is implausible (Klaczynski, 2000). In other situations, children are more prone to rely on stereotypes to make judgments about belief-supportive evidence, whereas adolescents are more likely to rely on personal experiences (Klaczynski & Fauth, 1997).

Although some studies (e.g., Davidson, 1995; Jacobs & Potenza, 1991; Reyna & Ellis, 1994; Markovits & Dumas, 1999) have shown that adolescents and adults rely more heavily on heuristics than children, these findings should not be taken to mean that adolescents rely more on experiential processing than
children. In part, this is because many of these studies used methods geared toward detecting specific heuristics (e.g., representativeness); if that heuristic had not been acquired by children, then the forced-choice procedures of these studies may have given the appearance of greater analytic processing preference among children. In addition, the host of studies (see Moshman, 1998, 1999) indicating that adolescents are more likely to construct decontextualized task representations than children argue that findings of greater experiential processing among adolescents are exceptions rather than the rule. Although there are undoubtedly some conditions under which adolescents and adults are more heuristically governed than children, available evidence does not support the conclusion that experiential processing rules adolescents’ thinking more than it does children’s thinking. Adolescents have access to more heuristics than children, but this does not mean that they will use these heuristics more often than children. If, as I have argued, there is not a domain-general analytic to experiential shift (and there is not the reverse, experiential to analytic shift), then what is needed are further investigations to determine the conditions and/or domains in which age-related shifts do occur. As things stand, there is a hodgepodge of findings indicating (a) experiential to analytic shifts, (b) analytic to experiential shifts (although there are relatively few investigations demonstrating shifts in this direction), (c) differences in the types of heuristics children and adolescents use, but little suggestion that these differences indicate shifts in the predominance of one system or the other, and (d) no differences between adolescents and children. Attempts to sort out, integrate, and understand the complex array of data are sorely needed.

Given their larger heuristic repertoire, why is it that adolescents are not generally more experientially governed than children? A third, and perhaps most important, difference between adolescent and child thinking is that adolescents have a greater capacity for metacognitive intercession into experiential processing interference. Even if more heuristics are available to adolescents and even if, as is likely, these heuristics are more easily activated in adolescents (i.e., because the associations between heuristic rules and contextual cues are stronger due to more experience), the momentary availability of these heuristics in working memory provides adolescents the opportunity to inhibit heuristic utilization more easily than children.

Despite the metacognitive advances of adolescents over children, neither adolescents nor adults appear to have complete control over the ability to shift from predominantly experiential processing to predominantly analytic processing. One illustration of this point comes from studies of the effects of accuracy motivation on biases in reasoning. A second illustration comes from the Klaczynski (2001b) study of decision making. Simple cues to reason logically, although these led to considerably more normative responding than in the “usual” condition, did not lead most adolescents to normative responding. Kuhn’s (1989)
(e.g., Kuhn, Amsel, & O’Loughlin, 1988; Kuhn et al., 1995) work on biases in scientific reasoning also shows that, despite their superior metacognitive skills, adolescents and adults are only slightly less biased by their beliefs than children. However, neither Kuhn’s work nor my own studies involved simultaneous assessments of both metacognitive abilities and thinking dispositions. Some studies suggest that these motivational dispositions (which are likely to facilitate metacognitive engagement) are more important than the actual metacognitive abilities required to monitor reasoning for consistency and to shift from experiential to analytic processing. Thus, additional research on the development of thinking dispositions (see Stanovich, 1999) is required to sort out the influences of motivation and metacognitive abilities on reasoning and decision making.

The evidence presented here supports the dual-process assumption that, because it is the default system (i.e., that which is typically predominant), experiential processing, more often than not, is not overridden by analytic processing. Consequently, decisions are made and arguments are evaluated on the basis of cursory analyses of the circumstances and stereotypes, beliefs, and heuristics activated by these circumstances. Although I did not discuss this point at length, often the outcomes of this processing are in line with those that would have been produced had analytic processing been predominant (see also Stanovich & West, 1998, 2000; Denes-Raj & Epstein, 1994). In other cases, the decisions produced by the two systems differ, but they may be equally useful in achieving a goal (i.e., via different routes). Furthermore, in many cases, although experiential processing may lead to non-normative decisions, the outcome of following the actions dictated by those decisions is not particularly harmful to the decision maker. For example, in a common sunk cost situation, no great harm typically comes to the movie goer who decides to continue watching a terrible film. In sum, reliance on the default processing system often has adaptive—or at least not maladaptive—value (e.g., when it produces the same decisions as analytic processing, experiential processing does so more quickly, saving time and cognitive effort).

Nonetheless, as research on belief-motivated reasoning illustrates, experiential processing often interferes with analytic processing to produce biases that not only preserve existing beliefs, but also perpetuate stereotypes and inhibit development. In the case of motivated reasoning, novel belief-threatening information may provide an adolescent new insights into the self and/or others. This information is often rejected, however, while similar evidence that supports existing (static) views of the self and social world is often accepted. Experientially biased decisions can have deleterious consequences, both short- and long-term. Variable reinforcement (e.g., occasional winning) may be implicitly processed to create a “schema” for committing the “gambler’s fallacy” and may contribute to addictive betting and gambling.
Experiential processing of ratios, in combination with unrealistic optimism, may contribute to the widespread tendency of adults to play lotteries. Clearly, numerous circumstances call for analytic processing to override experiential processing (Stanovich, 1999).

Equally clear is that there is variability—among decision and reasoning situations, between ages, and among individuals at particular ages—in the extent to which individuals can achieve analytic predominance. Studies of ratio bias and counterfactual decisions indicate that even simple cues to process analytically can, if only slightly, increase normative decisions from early adolescence through early adulthood. Studies of precedent setting and sunk cost decisions show that arguments for normative decisions can produce relatively dramatic shifts from non-normative to normative decisions, shifts that require analytic predominance and that are easier to achieve by adolescents than children. By contrast, as studies of the effects of accuracy motivations on belief-biased reasoning indicate, even adolescents and adults have difficulty inhibiting experiential interference when evaluating evidence bearing on strongly held beliefs.

These investigations indicate that the metacognitive abilities required to inhibit the implementation of automatically activated beliefs and heuristics are not always fully developed or, if they have in fact developed, the individuals possessing these abilities do not often expend the effort required to use them. Although there appear to be developmental improvements in metacognitive abilities, they may not be fully developed even by adulthood (Kuhn, 2000, 2001; Moshman, 1999). It remains to be determined, however, whether poor decisions and biased reasoning is more a matter of acquiring dispositions to be “metacognitively oriented” than of possessing metacognitive abilities per se. Critical to further investigation of these issues will be improvements in the methods used to index both abilities and dispositions.

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THE HIGH PRICE OF AFFLUENCE

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I. Introduction

In this chapter, we focus on adjustment problems in a group of youth little studied by developmental scientists thus far—those from families in the upper socioeconomic strata. Up to the mid-1900s, theories and research in child development were based largely on work with middle class Caucasian children. The latter half of the 20th century witnessed substantial increases in research with poor and ethnic minority groups in recognition of the unique risks that they face (see Bradley & Corwyn, 2002; Garcia Coll et al., 1996; Huston, McLoyd, & Garcia Coll, 1994; Luthar, 1999; Slaughter-Defoe et al., 1990). In contrast with this enhanced attention to disadvantaged children, there has been almost no research with those at the other end of the socioeconomic spectrum—youngsters in affluent, upper socioeconomic status (SES) families.

The near-total neglect of this group probably reflects two related assumptions among developmental scientists (Luthar, 2003). The first is that affluent youngsters are no different from the middle class majority (on whom there is ample evidence); and the second is that given their “privileged” status, the life circumstances of these youngsters must be harmless or even benevolent (and thus, presumably, undeserving of scarce research resources). Neither of these assumptions has been carefully scrutinized, however, and as we shall demonstrate in discussions that follow, both seem to be questionable at best.

Our objectives in this chapter are two-fold: to highlight adjustment disturbances that are salient among affluent children, and to examine the potential causes of these. We begin the chapter by briefly sketching problem domains as suggested by recent journalistic reports from various parts of the country, all pointing to similar types of disturbances in adjustment. In the next section, we describe findings from our own programmatic research based in quantitative empirical methods, in which we have compared upper-class, suburban middle- and high-school youth with their inner-city counterparts, and then follow this with relevant evidence from other research on developmental processes. Across these sources of evidence, four themes have emerged thus far: (1) teenagers from rich communities can manifest as much or more disturbance when compared with their counterparts in poverty, with particularly pronounced problems in the domains of substance and internalizing problems; (2) among teens in wealthy suburbs, just like those in urban poverty, socially deviant behaviors can be reinforced by peers’ positive attitude to them; (3) contextually salient stressors in affluent communities include excessive pressures to achieve across multiple domains; and (4) youngsters at the high end of the socioeconomic spectrum can experience as much isolation from parents as do those at the lowest extreme, and in both cases, deficits in parent—adolescent relationships are mirrored in children’s own vulnerability in emotional and academic domains.
After presenting evidence on upper SES children’s developmental processes, we go on to appraise critical aspects of their contextual surrounds; that is, characteristics of families and of neighborhoods in wealthy communities. Throughout these discussions, we draw on research findings from diverse disciplines ranging from sociology and economics to social and evolutionary psychology. We conclude the chapter with a summary of salient directions for future work with children of affluence, across the dimensions of research, practice, and policy.

II. Problem Areas Among Affluent Youth: Suggestions in Press Reports

Since the start of the 21st century, there have been increasing reports of problems related to alcohol and drug use among upper class youth. A news feature in the fall of 2002 reported several disturbing incidents of underage drinking in Westchester County, a prosperous suburban area north of New York City (Fitzgerald, 2002). Among these was a party held in September 2001, where a high school football team in Chappaqua celebrated the start of the season with heavy drinking and a professional strip show at the home of one of the players. On a day the following April, Harrison High School let out early because of a power failure. An impromptu beer party ensued, during which a 17-year-old boy was fatally injured when he was punched in the face and hit his head on a concrete patio. As he lay unconscious, other teens tried to hide evidence of the party rather than call for help. In September 2002, as many as 200 Scarsdale High School students were drunk on arrival at the annual homecoming dance; 5 had to be taken to hospitals and 28 were suspended (Fitzgerald, 2002).

In another news report from the summer of 2002, Florida authorities reportedly arrested more than three dozen youth between the ages of 14 and 19 years on the Intracoastal Waterway near the Florida—Alabama line. Along with numerous beer cans and liquor bottles, the teenagers had left nine powerboats, presumably owned by their family members, beached on the island. Commenting on the incident, police officials indicated that underage drinking was common among wealthy students, possibly deriving from their easy access to alcohol given money and transportation with which to acquire it (Smith, 2002).

Also in Florida, a 2002 survey of prevalence of substance use among students in Pinellas county found disturbing rates of alcohol use among students in an affluent community (Scott, 2003). According to news accounts of the findings, between a third and a half of the students in northern upper middle class Pinellas were engaged in underage drinking. Acknowledging that the Northern County had a “serious problem,” the chief operating officer for the Juvenile Welfare
Board once again cited the suburban students’ access to money and transportation as explanations for the alarming rates of underage drinking. A subsequent news report documented community concern about drug use among suburban youth in the upper middle class community of Bloomingdale, Florida (Colavecchio–Van-Sickler, 2003). Following increasing reports of teens using drugs, a community anti-drug alliance developed a grant-funded initiative to administer school surveys to track crime and drug trend data, and to develop a prevention program.

Absence of parental supervision and achievement pressures has been seen as implicated in adolescent substance use and related deviant behaviors in wealthy communities. An article based on dozens of interviews with suburban middle school children described casual attitudes to substance use, beginning as early as the age of 13. “Boys…casually discussed the beers they liked and joked about (the) ‘international 4:20 club’, which is supposed to be the universal time to smoke pot.” (Franks, 2000, p. 102). Factors implicated included parents’ demanding careers and long work hours, as well as pressures faced by the children themselves: “We work so hard during the week, because of college pressure, that by the weekends we’re totally, like, let the games begin” (p. 104). In another investigative report following the outbreak of syphilis among many youth in a prosperous Georgia town, interviews were conducted with a cross-section of teenagers in the town. These youngsters described frequent substance use, sexual promiscuity, their yearning to fit in and have friends, and their desire for attention from parents who were just too busy or too tired to monitor or discipline their children. Developmental scientists, reacting to this show, commented: “What is (particularly) disturbing…is the tremendous disconnect that exists between the children of Rockdale County and their families” (Blum, 1999). “… between the hours of 3 pm and 7 pm on weekdays…many adolescents have left the supervision of the school setting where they do not report to anyone as their parents finish their workday” (Gallagher, 1999). “We heard a lot about emptiness. Houses that were empty and devoid of supervision, adult presence, oversight” (Resnick, 1999). (Transcripts of these interviews are available at http://www.pbs.org/wgbh/pages/frontline/shows/georgia/etc/synopsis.html).

The psychological costs of highly pressured lifestyles have also been noted by many. Psychotherapists indicate that children in affluent communities are often overscheduled with organized extracurricular activities to the point that they suffer stress-related symptoms like insomnia, stomachaches, headaches, anxiety, and depression (Gilbert, 1999). Developmental scientists, similarly, have warned that the “scheduled hyperactivity” of children greatly erodes family togetherness (Kantrowitz, 2000; Kantrowitz & Winger, 2001) as well as deprives children of “stabilizing, character-shaping experiences like suppertime conversations and family outings” (Belluck, 2000). In other reports, pediatricians and psychologists
have cautioned that the high rates of problems such as substance use and depression among affluent teens reveals a breakdown of social connections, as family lives become overburdened with demands of parents’ professional careers and children’s extracurricular activities (Gottleib, 2003; Julien, 2002; Wen, 2002). Echoing these sentiments are those of suburban youth in treatment for heroin addiction interviewed for a report on the shifting popularity of heroin from the inner city to the suburbs (Wren, 2000). Each of these individuals mentioned stress at school or home as significantly precipitating their initial use of heroin as teenagers.

Still more seriously, the pressures and stress of contemporary suburbia have been cited, in some instances, as being implicated in adolescent suicide. In Cherry Hill, an affluent town in New Jersey, six teenagers committed suicide over a 3-year period, leaving a frightened community “asking why and fearing who will be next” (Huber, 2003). In a news interview, Dan Gottlieb, a clinical psychologist and host of National Public Radio’s “Voices in the Family,” suggested that the tragedies may reflect larger problems of emotional disturbances deriving from high stress and undue performance demands, warning that, “Cherry Hill East High has big banners flying about academic achievement and its great scores. I think we need to look at the mental health of the community” (Huber, 2003). Rachel Sherman, the daughter of the Cherry Hill superintendent and a youngster who attempted suicide after a yearlong battle with depression, echoed this sentiment. “You have so much to accomplish in such little time before you can be someone or do something with your life,” she said. “I think a big stress a lot of kids face is not knowing what to do or feeling pressured into going to college because their friends are doing it or because their parents are making them and it’s not something they want to do. Everything builds on top of that. I think a lot of kids feel so stressed and pressured into doing things, it overpowers them” (Huber, 2003).

Finally, there have been several reports of vandalism and acts of violence among wealthy youth, generally occurring in the context of alcohol and drug use in social gatherings. In an article summarizing multiple reports of delinquency by upper class teens (Jonsson, 2001), Gary Melton, director of the Institute on Family and Neighborhood Life at Clemson University in South Carolina, argued that some of the nation’s most destructive teen vandals reside in affluent suburban communities. In one of the incidents described, wealthy Houston teenagers had stolen a plane and proceeded to toilet-paper a high school stadium during a football game, and in another, youth from an affluent suburb of Henrico County, Virginia, torched a car, setting fire to a nearby bungalow and burning it down. Yet another news report featured a gang of adolescents from upper middle class families in the northwest known as the 311 Boyz, thought to be responsible for multiple assaults in northwest Las Vegas (Puit & Bach, 2003). Nine teenagers allegedly from this gang were charged with attempted murder with use of a deadly
weapon stemming from an incident that occurred in the upper class community of Canyon Terrace. Police reports indicated that the group was attending a party when a fight broke out between one of the 311 Boyz members and another teenager. This young man was reportedly punched repeatedly and eventually, as he tried to drive away from the scene, was struck in the head by a rock thrown by an irate gang member.

Of course, the generalizability of any of these adjustment problems, as portrayed by news reports, is open to question as they were not ascertained via scientific research methods.\(^1\) It is entirely conceivable that the disturbing trends suggested here actually occur rarely (or in less extreme form) than has been portrayed, but were highlighted in the media to pique the interest of target audiences. Unfortunately, as data garnered via scientific research methods do begin to accumulate, the findings are largely consistent; although not “proving” the veracity of these press reports, extant empirical evidence clearly do not unequivocally refute or even trivialize them.

\(^1\)All of these themes—problematic substance use and high-risk behaviors among privileged youth as well as the tenuousness of connections in their families and communities—have been portrayed in several contemporary feature films rendering commentaries on lives in affluent America. Examples include \textit{The Ice Storm}, \textit{American Beauty}, and \textit{Traffic}.  

III. Evidence of Adjustment Problems: Findings from Developmental Research

Our own first empirical study of affluent youth occurred somewhat fortuitously: the first cohort we studied was considered not so much for its own sake, but rather, as a comparison group for inner-city teens. Beginning in the 1990s, a series of studies with poor, urban adolescents had shown that the high school peer group apparently endorsed several behaviors disapproved of by mainstream society. Specifically, students’ popularity with peers was positively linked with their disruptive and aggressive behaviors at school (Luthar & McMahon, 1997), and was also associated with declines in academic grades over the school year (Luthar, 1995). Recognizing that among young children peer popularity is typically linked with \textit{good} school behavior (Berndt & Keefe, 1995; Wentzel & Caldwell, 1997), we confronted the question of whether our findings were unique to inner-city teens, or were more broadly characteristic of adolescents in general. It was to address this issue that we first sought to study suburban high school students.

In the discussions that follow, we describe the sequence of studies that ensued which, considered collectively, were characterized by three features. First, their
findings echoed themes previously noted in press reports. Second, they were each
designed to build upon and extend the findings of the others. And third, they were
all of an applied nature; the research program evolved in collaboration with
school administrators and parent representatives in a suburban town in the
Northeast region of the US, with the goal of using research-based insights, as they
accrued, to inform the development of interventions to foster positive youth
development. Thus, as we describe the sequence of studies here, we list the
central questions addressed by each, a summary of major findings, as well as
interventions that were derived as appropriate.

A. STUDY I: INNER-CITY VERSUS AFFLUENT ADOLESCENTS

The first study in this series was comparative in nature, involving 264 suburban
10th graders and 224 inner-city students (Luthar & D’Avanzo, 1999). The two
schools sampled differed sharply in SES. To illustrate, median household
incomes for the three townships served by the suburban school ranged from
$78,365 to $102,121, and education levels were relatively high with the
percentage of people 25 years and over who had a graduate or professional
degrees ranging from 24.1 to 36.9% (over four times the national average). In
each of these towns, furthermore, the percentage of people receiving public
assistance was 1.5% or less. By contrast, census data for the inner-city township
indicated a median household income and graduate degree attainment well below
the national average at $34,658 and 4.6%, respectively, and 8.1% of the urban
township was receiving public assistance.2

Disparities in ethnic composition were equally pronounced. Students in our
suburban sample were generally Caucasian with only 18% from ethnic minority
families: 1% African-American, 3% Latino, 8% Asian, and 6% other ethnic
backgrounds. By contrast, only 13% of the inner-city sample was Caucasian, with
the balance including 41% African-Americans, 31% Latinos, 7% Asians, and 8%
other.

Study participation in both schools was high: of the 264 eligible students in the
upper SES school, 91% participated, and of the 267 students invited to participate
in the low-income school, 84% participated. As in our research on resilience and
vulnerability (Luthar, 1991, 1995; Luthar, Doernberger, & Zigler, 1994),
assessments were based on a multi-informant, multi-trait battery encompassing
self-reports of various symptom dimensions, as well as academic records and
behavior ratings by both peers and teachers.

2The disparity between the two schools is further evident in data from a statewide survey of
youth (Beuhuring et al., 1996), in which the suburban schools we studied placed in the second
highest of nine categories of school districts grouped by family socioeconomic status, and the
inner-city school placed in the lowest of the nine categories.
The first set of questions addressed with this sample focused on substance use and related problems (Luthar & D’Avanzo, 1999), and descriptive analyses showed, somewhat surprisingly, that the suburban 10th-graders fared more poorly than those inner-city students on multiple indices. Specifically, the affluent youth reported more frequent substance use than their inner-city counterparts, with consistently higher use of cigarettes, alcohol, marijuana, and illicit drugs. They also reported significantly higher levels of anxiety across several domains, and levels of depressive symptoms were somewhat higher.

We also appraised adjustment difficulties in comparison with national normative data and here, again, saw some startling trends. For example, 72% of suburban girls reported ever having used alcohol as compared to 61% in normative samples, and parallel values for boys’ use of illicit drugs were 59 versus 38%. Similar patterns were observed for internalizing problems. Among suburban girls in the 10th grade, one in five reported clinically significant levels of depressive symptoms; this rate is three times as high as that among normative samples. Rates of clinically significant anxiety among both girls and boys in the suburban high school were also somewhat higher than normative values (22 and 26%, versus 17%).

This study also revealed some troubling patterns concerning correlates of substance use. Among affluent (but not inner-city) youth, substance use was significantly linked with depressive and anxiety symptoms, suggesting self-medication to alleviate distress (Luthar & D’Avanzo, 1999). These findings were of particular concern as the “negative affect” subtype of substance use tends to show relatively high continuity over time (e.g., Zucker, Fitzgerald, & Moses, 1995). Additionally, among suburban boys, high peer status (as indexed by peers’ responses to, “Who do you like most?”) was linked with high substance use. This link remained significant despite statistical controls for various possible confounds including depression, anxiety, delinquency, and teacher-rated classroom behaviors (Luthar & D’Avanzo, 1999). Thus, to revert to the question that originally sparked this work, our data suggested that peer admiration of counter-conventional behaviors was in fact not unique to youth in poverty, but as in the case of substance use, could occur among wealthy teens as well.

Summary of salient findings:

a. Teenagers in wealthy suburbs reported as much or more disturbance across several domains when compared with those in extremely poor urban areas.

b. Particularly prominent were substance use and internalizing symptoms; these problems often co-occurred among affluent (but not low income) youth, suggesting efforts to self-medicate.

c. Peers seemed to approve of—and thus potentially reinforce—high substance use among suburban boys.
B. QUESTION: DO THESE PROBLEMS ENDURE OR DISSIPATE OVER TIME?

Faced with these signs of trouble in our cross-sectional data, we followed our suburban 10th graders through the remainder of the high school years to examine the continuity of problems over time. Follow-up assessments (based on approximately 90% of the original sample) revealed, not surprisingly, that rates of substance use increased between the 10th and 12th grades. Whereas 62% of girls and 58% of boys reported never having drunk to intoxication during their 10th grade, 40% of girls and 37% of boys reported this as high school seniors. Similarly, abstention from marijuana use was reported by 60% of girls and 62% of boys in the 10th grade, but by only 40% of girls and 50% boys during grade 12 (D’Avanzo, Hites, & Luthar, 2001).

The data also showed that among girls, the incidence of internalizing problems generally remained high between the 10th and 12th grade. To illustrate, almost 22% had been above the clinical cutoff for depressive symptoms as 10th graders, and 19% were above the cutoff as 12th graders. With regard to anxiety, incidence of clinically significant symptoms among girls increased over time from one in five to almost one in three by the end of high school. Depression and anxiety values among boys remained at near-average levels at both assessments.

Using longitudinal data, we also examined Luthar and D’Avanzo’s (1999) cross-sectional findings on potential antecedents of substance use. Hierarchical multiple regression analyses with controls for baseline scores yielded results corroborating earlier suggestions of self-medication, with physiological anxiety at baseline, for example, being significantly linked with increases in both cigarette and alcohol use over two years. Findings also showed that baseline peer popularity was significantly linked with increases in boys’ substance use between middle and late adolescence.

Summary of salient findings:

d. Problems identified among affluent mid-adolescents had not altogether disappeared by age 18; in fact, many had escalated over time.

e. Prospective results also suggested self-medication effects, as well as escalating substance use among popular suburban boys.

C. QUESTIONS: MIGHT SUCH PROBLEMS OCCUR AMONG YOUNGER AFFLUENT CHILDREN TOO? WHAT MIGHT CAUSE HIGH DISTRESS IN THE CONTEXT OF MATERIAL WEALTH?

Around the time we first obtained evidence of distress among upper SES high school youth (data reported in Luthar & D’Avanzo, 1999), coincidentally, the first author was asked to consult with a middle school in a nearby town, also affluent. Following a rash of incidents involving substance use among the students, school
administrators sought to determine the magnitude of this and related problems as well as potential causes using scientific research methods and instruments. Accordingly, we surveyed all 6th and 7th graders in this school ($n = 302$), tapping into major maladjustment indices as well as possible antecedents.

In terms of SES, families in this school district were at an even higher level than the suburban high school sample previously studied. According to census data, median family income for the township was $119,872 annually, and a third (32.8%) of the town’s 25 and over population had a graduate or professional degree. Only 1.3% of the population received public assistance (US Census Bureau, 2000). Ethnicity of the student body was, again, primarily Caucasian; in our sample of 6th and 7th graders, only 8% were ethnic minorities (1.5% were African-American, 1.5% Hispanic American, 3% Asian-American, and the remainder were of other ethnic backgrounds).

In examining the incidence of different problems, we found that internalizing symptoms were below normative levels among 6th graders but that 7th grade girls showed elevations in clinically significant depressive symptoms. Specifically, rates among the 7th grade girls were twice as high as those in normative samples; that is, 14% as opposed to 7% (Luthar & Becker, 2002). Similarly, substance use was negligible among 6th graders but was beginning among 7th grade boys. Seven percent of these boys reported having drunk till intoxicated or used marijuana about once a month, whereas no boys in the 6th grade had used either alcohol or marijuana. Finally, analyses of data from this middle school cohort supported earlier findings on correlates of substance use: there were significant links with internalizing symptoms among both boys and girls, and with high levels of peer popularity among the older (7th grade) boys (Luthar & Becker, 2002).

In beginning to explore roots of adjustment problems, we drew upon diverse sources to formulate our initial hypotheses, including findings from related disciplines such as sociology and clinical psychology as well as qualitative data obtained during our own interviews with “key informants.” Using a strategy commonly employed in ethnographic research (LeCompte & Preissle, 1993), we interviewed several suburban community members, all of whom were likely to have a good understanding of processes implicated in adjustment of students in that community. Respondents included senior school administrators, community clinicians, as well as several parents and children. Insights gained from these various sources consistently pointed to two major factors as being implicated, both of which were empirically appraised in our study (Luthar & Becker, 2002).

The first of these factors was achievement pressures. In upwardly mobile suburban communities, there is often a ubiquitous emphasis on ensuring that children secure admission to stellar colleges. Many youngsters, therefore, feel highly driven to excel not only in academics but also in multiple extra-curricular activities, with these pressures beginning as early as the middle school years.
In our study, we operationalized achievement pressures in terms of two dimensions: students’ own maladaptive perfectionist strivings, and their perceptions of parents’ emphasis on achievements. The former was assessed by a self-report questionnaire (Frost et al., 1990) and reflected excessive investment in accomplishments and need to avoid failure. To assess the latter, children were asked to rank-order the top five of ten values potentially important to all parents, in terms of what their parents would value the most. Half of these values pertained to achievement (e.g., “that you… attend a good college; shine in extra-curricular activities”), and the other half represented personal character and well-being (“that you… are respectful to others; always try to help others in need”). The total number of achievement items endorsed in the top five items represented the degree to which students felt their parents emphasized achievements relative to personal qualities.

The second factor believed to be a major cause of suburban students’ adjustment problems was isolation from adults—both literal and emotional (Luthar & D’Avanzo, 1999). Sociological research has shown that among upper middle class families, junior high and high school students are often left alone at home for several hours a week because many parents believe that this will promote children’s self-sufficiency (Hochshild, 1997). Similarly, suburban children’s needs for emotional closeness may often suffer as the demands of professional parents’ careers erode relaxed “family time” and youngsters are shuttled between various after-school activities (Luthar & D’Avanzo, 1999; Rosenfeld & Wise, 2000; Shafran, 1992). Accordingly, we asked students about the degree to which they were supervised by adults after school, and assessed perceptions of emotional closeness to parents separately for mothers and for fathers.

Results were consistent with expectations. Hypotheses were tested via hierarchical multivariate regression equations, with controls at the outset for variance due simply to shared measurement by self-report (by including students’ perceptions of their victimization by peers). Even after these controls, all of the hypothesized predictors were statistically linked with one or more maladjustment indices—internalizing symptoms, delinquency, as well as substance use (Luthar & Becker, 2002)—attesting to the likely salience of achievement pressures and isolation from parents in upper class suburbs.

**Summary of salient findings:**

- Affluent 6th graders were not unusually troubled but problems seemed notably greater post-puberty, that is, among 7th graders.
- Even in these relatively young children, the data suggested some use of substances for self-medication, as well as peers’ approval of boys’ substance use.
- Causes of distress in the context of affluence seemed to include excessive achievement pressures and isolation from parents—both physical and emotional.
D. QUESTIONS: TO WHAT DEGREE MIGHT THESE PROBLEMS GENERALIZE? WHICH PARENT SOCIALIZING DIMENSIONS ARE POTENTIALLY THE MOST SALIENT IN AFFECTING MALADJUSTMENT AMONG UPPER CLASS YOUTH?

Faced with the troubling cross-sectional findings of 6th and 7th graders in one of their two middle schools, school administrators took two steps, the first of which entailed preventive measures guided by what was seen thus far. One such initiative, for example, involved a series of talks and workshops for parents on problems suggested by research findings, and another involved the introduction of an after-school program for middle school students.

The second step was to seek a more comprehensive study to illuminate potential causes of adjustment problems of these youth across the middle as well as high school years. Accordingly, we designed a new investigation that incorporated the town’s entire cohort of children in the 6th grade (i.e., from both middle schools), with the intention of following them through the end of their high school years. This work was to be implemented in parallel with another study already under way with low-income, inner-city students, also of an applied nature, so that we were in a position not only to view trends over time among affluent youth, but also to compare these patterns with those in a radically different demographic setting. Inasmuch as this would maximize variance on the major contextual variable of interest—family SES—the availability of an inner-city comparison group was particularly useful in ascertaining whether material wealth protects against the vicissitudes of adolescence, reducing risk for maladaptive processes (if not actually ensuring unusual well-being) among children and their families.

With regard to specific demographic characteristics, families in the new 6th grade cohort had estimated median family incomes of $125,381, and as noted earlier, approximately 32.8% of adults in this town had graduate or professional degrees. The low-income students with whom we worked concurrently lived in a town where median incomes were estimated at $27,388 annually, and percentages of the town’s population with college degrees, and with graduate or professional degrees, were 9.4 and 5.9%, respectively (as compared to 15.5% and 8.9% in the national population). Percentages of students receiving free or reduced lunches also differed sharply: 3% in the suburban sample and 79% in the inner-city sample. Ethnic representation in the two schools, respectively, was approximately as follows: Caucasians, 93 versus 20%; African-Americans, 2 versus 20%; Hispanics, 2 versus 48%; and Asians, 3% versus less than 1%. Again, participation rates were high, with 94 and 90% of the students in the high- and low-income schools participating, to yield total sample sizes of 314 and 300, respectively, in the two schools.

In contrasting wealthy and low-income students, then, the first set of questions we addressed concerned the quality of different aspects of children’s
relationships with parents, and their potential ramifications for child maladjustment (Luthar & Latendresse, in press). Parenting dimensions examined included those previously suggested to be significant in our prior cross-sectional work: isolation from parents (emotional as well as physical indices) and parents’ emphasis on achievements (overall expectations and emphasis on personal integrity over success). Adjustment outcomes included subjective well-being as well as school competence.

Our results showed that on average, affluent children perceived their parents to be no more available—emotionally or physically—than did youth in poverty. Children’s perceptions of seven parenting dimensions were considered in this study, and mean scores on four of these were similar among high-and low-income youth: closeness to mothers, closeness to fathers, parent values emphasizing personal integrity (as opposed to personal success), and regularity of eating dinner with parents. Of the remaining three, affluent students did fare better on two—parent criticism and lack of after school care by adults—but at the same time, their scores were significantly worse on the last, high parent expectations.

The ramifications of parenting dimensions for children’s adjustment also seemed to be similar. Closeness to parents was beneficial for both sets of students just as criticism was deleterious. Somewhat surprisingly, even after considering the emotional quality of parent–child relationships in analyses, parents’ physical absence (e.g., at dinner) connoted high vulnerability not only for distress but also performance at school (e.g., in relation to suburban students’ academic grades). Fiese et al. (2002) have suggested that it is comforting to children when families have regular “rituals” for major events such as birthday or holiday celebrations; our own data suggest that failure to observe what is among the simplest of family rituals—children dining with at least one parent—tends to be harmful for preadolescents, linked with their unhappiness as well as poor school performance.

**Summary of salient findings:**

i. Across various relationship dimensions, wealthy suburban youth perceived their parents no more positively than did students who lived in harsh conditions of urban poverty.

j. In the rich community just as in the poor one, some children felt quite distant from their parents and concomitantly reflected notable vulnerability in emotional as well as academic domains.

E. QUESTION: WHAT ARE THE IMPLICATIONS OF MEMBERSHIP IN PARTICULAR PEER “CROWDS”?

Although our own cross-sectional findings with a different cohort (Luthar & Becker, 2002) had led to the previous enquiry into different dimensions of preteens’ relationships with parents, a national tragedy—the shootings at
Columbine High School—spurred the next one, aimed at illuminating links between status of peer crowds in affluent settings, and students’ self-esteem and problem behavior. Links between these constructs were addressed in a one-year prospective design (Galen, 2002); 98% of 6th graders in our longitudinal study were retained in the 7th grade assessments.

In this peer-focused enquiry, students were asked to indicate their membership in up to two of a list of 12 crowds that existed in their school (the list had been derived previously and refined with input from a different group of students in the same school system, and included groups such as Jocks and Preppies). All students also rated the desirability (“having a lot of power, influence, and prestige”) of each of the groups on a seven-point Likert scale. To evaluate whether peer crowds were arranged in a status hierarchy, the desirability of each crowd was calculated by taking the mean of ratings given by the entire sample of students. A clear and reasonably stable hierarchy did emerge, with Jocks and Populars being at the top, Intelligent, Theater, Preppies, Independent, and Normal groups in between, followed by Skaters, Rebels, Wannabes, Left outs and War/Gun groups.

To validate the self-reported crowd membership, links were then examined between crowd membership and several constructs previously known to discriminate among adolescent crowds: substance use, delinquency, and school grades. Results generally indicated the validity of the groups, showing conceptually meaningful cross-domain associations (e.g., with grades being highest among the Intelligent group and delinquency highest among the Druggie group). In addition, findings rendered support for a pattern previously seen in our own work: the Popular 7th graders reported greater substance use than all but the Druggie crowd, as well as relatively high involvement in delinquent activities. Thus, whereas our earlier works had shown variable-based links between peer-rated popularity and substance use among suburban 7th graders (Luthar & Becker, 2002) and 10th graders (Luthar & D’Avanzo, 1999), person-based analyses in this study—involving a third suburban cohort—showed that affluent students who self-identified as popular reported among the highest levels of substance use.

Finally, ramifications of crowd status for self-esteem were examined via regression analyses with controls for baseline scores on outcome variables. Results indicated bi-directional links between crowd-membership status and social self-concept for both boys and girls. The data thus indicated a cyclical (and potentially mutually reinforcing) relation among these constructs, wherein the status of students’ school crowds predicted changes in levels of social self-esteem one year later, and conversely, early adolescents’ views of their own social competence was related to changes in the status of their peer crowds. For school officials, findings corroborated what was often reported anecdotally—that crowd membership could, in fact, affect students’ feelings of self-worth—and
a district-wide initiative was launched soon after to contain bullying and victimization of subgroups of students.

Summary of salient findings:

k. Even in their highly “privileged” school settings, some youth were quite vulnerable to low self-esteem—those in crowds deemed to be of low overall status by the larger peer group.

l. Students who saw themselves as Popular reported high levels of substance use as well as delinquency.

F. QUESTION: DO SELF-REPORTED PROBLEMS SUCH AS SUBSTANCE USE AND DELINQUENCY MATTER FOR GRADES?

Acknowledging that a few wealthy youth might, in fact, manifest problems behaviors such as substance use and delinquency, they might still perform adequately at school for two reasons: (a) unlike their low-income counterparts, they would have various treatment resources available to them, and (b) the negative influence of engaging in problem behaviors may be offset by the tremendous pressure on affluent high schoolers to maintain good grades in order to ensure access to prestigious colleges. To address this question, we reverted to the suburban and inner-city high school samples described by Luthar and D’Avanzo (1999), as older teens are likely to reflect more variability on problems such as delinquency and substance use than are middle school students. In these new analyses (Luthar & Ansary, in press), our effort was to disentangle the effects of three discrete but related dimensions of behavior disturbance among high school sophomores—self-reported substance use, self-reported delinquency, and teacher-rated low engagement with school.

Again, our results indicated more similarities than differences at the two socioeconomic extremes. In variable-based analyses considering the three behaviors simultaneously, two of the three had unique links with grades in both samples—delinquency and low engagement with school. Person-based analyses also showed similarities, wherein youth who manifested multiple behavior problems had far poorer grades than did others. The findings on urban teens were unsurprising in light of empirical evidence in similar settings, but the results on affluent youth were noteworthy in indicating that, despite the resources ostensibly available to them, nearly one of every ten teenagers in the sample exhibited high disturbance across multiple domains, and concurrently experienced significant risk for poor grades during the high school years.

The most striking differences between the urban and the affluent groups were the effects involving substance use. In the suburban school only, variable-based analyses showed significant links between substance use—cigarettes in particular (more than alcohol or marijuana)—and poor academic grades.
Similarly, person-based analyses showed that among suburban but not inner-city students, the cluster primarily distinguished by high substance use had significantly poorer grades than others. In other words, high substance use in itself connoted as much risk for concurrent academic failure among suburban youth as did the manifestation of multiple problems, including high delinquency, high substance use, and high disengagement from school.

**Summary of salient findings:**

- Wealthy suburban students and their poor urban counterparts were more alike than different in behavior patterns that were linked with poor academic grades.
- Teens with multiple problem behaviors showed deficits in a domain that is much emphasized in affluent communities—academic grades in high school.
- Substance use, though usually thought of as an “inner-city problem,” was linked with significant risk for poor grades among the wealthy but not the poor adolescents.

G. **QUESTION: WHAT ARE PEERS’ FEELINGS ABOUT “BAD BEHAVIORS” AMONG WEALTHY VERSUS POOR TEENS?**

Finally, we sought to determine the degree to which wealthy and poor youth might differ in the types of attributes they most appreciated among their peers, and those they most disliked (Becker & Luthar, 2003). Again, whereas the inner-city peer group is typically assumed to admire delinquency, we had seen some evidence, as noted earlier, that even suburban teenagers can admire some rebellious, anti-establishment behaviors, such as substance use. In the new study, then, we sought to determine which of several often-overlapping attributes might take precedence in shaping peers’ perceptions across sociodemographic contexts. These attributes fell in three broad categories: rebellious behaviors (being perceived as a “bad student,” high aggression, and high substance use), academic success (reputation of “good student” and high school grades), and physical attributes (attractiveness and athletic ability). Ramifications of these attributes were assessed in relation to peers’ nominations on three dimensions: classmates they admired the most, liked the most, and liked the least. Participants were students in our ongoing longitudinal study, assessed when they were in the 7th grade.

Yet again, overwhelming similarities were seen in patterns across demographic settings, with peers endorsing some counter-conventional, rebellious behaviors in each case (Becker & Luthar, 2003). Results showed that suburban students admired academic disengagement (or “bad student” reputation) as well as aggressiveness among girls, while they liked boys who reported high substance use. By contrast, inner-city students admired students’ aggressiveness, substance
use, and school disengagement, but they did not like students exhibiting any of these. Of the three rebellious behaviors examined, only aggressiveness was linked to peer dislike, and this was true in both samples.

Academic effort ("good student" reputation) was apparently appreciated in both settings, being linked with likeability among suburban students, and with both admiration and likeability among inner-city youth. In addition, it was modestly related to being "liked least" in the urban context, suggesting some ambivalence in low-income adolescents' sentiments toward peers who worked hard at school.

Whereas the two physical attributes examined were linked with all three peer regard dimensions in both groups of students, particularly startling were findings on attractiveness among suburban girls. This variable alone explained almost half of the variance (47%) in scores on peer admiration; attractive girls had admiration scores 2.5 standard deviations above the group mean (the parallel value for low-income girls was 1 SD above the mean). These findings, along with the previously mentioned ones on aggression and peer admiration, lend support to concerns that among affluent adolescent girls, there probably does exist an elite group of students who are socially dominant and aggressive toward others, and at the same time, are admired and seen as highly attractive (e.g., Crick & Bigbee, 1998; Pipher, 1995; Simmons, 2003). Furthermore, the strength of the attractiveness–admiration link renders it unsurprising that girls in affluent, Caucasian families are as intensely preoccupied with body image and appearance as they are reputed to be (see Franko & Striegel-Moore, 2002; Neff et al., 1997).

Summary of salient findings:

p. Some socially deviant peer values are probably universal to the adolescent experience, prevailing among children of very wealthy parents and those in urban poverty alike.

q. Affluent teenagers are not as risk free as one might assume, for peers can reinforce various undesirable attributes including disruptive and disobedient behaviors at school, excessive concern with physical attractiveness and aggressive behaviors toward peers among girls, and among boys, risky tendencies to experiment with substances.

IV. Other Research Evidence on Suburban Youth: Consistency of Themes

Our own programmatic research has suggested various problems among affluent youth, but in weighing the potential seriousness of these problems, two questions must first be considered. First, is there any evidence supporting these
findings in work other than our own studies conducted with three samples of students in two suburbs in the Northeastern US? Second, even assuming that the problems we have found are “real,” might they dissipate by adulthood? These questions are addressed in the following two sections, drawing upon cross-disciplinary research.

To begin with, in the little research outside of our own that has focused specifically on affluent children, there are some other findings that support ours on the prevalence of problems among these youth. In a sample of over 800 teens, Csikszentmihalyi and Schneider (2000) found a low negative relationship between parents’ social class and teenagers’ well-being. Experience sampling across three consecutive years revealed that the most affluent children reported the least happiness and those in the lowest socioeconomic strata reported the most (Csikszentmihalyi, 1999). With regard to substance use, similarly, data from the Monitoring the Future study have shown that during pre- and early adolescence, family SES is linked only weakly with use of most drugs. By the 12th grade, in contrast, upper SES youth reflect the highest rate of several substances including marijuana, inhalants, and tranquilizers (Johnston, O’Malley, & Bachman, 1998). Also relevant are recent reports of sharp increases in the popularity of “club drugs” (such as MDMA, Ketamine and Rohypnol) that are used by the relatively affluent; between 1998 and 1999, the percentage of lifetime use among 12th graders increased from 5.8 to 8.0%, and monthly use changed from 1.5 to 2.5%. (National Institute on Drug Abuse, 2000).

Regarding correlates of substance use, Way et al. (1994) found, using both qualitative and quantitative data, that high SES youth (but not their inner-city counterparts) often used substances in efforts to alleviate emotional distress. Similarly, Feldman et al. (1995) detected associations, as did we, between boys’ high peer status and their vulnerability to substance use. Popular pre-adolescent boys were subsequently among those most prone to partying and heavy drinking as high school students. In their research on adolescent crowds, Brown et al. (1993) found that students in the Popular crowd reported relatively high levels of substance use. Research at the college level (Perkins, 2002) showed that parents had far less influence than did peers on students’ drinking behaviors, and the more socially integrated students typically drink the most heavily. Thus, measures reflecting high sociability, such as socializing with friends more than 2 hours a day and having five or more close student friends, were significantly linked with high levels of drinking (Wechsler et al., 1995). Finally, a review of research in higher education indicated that American college students, particularly at the more elite or renowned universities, are caught up in a triad of alcohol, spectator sports, and partying (Sperber, 2000), sometimes with consequences as serious as alcohol blood poisoning (e.g., McCormick, 2000).
With regard to *achievement pressures*, there is no research, to our knowledge, that has documented greater incidence of this among wealthy parents as compared to others; however, there is ample evidence that children who do feel high pressure to excel are in fact vulnerable to various adjustment problems. Maladaptive perfectionism and pressures to achieve at school have shown significant links with depression and anxiety symptoms as well as levels of substance use among both preadolescent and adolescent samples (Ablard & Parker, 1997; Flett, Hewitt, & Dyck, 1989; Frost, Lahart, & Rosenblate, 1991; Hewitt, Flett, & Turnbull-Donovan, 1992; Kumpfer & Turner, 1990–1991; Mukhopadhyay & Kumar, 1999; Steinhausen & Metzke, 1998).

There is some convergence of evidence from survey reports on *parents’ emotional and physical presence* in wealthy families. National survey data (US Department of Health and Human Services, 1999) showed that among 12- to 17-year-olds, closeness to parents was inversely linked with household income. Feelings of high closeness to resident biological mothers were reported by 65% of those with family incomes more than $75,000 and by 75% of youth whose family incomes were below $15,000. Comparable statistics for closeness to resident biological fathers were 54 and 66% respectively. Similarly, survey findings by the non-partisan Urban Institute indicate that 10- to 12-year-olds are more likely to be unsupervised by adults after school if they are Caucasian, and if their families are of higher SES (Capizzano, Tout, & Adams, 2002). These findings were explained as possibly reflecting wealthy parents’ beliefs in the relative safety of their neighborhoods; however, the absence of adult supervision can bode ill for all children, regardless of how pristine their neighborhoods (e.g., Casper & Smith, 2002).

Corroborating these findings as well as our own research data are reports in the clinical psychology and pediatrics literatures that experiences of parental deprivation are common among upper SES youth (Shafran, 1992). The lack of family-centered interactions due to parents’ professional and social demands has been described by some as the “silver spoon syndrome” or “rich kids syndrome” (Alderman & Friedman, 1995; LeBeau, 1988; Miner & Proctor, 1987). Psychotherapists have also suggested that children from rich families tend to spend more time with hired help than with their parents and often fail to develop authentic friendships and appropriate role models (Pittman, 1985; Shafran, 1992). As a result of their low levels of parental nurturance and excessive reliance on external rewards, such as gifts or money, these youngsters tend to feel superfluous to society and to their own families and are vulnerable to depression, substance abuse and delinquency (Alderman & Friedman, 1995). Along these lines, Aldrich (1988) has noted: “For many beneficiaries, a life spent without having to take the risk for paying the cost of consequences is, quite simply, an inconsequential life… I think that’s the crux of the problem, right there, what money does to most people who have it. It takes away a certain drive.”
V. The Ecological Context: Suburban Parents and Communities

Moving from a focus on affluent children themselves in the preceding section, in discussions that follow we shift to the ecological context of upper class suburbia. At this time, there exists considerably more research evidence on adults in affluence as compared to children. This evidence is reviewed here not only because it is relevant to the previously noted question of whether rich youngsters might “outgrow” their problems, but also because forces that affect adults in affluence will inevitably affect their children as well.

Accordingly, in this section we focus on the mesosystem, consisting of the family or parents, as well as characteristics of the exosystem, or the broader community and culture of affluence (Bronfenbrenner, 1977; Bronfenbrenner & Ceci, 1994). We begin by presenting available evidence suggesting that rich people can be prone to unhappiness, and then discuss the two themes that seem to be commonly implicated: pressures to achieve material goals and status, and the undermining of personal relationships and support networks.

A. RICH PEOPLE CAN BE UNHAPPY

Although the “American Dream” is predicated on the belief that financial success creates opportunities for maximizing happiness, substantial research suggests that high material wealth can be associated with low psychological well-being. In a special issue of the American Psychologist devoted to this topic, Buss (2000) reviewed cross-national epidemiological data and determined that rates of depression, which have increased in recent years, are higher in more economically developed countries. Considering the United States specifically, historical trends show that Americans have far more luxuries than they had in the 1950s, with twice as many cars per person, plus microwave ovens, VCRs, air conditioners and color TVs. Despite this, they are no happier (Diener, 2000; Myers & Diener, 1995). In fact, survey data have shown that between 1958 and 1998, the number of people saying that they were “very happy” went down from 35 to 30%, and the proportion who said they were “pretty well satisfied” with their financial situation went from 42 to 30% (Myers, 2000a, p. 137). In short, “(Americans) are twice as rich and no happier. Meanwhile, the divorce rate doubled. Teen suicide tripled...Depression rates have soared, especially among teens and young adults...I call this conjunction of material prosperity and social recession the American paradox. The more people strive for extrinsic goals such as money, the more numerous their problems and the less robust their well being” (Myers, 2000b, p. 61).

Before proceeding further, it is useful to note an important qualifier to the preceding statements: it is not the possession of wealth in itself but rather
the over-emphasis on status and wealth that is likely to compromise well-being (Luthar, 2003). Clearly, people who can comfortably meet basic life needs of food and shelter face fewer threats to emotional equanimity than those who struggle to meet such needs (Diener & Biswas-Diener, 2002). It is when riches go well beyond the point of comfortable subsistence and preoccupation with acquiring more persists that there can be some threats to mental health, for reasons we will demonstrate in discussions that follow.

High affluence can exacerbate unhappiness partly because it can engender an *inflated sense of one’s own control* over life events. As Schwartz (2000) has argued, the high degree of autonomy implied by personal wealth leads many to believe that they can live exactly the kind of lives they want. These individuals have the ability to purchase an endless variety and quantity of goods and services, and given high professional skills, are also able to move from one job to another in relatively short spans of time. Whereas all of these options might be assumed to engender happiness, they often lead to depression instead, essentially because “increases in experienced control are accompanied by increases in expectations about control. The more we are allowed to be the masters of our fates in one domain of life after another, the more we expect to be...in short, life is supposed to be perfect” (Schwartz, 2000, p. 85).

An obvious problem with high investment in controlling life’s events is that when it cannot be achieved, risk for depression is high. With the prevailing culture of individualism, Schwartz notes that Americans not only expect perfection in all things but also expect to produce this perfection in themselves. When they fail—which they inevitably must—the ethos of individualism biases them toward attributing the failures to internal and personal factors, rather than to external causes. As Seligman’s (1990) seminal works have established, this sort of causal attribution is just the type that fosters depression in the wake of failures.

In a related vein, Peterson (2000) has noted that in the United States today, there is rampant emphasis on individual choices, individual rights and individual fulfillment as well as a pervasive preoccupation with personal accomplishments and acquisitions. He argues that people are increasingly turning themselves into commodities, wanting to be marketable and to keep their options open. “‘Because it will look good on my resume’ is a rationale I hear increasingly often from my students as an explanation for why they are pursuing some seemingly selfless and good activity. No wonder people are alienated and no wonder depression is on the rise among young adults” (Peterson, 2000, p. 52).

Aside from potentially damaging illusions of control, another reason for the enhanced vulnerability of the rich lies in the *addictive potential* of wealth, wherein rapid habituation to accumulated riches leads to an endless escalation of expectations. Following Brickman and Campbell’s (1971) suggestions that people tend to labor on a “hedonic treadmill”, several scholars have argued that when individuals strive for a certain level of affluence and reach it, they quickly
habituate and then start hankering for the next level up, becoming discontented when this is not achieved (Csikszentmihalyi, 1999; Diener, 2000; Myers, 2000a; Schor, 1999). Thus, winning a lottery can result in intense joy, but this elation tends to be short lived and in order to be revived, will require further increases in personal fortunes.

A corollary to the habituation argument is the well-documented phenomenon of “relative deprivation” (Csikszentmihalyi, 1999; Diener & Lucas, 2000; Martin, 1981; Myers, 2000a; Williams, 1975) in which individuals evaluate themselves according to the relative standards in their particular context. Goff and Fleisher (1999) point out the basic desire for material improvement is ubiquitous, and levels of stress about increasing wealth and consumption are directly based on experiences of social comparison. “A primitive villager desires a hut that is a little more comfortable than the current one. The family in a comfortable three-bedroom home imagines the same home or a different one with a little more room, a swimming pool, a game room, a home theater, and improved décor. The estate owner yearns for more luxurious appointments, and a second home by the sea, a summer house in the mountains” (p. 161). Corroborating these arguments, Dutch economists Van Praag and Frijters (1999) found that income satisfaction depended on one’s past income and on comparison with the incomes of others in one’s own social context. Similarly, Hagerty (2000), writing from a business management perspective, demonstrated that, even after controlling for absolute levels of income, earning satisfaction was affected by income change and community income levels. By implication, then, individuals currently in the bottom quartile of the highest income brackets would compare themselves with those earning more than them, and thus apt to feel discontent regardless of their own absolute wealth.

Although it is a widespread phenomenon for all people to want more than they have currently, those with the highest earnings can feel driven more than others to actually acquire more, rendering them particularly vulnerable to unhappiness. As economist Linder (1970) has said, as one’s earning potential becomes higher and higher, it feels less and less reasonable to devote time to pursuits other than earning more. In turn, the more single-minded one’s pursuit of wealth becomes, the greater the potential threats to other types of rewards that are critical for feelings of well-being, for reasons described in the section that follows.

B. “TRADE-OFFS” OF WEALTH WITH OTHER REWARDS

Life patterns associated with high wealth can leave various socioemotional rewards unfulfilled. Deiner (2000), for example, has noted that to the extent that the high productivity associated with affluence involves little leisure time and high stress, people become increasingly prone to feelings of low well-being or
high distress. Economist Juliet Schor (1999) described how the pressures to work, acquire and consume tend to deplete personal energies, and Csikszentmihalyi (1999) has argued that “…to the extent that most of one’s psychic energy becomes invested in material goals, it is typical for sensitivity to other rewards to atrophy. Friendships, art, literature, natural beauty, religion and philosophy become less and less interesting” (p. 823).

A series of studies led Kasser, Ryan, and their colleagues to conclude that excessive emphasis on the American dream can lead to an “organismic nightmare,” as adults who disproportionately valued job success and prestige were more unhappy than were others. Specifically, these authors demonstrated poorer mental health and lower well-being among individuals with a strong investment in extrinsic, materialistic goals such as fame and wealth, relative to intrinsic ones such as interpersonal relatedness, personal growth and community service (Kasser, 2002; Kasser & Ryan, 1993, 1996; Ryan et al., 1999; Sheldon & Kasser, 1995). Consonant findings were seen in another study involving 800 college alumni, where people with Yuppie values—preferring affluence, professional success, and prestige over intimacy in marriage and with friends—reported being “fairly” or “very” unhappy twice as often as did their former classmates (Perkins, 1991).

Although high investment in wealth can lead to impoverished relationships, causal links may also operate in the opposite direction, as affluence strivings can derive from a history of emotional deprivation. Kasser et al. (1995) showed that teens exposed to cold, controlling maternal care came to develop relatively materialistic orientations, whereas better nurtured teens more strongly valued intrinsic goals such as personal growth, relationships, and community. Similarly, Diener and Biswas-Diener (2002) indicated that adults who are unhappy or lonely tend to seek solace in the acquisition of material goods. Supporting this argument, they cite evidence showing that materialism is linked with motives to overcome self-doubts and to obtain power and status, as well as experimental research showing that after people list their inadequacies, they tend to rate money as more important (as though wealth might compensate for low self-esteem). Experiments by Chang and Arkin (2002) yielded consonant evidence, demonstrating that people tend to turn to materialism when they experience feelings of self-doubt or question the meaning of their existence in society.

Evidence from various other disciplines suggests that the very wealthy, paradoxically, can be among those most likely to feel lonely and friendless. Evolutionary psychologists Tooby and Cosmides (1996) have argued that the most reliable evidence of genuine friendship is being offered help during times of dire need: people tend never to forget the sacrifices of those who provide help during their darkest hours. Modern living conditions, however, present relatively few threats to the fulfillment of basic needs. Medical science has reduced many sources of disease; many hostile forces of nature have been controlled; and laws
and police forces deter stealing, assault, and murder. Ironically, therefore, the greater the availability of amenities of modern living, the lower the frequency of critical events indicating to people which of their “friends” are truly engaged in their welfare and which are only fair weather companions. As wealthy individuals are amply able to purchase all types of services (e.g., optimal medical care for physical illness, psychotherapy for depression, and hired help to care for children or the elderly), they would be particularly deprived of proof of others’ authentic concern. This lack of critical assessment events, in turn, engenders lingering mistrustfulness, despite the presence of apparently warm interactions (Tooby & Cosmides, 1996). The rich, therefore, are the least likely to experience the security of deep social connectedness that is routinely enjoyed by people whose environments forced them into mutual dependence (Myers, 2000b).

Also implicated in links between wealth and isolation could be the physical characteristics of wealthy suburban communities. In the most affluent of these, houses are far apart with privacy of all ensured by long driveways, high hedges, and sprawling lawns (Weitzman, 2000; Wilson-Doenges, 2000). Neighbors are unlikely to casually “bump into each other” as they come and go in their communities. Therefore, the wealthiest neighborhoods may be as vulnerable as poor inner city groups to low levels of cohesiveness and efficacy (Sampson, Raudenbush, & Earls, 1997). When fortuitously encountering a disruptive child of the millionaire acquaintance next door, for example, neighbors could often be hesitant to intervene, checked not only by “respect for others’ privacy” but also, more pragmatically, by fears of litigation (e.g., Warner, 1991).

At a group level, social psychologists have argued that pressures to be upwardly mobile can threaten a critical “vaccine against depression” (Schwartz, 2000)—feelings of connectedness with others. In highly competitive, capitalistic communities, concern for the welfare of others can actually be counterproductive for one’s own interests and vice versa (Myers, 2000b). As Myers and Diener (1995) have noted, meaningful involvements in groups such as civic communities always call for some subordination of one’s own interests to those of the group, and conversely, when people focus intensively on maximizing their own goals and possessions, they are likely to feel increasingly detached from the group around them—and thus more vulnerable to depression.

In a similar vein, cross-cultural researcher Triandis (1994) has observed that in wealthy, individualistic cultures, people tend to belong to many groups (e.g., churches, clubs, professional organizations) but do not feel strongly committed to any; they make their selections from an array of choices and stay or leave as suits their needs. In simpler, collectivist societies, by contrast, choices are far fewer, groups (such as village or tribe) are more often assigned, and alliances are changed less often. The implication, again, is that the relationships and connectedness are fostered—rather than the aloneness that is borne of rugged
individualism. Finally, Frank and Cook (1996) have argued that the competitive structures of market economies generally impoverish the interpersonal relationships of their inhabitants, and political scientist Robert Putnam has argued that the high use of market-based services is linked with declines of social capital in communities. In circumstances where there is low cooperation among individuals for shared goals and growing use of the market for services historically provided by family and neighbors (such as childcare), there is, concomitantly, an erosion of social capital, as exemplified by diminished attendance at PTA meetings, churches or temples, or community development groups—all groups that are vital for the well-being of communities (Putnam, 1993; 2000).

C. GENDER-SPECIFIC STRESSORS

As we consider families in affluence, there are also some gender-specific stressors that can exacerbate alienation among mothers in particular and others that more strongly affect fathers. To consider women first: many well-educated, highly skilled upper SES women leave the work force after they have children, in part because their incomes are not critical to support the family, and partly because of reluctance to have both parents committed to jobs requiring frequent absences from home (e.g., Schwartz, 2000). As a result, they can be deprived of not only the gratifications of being engaged in intellectual challenges and self-views of efficaciousness (Csikszentmihalyi, 1997; Diener & Biswas-Diener, 2002; Hochschild, 1997), but also access to supportive relationships. Jobs can provide people with vital networks of supportive relationships and a sense of community (Myers & Diener, 1995)—factors particularly valuable for women who tend to place high emphasis on interpersonal relationships in their lives (Gilligan, 1982; Leadbeater, Blatt, & Quinlan 1995; Maccoby, 1998; Zahn-Waxler, 1993).

Women in two-career, upper class families, conversely, often experience dual pressures of high performance in fast-paced, demanding careers, and also in their roles as mothers (e.g., Berger, 2000). Their professional obligations require them to put in the same long hours at work as do their male colleagues, while their self-imposed expectations as parents can be no less demanding—again, exacerbating risks for both physical and emotional fatigue (Luthar, 2003). Also stressful for many of these employed women are issues of competition, as women are particularly uneasy about outperforming others in traditionally male domains, such as income or occupational prestige (see Exline & Lobel, 1999).

Whereas competing in high career ranks can make women uncomfortable about “winning,” it can engender uneasiness among some men around the prospect of losing. Evolutionary psychology experiments have shown that when men are exposed to other socially dominant men, they subsequently report lower
feelings of personal adequacy and decreased ratings of their own attractiveness as marriage partners (Gutierres, Kenrick, & Partch, 1999; see also Kenrick & Keefe, 1992; Kenrick et al., 1994; Sadalla, Kenrick, & Vershure, 1987). Given that dominant and influential men are likely to be ubiquitous in the highest paying professions, there is considerable potential for the festering of self-doubt. Similarly, studies with animals have indicated the potential for vulnerability to depressed mood among high status males. Raleigh et al. (1991) demonstrated that within groups of vervet monkeys, the highest-ranking (alpha) male had levels of the neurotransmitter serotonin that were twice as high as those of other males. When these alpha males lost their position, their serotonin levels immediately dropped and their behaviors resembled those of depressed humans: they huddles, rocked, and refused food. Reduction in these behaviors was evident after the administrations of drugs that raise serotonin levels, such as Prozac. Among humans, particularly in economic circumstances where fears (if not facts) of losing high status jobs are commonplace, there would analogously be considerable potential for the accumulation of negative affect. As Buss (2000, p. 20) has concluded, “Perhaps the most difficult challenge posed by our evolved psychological mechanisms is managing competition and hierarchy negotiation, given that selection has fashioned powerful mechanisms that drive rivalry and status striving.”

Finally, as highly paid jobs often require a great deal of time away from home, many men can face difficulties integrating family life following absences from home. Based on her ethnographic research with families, Mederer (1999) has provided a vivid view into stresses experienced as a result of the father’s frequent trips away: wives (and children) report difficulties readjusting their role boundaries and everyday routines to accommodate to the man’s re-entry after prolonged absences. Being shut out from the family circle could in turn vastly exacerbate their feelings of alienation, in view of evidence that support from marriages can be particularly critical for conferring psychological protection to men (more so than women) (see Bebbington & Tansella, 1989; Cyranowski et al., 2000; Dempsey, 2002).

Summary of extant evidence: Contextual risks factors among wealthy adults.

Obviously, rich people are not all unhappy (any more than poor people are all unhappy); however, some factors associated with high material wealth can, probabilistically, exacerbate risks for psychological distress. High affluence can foster an inflated sense of control over one’s life, which in turn results in depression in situations when such control is not achieved. Many scholars have noted the addictive potential of material wealth, as people generally tend to habituate fairly quickly to what they possess and then desire more. Furthermore, as one’s earning potential escalates, it can become increasingly difficult to justify not devoting time to working for more; in turn, the more time devoted to earning, the less the time available for leisure and to develop strong
interpersonal relationships—all critical in warding off feelings of alienation and depression.

Materialism is also frequently related to motives to overcome insecurity, so that for many the resolute pursuit of still more power and status represents efforts to overcome deep-seated self-doubts or low self-esteem. Paradoxically, the rich can feel among the most friendless because they can easily buy the types of help that “prove” to those less well off which of their friends truly care about them (being willing to undergo personal sacrifices to provide help when needed). In wealthy neighborhoods, privacy is often at a premium—once again, increasing risks for isolation. At a group level, resolute pursuit of one’s own success tends to involve compromises in seeking the welfare of others in the group, and the high used of market-based services is linked with declines of social capital in communities.

Mothers in affluent communities often leave the work force to stay home with young children and thus are deprived of the intellectual gratification and supportive relationships that tend to be available through jobs. Those who retain their careers, by contrast, often face two demanding sets of expectations—in their roles as mothers and professionals—and also can be quite uneasy about outperforming others in the traditionally male domains of income or job status. Men in high career ranks, by the same token, may often struggle with the negative affect resulting from real or anticipated loss of status at work, and long work hours as well as demanding travel schedules can lead to feelings of alienation from the family.

VI. Implications for Future Work

Having reviewed this evidence on children and families of affluence, we turn to the implications for future work across the realms of both research and practice. For researchers, it is critical to appraise more systematically the adjustment problems we have now glimpsed more than once. Longitudinal studies are needed to illuminate the degree to which, and the circumstances under which, particular adjustment difficulties might endure, intensify, or dissipate among children in wealthy communities. There certainly are many safety nets available to these youth (such as school-based mental health services), so that only a few of them may be truly troubled, and even for these their angst or misbehavior may be largely limited to adolescence (Bradley & Corwyn, 2002; Luthar & Burack, 2000). We acknowledge these possibilities, but believe that it is unwise to see them as altogether reassuring given the recurrence of similar themes (e.g., depression among girls, peers approval of boys’ substance use) in three different cohorts of suburban youth we have studied, as well as the cross-disciplinary evidence cited showing that rich adults can be quite unhappy, which
suggests that adolescent problems may not entirely dissipate. Therefore, we need prospective research illuminating exactly when problems of upper class youth mushroom into serious psychopathology and when they represent relatively benign perturbations of the teenage years.

It will also be useful to obtain more information on the degree to which disturbance among wealthy youth generalizes across geographic locations, as well as on “third variables” that might account for adjustment problems found. The patterns we have identified in suburban areas of the northeastern United States may or may not generalize to suburbs in other parts of the country, or in high-income communities within large cities. On the subject of third variables, Bradley and Corwyn (2002) have noted that much prior research on SES is limited by the failure to consider multiple, correlated mediating mechanisms that might connect family income to child outcomes. Cognitive outcomes of low SES children, for example, can be compromised not only by inadequate nutrition but also by exposure to environmental hazards prenatally (e.g., via maternal substance abuse) and postnatally (e.g., via disturbed parenting), and failure to simultaneously consider these various processes may lead to erroneous inferences about the salience of any one of them. In future studies of high SES children, analogously, it will be important to examine, via strategies such as structural equation modeling, the joint effects of diverse plausible mediators suggested by the early, more exploratory studies, such as achievement pressures or isolation and loneliness among children and their parents.

It will also be useful to try and disentangle effects of ethnicity and family income, although this task will undoubtedly be complicated by the vast differences in income distributions by ethnicity prevalent in contemporary American society. In our own study samples as in society more generally, the wealthy students were mostly from White families while the low-income youth were mostly minority families. In future research, any efforts to disentangle ethnicity and income effects will necessitate sampling of a large number of school districts in order to recruit a sufficiently large sample of minority youth from extremely wealthy families.

Carefully assessing the rates of psychiatric disorders among the rich—children as well as parents—is also critical to understanding the scope and nature of problems in this population. Although completeness of sampling is the sine qua non of epidemiology, there is invariably a subset of hard to reach families, such as the very poor that have major mental illnesses disorders (O’Conner & Rutter, 1996; Verhulst & Koot, 1992). Quite conceivably, it would be as if difficult if not more so to recruit the very wealthy to participate in research evaluations, given that the monetary incentives commonly used to attract poor participants would hold little appeal for them. To the degree that refusals in epidemiological surveys do include a disproportionate number of the wealthiest individuals, this in turn could imply an incomplete research-based understanding of mental health issues.
in this group. In a similar vein, it is unclear whether incidents of violence, crime, and drug abuse among affluent youth—increasingly reported in the media—are relatively rare events, as many tend to believe. Such events may well be far less frequent in these than in poor urban communities; however, what is publicly reported is clearly an underestimate of what actually occurs, as wealthy parents can (and undoubtedly often do) use their influence to purge records of their children’s misdemeanors.

Turning from researchers to practitioners, it is critical to recognize explicitly that children in upper SES families may be an underserved group from the standpoint of mental health needs. Although counseling services are commonly available in schools and parents can seek psychotherapy privately, such services likely are not used as often as they should be, for at least three reasons. First, in general, parents tend not to seek therapy even when they know that their children are troubled (Puura et al., 1998). Second, affluent parents may be more reluctant to do this than most: “Those at the top are supposed to be better able to handle their problems than those further down the scale; and a very important part of “looking good” is never letting any chinks in your (or your family’s) emotional armor become visible” (Wolfe & Fodor, 1996, p. 80). And third, in most cases, children cannot easily access mental health services independently,3 and those likely to benefit most from family therapy may not obtain the requisite engagement from their parents. By the time these youngsters are in a position to obtain psychotherapy, many of their problems may have become crystallized. Acknowledging factors such as these, school psychologists have warned that, paradoxically, children from the wealthiest families may have less access to school and community mental health services than do those from more modest backgrounds (Pollak & Schaffer, 1985).

Of course, the suggestion here is not by any means that the scant resource dollars available for children’s mental health be diverted to the rich, but there are other potential avenues toward prevention. There is some promise, for example, in information dissemination to community groups directly, or via media sources (Doherty, 2000; Luthar, 2003). Notwithstanding the sometimes unhealthy emphasis on achievement and status in these communities, many parents are conscious that these problems exist but are reluctant to question them too stridently given risks of being ostracized as eccentrics (Rosenfeld & Wise, 2000; Taylor, 2003). In communities where a few parents have been outspoken on these issues, strong grassroots movements have developed toward reducing pressures

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3States’ laws and policies regarding minors’ rights to consent to mental health services currently vary by state. See http://www.guttmacher.org/pubs/ib_minors/minors_table.html for a table summarizing states’ policies in this area. Policies that allow minors to independently procure counseling or psychotherapy may provide an important public health benefit for this population.
for children (e.g., “Putting Family First” movement that began in Wayzata, Minnesota). This is not to say that all parents will be changed through information dissemination, but it is quite possible some will be reached, enabling initial inroads into “community empowering” (Doherty, 2000).

Even as we suggest these various directions for researchers and practitioners, we recognize that there will be some non-trivial obstacles to be reckoned with in any future attempts to work closely with affluent youth and families. For researchers, access into these “gated communities” can be difficult. In point of fact, the dearth of developmental research on the wealthy probably derives not only from a lack of interest among scientists, but also, partly from the intense concerns about privacy among the rich and their aversion to disclosing family troubles to strangers. For those seeking to study children in upper class families, then, it will be necessary to first gain the trust of the community (as must be done to work in poor communities, also wary of researchers though for different reasons, see Knitzer, 1996; Schnitzer, 1996). Furthermore, once such research is underway, it will be equally important to sustain it, by bringing knowledge back to the community as it accumulates, for example, and by ensuring that results are not presented in ways suggesting judgmental or condemning attitudes (another parallel with the poor, see Haynes & Comer, 1996; Luthar, 1999).

For practitioners, it is critical to guard against negative attitudes that minimize or dismiss the problems of the rich (e.g., Wolfe & Fodor, 1996). Many believe that the wealthy cannot really be victimized by problems such as child maltreatment and domestic violence, for even if they experience these problems, they can ameliorate them on their own. Weitzman (2000) has noted that domestic violence is under-reported in the social work and psychology literature not only because service providers tend to be dismissive of the problems of the wealthy, but also because affluent women themselves believe that abuse affects only the underprivileged, and, consequently, are too ashamed to seek help. What is all-too-rarely recognized is that an abused or alcoholic parent earning $200,000 a year can be no more likely to seek help for him or herself than is one earning $20,000. As Bradley and Corwyn (2002, p. 378) caution, “the poor are more likely to be defined as mentally ill even when they manifest the same level of symptomatology as do more affluent individuals;” by corollary, there is a danger that the rich are more likely to be dismissed as “not needing help” even when reports of distress are commensurate with those of their less wealthy counterparts.

Conceding that some rich people can be difficult to work with, displaying entitled, arrogant, or inconsiderate attitudes, practitioners warn at the same time that clinicians themselves can bring considerable negative affect to these interactions. Aside from dismissiveness, a frequently noted pitfall is scorn or contempt: practitioners may often experience some envy of their clients’ far greater access to luxuries, and this envy then gets converted to emotions seen as
less socially repugnant such as scorn or ridicule (Kleefeld, 2000; Pollak & Schaffer, 1985; Warner, 1991). Thus, just as it is important for therapists to guard against judgmental countertransferential reactions in working with the very poor (e.g., substance abusing mothers), similar precautions apply in work with the rich (Luthar, 2003). More broadly, there is a need for vigilance against negative stereotypes about the rich just as has been noted for the poor. Lott (2002) noted that the poor are often seen as being characterologically wanting, with their indolence and indiscipline responsible for their own misfortunes; analogously, again, the rich are often seen as lacking in character, with their shallow and single-minded preoccupation with amassing wealth responsible for their own despair (Luthar, 2003).

As mental health professionals or scientists who are concerned with the welfare of children and families, we must not treat any group as being undeserving of our attention. There has been, fortunately, increased attention to the barriers that the poor face in acquiring help for mental health, with explorations of ways to foster accessibility (e.g., by providing multiple services in single sites) or to overcome resistance due to wariness (see Haynes & Comer, 1996; Luthar & Cicchetti, 2000; Schnitzer, 1996; Yoshikawa & Knitzer, 1997). There must now be attention to mental health issues of the affluent, too. We would do well to remember that no person—wealthy or otherwise—deliberately “chooses” to remain unhappy; psychological distress that does sustain must derive from some forces, intrapsychic or external. Our job as psychologists is to try and identify and ameliorate these forces for all groups—ensuring that no child, or family, is deliberately and indifferently left behind.

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ATTENTIONAL INERTIA IN CHILDREN’S EXTENDED LOOKING AT TELEVISION

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IV. QUESTIONS FOR FUTURE RESEARCH

REFERENCES
In this chapter we consider sustained visual attention in children and adults. We not only focus on children’s looking at television but we also consider sustained play with toys. Our work indicates that sustained looking at television or during play reveals attentional processes that have not been apparent in standard experimental studies of attention to static visual displays. In the child’s typical environment, attention is drawn to interesting, informative, and important aspects of the real world. The sensory and cognitive properties of such objects are often meaningful to the child and incorporate movement and change over time. We believe that often television programs and movies, and probably play with toys, mimic these types of stimuli and reveal patterns of attention that are not typically found in laboratory studies. In the present chapter, we focus on a phenomenon we call *attentional inertia*, which is a progressive increase in the attentional engagement as a look is sustained.

This view of attention differs from that typically used to study attention in infants and young children. For example, studies of visual attention in infants and very young children usually involve repeatedly presenting a static visual stimulus until looking times become shorter and shorter. Depending on the study, the experimenter may introduce a change in the stimulus to see whether looking time increases in response to the change. Theories to explain these phenomena are generally variants of Sokolov’s broad formulation: the child gradually forms a neural or mental representation of the stimulus and compares that representation to subsequent encounters with that stimulus. As the representation comes to match the perceptual input, attention to the stimulus wanes. When a discrepancy is detected, attention increases.

As important as the phenomenon is, habituation likely accounts for a small portion of the variability of sustained visual attention in the real world. The aspects of the environment to which attention is drawn are not static. Rather, attention is engaged with meaningful events that change dynamically. In addition to sensory-perceptual changes (movement, appearance), events that provide changes in information over time also easily attract attention in young children. Except for inhibition of attention to the unchanging aspects of the child’s environment, habituation likely accounts for little of the dynamics of attention in the real world. We believe that a model of attention that stresses an increase in attentional engagement over time may be more realistic for the child’s real environment than one that stresses a decrease in attentional engagement.

Television is not the real world, but it is like the real world insofar as it provides meaningful, audiovisual stimulation that changes over time. There is little opportunity for habituation of looking because the images are not ordinarily static or repetitive. Even when television programs are repeated exactly, children’s looking does not decline with subsequent viewings. At home, children watch videotapes over and over (Mares, 1998) with little or no loss of attention,
at least at younger ages. In an experiment with 3- to 5-year-olds, children were shown the same episode of the preschool program *Blues Clues* on five consecutive days. Only 5-year-old boys showed a slight drop of looking across the repetitions. All the children showed a great increase in overt interaction with the program (e.g., talking to the TV, pointing, laughing), as repetitions increased (Crawley et al., 1999). Similarly, infants between 12 and 15 months of age actually showed increased, not decreased, looking at baby videos as a function of 30 or more repetitions (Barr et al., 2003).

What accounts for looking at television? The onsets of looks appear to be elicited by auditory features, visual movement, and other forms of visual change that may be detected in peripheral vision as the child plays with toys or engages in other nonviewing activities (Alwitt et al., 1980; Anderson & Levin, 1976). These onsets of looks are usually accompanied by orienting reactions as indexed by heart rate decelerations (Lang, 1990; Richards & Cronise, 2000). If other viewers are present, a child may also look at the screen because he or she sees another child turn toward the television (Anderson et al., 1981b). In this chapter, we are primarily concerned with what happens once a look is initiated; why are looks subsequently sustained or terminated?

Our efforts in this chapter to answer this question take three forms. In Section I we review past work that shows attentional inertia during television and toy play. This review emphasizes work that has studied the distribution of look durations and has hypothesized that this distribution implies an increasing attention engagement across the course of a look. Section II consists of the analysis of look durations using data from a wide range of testing ages (3-month-olds to adults!). The purpose of this section is to show that the distribution of looking is very similar across the ages. This similarity implies that the same cognitive processes guide look duration at different ages. Finally, in Section III we present two quantitative models that account for extended looking during television viewing. These models account for the unique statistical distributions shown in Section II for look durations during television viewing. They provide some theoretical mechanisms that aid in our understanding of attentional inertia.

### I. Theories of Sustained Looking at Television

Theories of looking at television posit two phases in the course of looks (Anderson & Lorch, 1983; Huston & Wright, 1983). Once a look has begun, it is assumed that viewers quickly evaluate the content by determining the presence of particular auditory and visual features that signal relevant, comprehensible, and entertaining content. The theories posit that through experience with television, young children learn which auditory and visual features are most predictive of content that is relevant to them. If there is a peculiar voice and a puppet,
for example, a young child judges that the content is intended for children and will sustain looking beyond the initial, orienting phase into a phase of more sustained cognitive processing of content. If instead, an adult male is sitting at a desk and talking with a serious expression on his face, the child judges that the content is intended for adults and quickly looks away. Additionally, if the child has previously judged that the content is uninteresting, he or she will occasionally look at the TV to see whether anything has changed. If, upon looking, he or she finds the same characters and setting as before, the look ends quickly (Huston & Wright, 1983).

Theoretically, the cognitive processing of the narrative or other content drives the sustained phase of the look. The theoretical details of this processing are beyond the scope of this chapter, but are generally thought to parallel in most respects the cognitive processing of spoken or text narratives (Neuman, 1991). A look at the television eventually terminates when the viewer reaches the end of a unit of content, when he or she encounters an external distraction, when the content becomes uninteresting, or the viewer fails to comprehend.

Evidence in support of these theories is reviewed elsewhere (Anderson & Burns, 1991; Huston & Wright, 1989). Briefly, features of TV that are correlated with child-oriented content (e.g., children’s voices, peculiar voices, animation, puppets, etc.) are also associated with sustained looking whereas features correlated with adult-oriented content (especially men and men’s voices) are associated with terminations of looking (Alwitt et al., 1980; Anderson & Levin, 1976; Campbell, Wright, & Huston, 1987; Schmitt, Anderson, & Collins, 1999). Evidence indicating that looking is related to cognitive processing of content is provided in a variety of investigations (e.g., Anderson et al., 1981a,b; Campbell, Wright, & Huston, 1987; Lorch, Anderson, & Levin, 1979; Lorch & Castle, 1997; Lorch et al., 2004; Pingree, 1986). For example, preschool children look substantially less at Sesame Street when the content has been rendered more difficult to understand by ordering the shots randomly, or by making the audio incomprehensible by, for example, running utterances backwards or presenting them in a foreign language (Anderson et al., 1981a). Note that each of these manipulations leaves the typical visual and auditory features of television unchanged, so that the reduction in looking at the screen is caused by a decrease in comprehensibility of the content indicating that looking is driven at least partly by cognitive processing of content.

In summary, the theories of television viewing suggest a phase of looking that consists of an initial evaluation of content and a phase of looking that involves sustained content processing. However, they do not necessarily imply that there are changes in the level of content processing during the sustained processing. Nor do they account for the unique distribution of look durations found in several studies (Section I.B), or what happens once a look is initiated. Attentional inertia
is a progressive increase in attentional engagement the longer a look at television is sustained. As a theoretical concept, attentional inertia has historical precursors.

A. PRECURSOR CONCEPTS

Historically, a number of observers have argued for processes that are analogous to attentional inertia. William James (1890) noted that as a person engages in thought about some interesting topic, he or she shifts the focus of attention from idea to idea while staying within a broad mental framework. The person may become increasingly engaged over time, becoming less distractible by the outside world. He considered this kind of attentional engagement as being effortless and labeled it “passive intellectual attention.”

Donald Hebb (1949) argued that in many if not most task situations the focus of attention must necessarily shift from one component of the task to another. To complete the task, however, attention must be engaged broadly with the task as a whole. He referred to this broad attentional engagement as “attitude” (as in the attitude or orientation of an airplane as it flies in three-dimensional space).

More directly relevant to present concerns, Hochberg and Brooks (1978) argued that when a person who is viewing a film encounters a cut, that is, two distinct shots that occur successively, some underlying process must drive attention forward in time. They referred to this underlying process as “visual momentum.” Without such a process, one might suppose that a person would simply look away when a scene disappears and is replaced by a different succeeding scene. Hochberg and Brooks suggested that this process is based in some way on the viewer’s knowledge that the shots are all part of one film and that they must be connected.

All these theorists argue for a process that drives attention forward in time, but note that this process differs from the processes involved in paying attention to a specific visual scene. In other words, attention is maintained to a topic, a task, or a communication medium even as the focus of attention is constantly changing. However, despite their compelling descriptions of attention, these theorists provided little or no evidence to support the existence of such a form of attention.

B. HAZARD ANALYSES OF LOOK DURATIONS

The distribution of look durations during television viewing has a characteristic shape. During television viewing there are many short looks, an intermediate number of medium-length looks, and a few long looks. For example, when preschool children watch television in a setting that affords other activities, such as toy play, they look at and away from the screen many times in the course of an hour, averaging about 150 looks (Anderson & Levin, 1976). The majority of these looks are quite short, under 3 sec in length, but some are quite long, up to
about 60 sec or more, producing a highly skewed distribution of look lengths (Anderson et al., 1979). This skewed distribution of look lengths is not limited to preschoolers; infant and adult television viewers produce similar distributions (Burns & Anderson, 1993; Richards, 2000; Richards & Cronise, 2000). A major emphasis of this chapter is to establish the validity of this distribution across a wide range of studies (Section II) and provide a quantitative model for the distribution that has theoretical implications for the understanding of extended television viewing (Section III).

This distribution of look durations during television viewing has some interesting probability relations. Anderson et al. (1979) coined the term attentional inertia to describe a pattern they had observed in 3- and 5-year-old children’s looks at television. The children were videotaped watching Sesame Street in a room that contained attractive toys. Videotapes were coded for start and stop times of looks at the TV screen from which look lengths were calculated. Anderson et al. (1979) noted that as looks at television became longer, they became less likely to terminate. For example, given that a look was initiated, it had a probability of about 0.57 of terminating within the first 3 sec; a look that survived the first 3 sec had a probability of 0.34 of terminating in the interval 3–6 sec; a look that survived to 6 sec had a probability of 0.24 of terminating in the interval 6–9 sec. Analyses of group data showed smooth, negatively accelerated decreasing curves describing the hazard of a look terminating in each successive 3-sec interval. A look was seemingly fragile early in its existence, and easily terminated. However, looks that survived beyond about 15 sec were robust and increasingly likely to survive through each successive period of time. Once set in progress for a substantial amount of time, a look metaphorically developed its own inertia. This pattern did not just represent an artifact of averaging across individuals. Rather, these same curves were found in the data of each of nearly 300 three- to five-year-olds studied.

One way to illustrate this finding is with curves from “hazard function” analysis. The hazard function is the conditional probability that a look will terminate (i.e., “die”) in a given interval given the probability of its surviving to that interval. A hazard function for adults’ looks during television viewing (which are distributed in a manner similar to children’s looks; Burns & Anderson, 1993) is shown in Figure 1. The hazard increases from 0 sec to a peak at a short interval (i.e., 1–2 sec) followed by a decrease in the hazard over time. In other words, at very short intervals adults often looked away, but at longer look intervals looking away was much less likely.

The shape of the hazard functions for looking at television is similar over a wide range of ages. A hazard function for infants from 3 to 6 months of age (Richards & Gibson, 1997) and for 5-year-old children playing with toys (Choi & Anderson, 1991) also appear in Figure 1. Here too the conditional probability of the look terminating increases for the very short duration looks then decreases
Fig. 1. Hazard function for looking toward television or toys. The hazard is the conditional probability that a look will terminate at a given interval. The data were from adults (left panel, Burns & Anderson, 1993, Figure 3), 3- to 6-month-old infants (center panel, Richards & Gibson, 1997, Figure 2), and 5-year-old children (Choi & Anderson, 1991, Figure 3).
with longer looks. Many other studies of television viewing have shown this in children. Anderson et al. (1979) showed this in 3- and 5-year-olds, and in 12- to 24-month-old children in a reanalysis of data collected by Anderson and Levin (1976). Richards and colleagues have found similar curves in infants as young as 3 months (Richards & Gibson, 1997) and in children from 6 months to 2 years of age (Richards & Cronise, 2000). In addition to these laboratory studies, Anderson and his colleagues videotaped TV viewing in homes (see Anderson et al., 1985, for a description of the method). Analyses of looks at the television screen coded from these videotapes revealed the same pattern of attentional inertia in home TV viewing both in children and adults (D.R. Anderson, unpublished analyses; for an example, see Anderson, Choi, & Lorch, 1987). Attentional inertia is not a phenomenon limited to the laboratory.

To summarize, analyses of looks at television show that the hazard of termination declines the longer a look has been in progress. Attentional inertia was revealed in all individuals ranging in age from 3 months to adulthood. In the rest of this chapter we review evidence that attentional inertia reflects an underlying process of progressive attentional engagement. We then describe efforts to quantitatively model attentional inertia, and conclude with comments suggesting directions for future research.

C. DOES ATTENTIONAL INERTIA REFLECT THE COGNITIVE PROCESSING OF SPECIFIC CONTENT?

A basic question about attentional inertia is whether it reflects engagement with specific content. Perhaps, as viewers watch a TV program they build up schematic knowledge about the content, thus causing increased engagement with that content (usually a story of some kind). If this is so, when the story ends, the engagement should end and not extend into new and different content. Anderson and Lorch (1983) tested this hypothesis with preschool children’s looking at *Sesame Street*. They reanalyzed looking data from 3- and 5-year-olds who were shown *Sesame Street* programs that had been edited such that content and format of successive segments (average duration of 90 sec) were unrelated (Anderson et al., 1981a,b). An animated segment about the letter H might, for example, follow a film segment about buffaloes.

Of key interest were looks that crossed segment boundaries; that is, looks that began before a segment boundary and remained in progress after the segment boundary. Did look length prior to the segment boundary predict the length of the look after the segment boundary? Because the content completely changed after the segment boundary, if attentional inertia is driven by engagement with specific content, look length prior to the boundary should be unrelated to the length of time the look remained in progress after the boundary. That is, the correlation should be zero. If, instead, attentional inertia drives looks across content
boundaries, the correlation should be positive. The analysis revealed a clear positive relation: the longer the look was in progress prior to the segment boundary, the longer, on the average, it remained in progress after the segment boundary. For example, for 5-year-olds, looks in progress for 5 sec prior to the content boundary lasted an average of about 18 sec after the boundary. Looks in progress for a minute prior to the boundary lasted an average of about 40 sec after the boundary.

Burns and Anderson (1993) repeated this analysis on adults looking data using the boundaries between primetime programs and commercials. They found the same result. The longer looks had been in progress prior to the block of commercials, the longer they remained in progress during the commercials. Attentional engagement during a program is sustained into advertisements that differ immensely in content. These results suggest that as children and adult viewers maintain their attention to TV, their engagement deepens. This engagement is not limited to processing a particular unit of content presented by the television, but rather, extends to any content presented by the television.

The idea that attentional inertia is deepened engagement to the medium of television and not to specific content is supported by consideration of studies comparing different types of stimuli. Richards and Gibson (1997) found the attentional inertia pattern to a children’s movie in 3-month-old infants who clearly could not understand the content of the film. Richards and Cronise (2000) found the typical distribution pattern of look durations not only to the movie, but also to computer-generated, randomly moving patterns and associated sounds. Not until 18 months of age did infants attend more to the movie than to the random patterns. A study with college-age participants (Richards, 2000) compared looking to a Seinfeld television program, a children’s movie (Follow that Bird), a Seinfeld television program with scrambled scene sequences, or stimuli that had mixed content (Seinfeld, Follow that Bird, and computer-generated audiovisual patterns). The same distribution pattern of look durations was found across all these stimuli even in the face of very disparate looking lengths.

Taken together, these studies suggest that sustained attention builds upon itself, producing deepened engagement with whatever stimulation is provided by the TV. Cognitive processing of meaningfully structured video is not a necessary requirement for attentional inertia although it may itself enhance attentional inertia as we note later in this chapter (also see Hawkins et al., 1995).

D. IS ATTENTIONAL INERTIA DURING TV VIEWING ASSOCIATED WITH DEEPENED ENGAGEMENT?

The analyses thus far imply deepened attentional engagement as a look is sustained, but do not test directly for it. Evidence from at least three types of
studies suggests that engagement becomes deeper the longer looking is sustained. First, level of distractibility while looking has been used to test sustained engagement. If viewers become more deeply engaged the longer they sustain looking at TV, they may suppress or inhibit attention to the environment outside the TV program. This is fairly obvious to parents who try to get the attention of children who are engrossed with television, and experimentation confirms this phenomenon. Anderson et al. (1987) showed Sesame Street to 3- and 5-year-old children. On a rear-projection screen to the side of the TV set, a brief “beep” signaled the appearance of a slide, which was shown for 4 sec. Intervals between slides varied randomly. If children become more deeply engaged the longer a look is in progress, they should be less likely to turn and look at the distractor. In fact, both the 3- and 5-year-olds were more likely to turn toward the distractor when they had been looking at the TV for less than 15 sec as compared to when they had been looking for more than 15 sec. When children did look at the distracting slide, their head turns were slower when they had been continuously looking at the TV for more than 15 sec. Richards and Turner (2001) found similar reductions in distractibility as looks were sustained for infants ranging in age from 6 months to 2 years.

Second, if engagement with TV deepens as a look at television is sustained, and if the hazard of termination curves are a good index of engagement, then a viewer should be slower to respond to a secondary task if a look has been sustained for more than 15 sec than if the look has been sustained for less than 15 sec. Lorch and Castle (1997) showed preschool children Sesame Street while they performed a secondary push-button reaction time task. Children were instructed to push a button as quickly as possible on hearing an auditory signal. Reaction times were shorter when the children were continuously looking at the TV for less than 15 sec than if they were looking for more than 15 sec. The authors interpreted this result as indicating that engagement with the TV deepened as a look was sustained.

Third, physiological signs often are used as markers of attention engagement. For example, heart rate changes during attention and these changes have been used to assess attention responses in television viewing (Lang, 1990; Reeves et al., 1985). In infants and young children, sustained attention to stimuli in a number of modalities is accompanied by an initial heart rate deceleration and a sustaining of heart rate as long as attention continues (Richards, 2002; Richards & Casey, 1992). This pattern is evident in the results of studies of children’s TV-viewing, shown in Figure 2 (Richards & Cronise, 2000; Richards & Gibson, 1997; Richards & Turner, 2001). Heart rate typically decelerates in the first few seconds of television viewing, and extended looks toward the television are accompanied by increasingly deep heart rate changes.

The heart rate responses are separated by look length in the left panel of Figure 2. Evident in this panel are the short-latency changes associated with
Fig. 2. Heart rate changes in infants and young children during television viewing. The data are plotted as changes in interbeat-intervals (IBI change), with longer IBIs reflecting a deceleration of heart rate. The data were from 3- to 6-month old infants (left panel, Richards & Gibson, 1997, Figure 3) and 6-month to 2-year-old children (right panel, Richards & Cronise, 2000, Figure 3). The left panel separates the heart rate changes by look lengths (1, 0–5; 2, 5–10; 3, 10–20; 4, 20–40; 5, >40; 6, 100–150 and 200 sec).
short looks, the increasingly sustained heart rate change for relatively long looks (> 40 sec, “5” in Figure 2), and the changes for extremely long looks (> 100 sec, “6” in Figure 2). Additionally, these changes in heart rate are associated with an increasing resistance to distraction by a peripheral stimulus (Richards & Turner, 2001).

Taken together, the findings from these studies are consistent with the view that the attentional inertia pattern is associated with deepened attentional engagement as indexed by decelerated heart rate, reduced distractibility, and increased interference with a secondary reaction time task.

E. IS ATTENTIONAL INERTIA RELATED TO INFORMATION PROCESSING?

In nearly all theories, the role of attention is to enhance information processing of selected stimuli. If attentional engagement deepens as the length of a look at television progresses through time, it is reasonable to expect that the content of the television program should be comprehended more effectively as the look progresses in time. In one study that addressed this issue, Burns and Anderson (1993) videotaped adults as they were shown primetime TV programs with associated commercials. The participants had magazines to look at and snacks to eat in addition to the TV to watch. After the viewing session the participants were shown brief 3- to 4-sec audiovisual excerpts of the programs and commercials they watched as well as foil excerpts taken from different programs in the same series along with associated commercials. Participants indicated whether they had seen the excerpt. Recognition memory was significantly more accurate for segments shown when the viewer had been looking at the television for more than 15 sec. This result is consistent with the hypothesis that information processing is more intense and more effective as attentional engagement deepens over the time course of a look.

Lorch et al. (2004) examined story comprehension in 7- to 11-year-old children diagnosed with attention deficit with hyperactivity disorder (ADHD) as well as typical comparison children. Children were observed watching television with and without toys available for play. Comprehension testing focused on factual information and causal relations between story elements. Consistent with prior work, ADHD children in the toys condition produced fewer long looks (> 15 sec) than did the comparison children. Looking in the no-toys condition was at ceiling for both groups. Comprehension testing indicated that although the diagnostic groups did not differ in the no-toys condition, ADHD children showed less comprehension of causal relations in the toys condition. However, the time spent in long looks statistically mediated the difference found between diagnostic groups. Although ADHD children showed lower comprehension of causal story relations, when they had been continuously looking for more than 15 sec at the time the information necessary to make a causal connection was presented, their
comprehension matched that of the comparison children. Lorch et al. (2004) interpreted the findings as providing “… further support for the interpretation that long looks lead to deeper cognitive processing” and that “… the amount of time spent in deeper cognitive processing during long looks helps explain the differential patterns of comprehension in children with ADHD and comparison children …”

F. IS ATTENTIONAL INERTIA LIMITED TO TELEVISION VIEWING?

Attentional inertia appears to be a robust phenomenon of television viewing. It is unlikely, however, that such a robust phenomenon is limited to TV. In fact, sustained toy play has properties analogous to attentional inertia. Anderson et al. (1987) noted that in the context of television viewing, the lengths of toy play episodes were distributed similarly as the lengths of looks at television. As toy play episodes were sustained in between looks at TV, children became less distractible by an external stimulus.

Choi and Anderson (1991) videotaped 5-year-old children’s toy play without a television present and coded the times of onset and offset of play episodes. They noted that the distributions of play episode lengths resembled the distribution that Burns and Anderson (1993) had found for looks at television. In a second study, Choi and Anderson (1991) found that the longer a toy play episode remained in progress, the less effective was an external distractor. Furthermore, when children were successfully distracted, the time to turn to look at the distractor increased as the length of the play episode increased. These results paralleled those found for looks at television by Anderson et al. (1987). The investigators argued that both toy play episodes and looks at television appeared to follow a time course such that the longer an episode or look remained in progress, the more engaged attention became.

Ruff (1986) has provided behavioral criteria by which to distinguish two components of attention during infants’ toy play that she labeled “focused” and “casual” attention. Focused attention is characterized by looking at the toy, a serious facial expression, knit brows, body posture oriented toward the toy, leaning in toward the toy, and suppression of vocalizations. Casual attention is largely defined by the absence of these things and by mouthing or repetitive banging of the toy. Focused attention increases with age, appears to be indicative of extensive cognitive activity in the infant, and is positively predictive of intellectual outcome (e.g., IQ; see Ruff & Rothbart, 1997 for a review). Importantly for present purposes, Ruff, Capozzoli, and Salterelli (1996) found that in 10-month-olds focused attention tended to occur during long play episodes whereas casual attention was associated with short play episodes. This is consistent with the attentional inertia hypothesis that attention becomes increasingly engaged as an episode is sustained. Using the external distractor
technique developed by Anderson et al. (1987), Ruff, Capozzoli, and Salterelli (1996) found that infants were less distractible from play when they were engaged in focused attention. If they were successfully distracted during focused attention, they were slower to turn their heads toward the distractor. Like the Choi and Anderson (1991) results with 5-year-olds, Ruff, Capozzoli, and Salterelli (1996) found an inverse relation between distractibility and length of play episode at the time the distractor was presented.

As in the studies described previously, Oakes, Ross-Sheehy, and Kanass (2004) found that 6½- and 9-month-old infants became less distractible the longer toy play episodes were sustained. Also, focused attention was more likely to be observed in the latter portions of long episodes. Of considerable interest, focused attention and length of play episode, although correlated, independently predicted resistance to distraction. Focused attention, when it occurred early in a play episode, did not reduce distractibility as much as it did when it occurred later in a play episode. Oakes, Ross-Sheehy, and Kanass (2004) suggested that focused attention (by the behavioral criteria of Ruff, 1986) and attentional inertia might reflect different but interacting underlying mechanisms of sustained attention.

Why would looks at television and play with toys be so similar with respect to the time course of engaged attention? Television viewing involves purely receptive perceptual and cognitive processing whereas toy play involves productive sensorimotor and cognitive activity. Both television viewing and toy play, however, require shifting foci of attention embedded within an overarching activity that extends in time. It is not unreasonable to suppose that both draw on the same underlying mechanism of engagement that allows variability of attention within a larger frame of reference.

II. A Distribution Analysis of Looking at Television

A second goal of this chapter is to examine age-related changes in the distribution of looks to television in children from a wide range of ages. There were two reasons for doing this analysis. One reason was practical. We have investigated television viewing with similar procedures across a wide range of ages, including 3–6 months of age (Richards & Gibson, 1997), 6 months to 2 years of age (Richards & Cronise, 2000; Richards & Turner, 2001), 2–5 years of age (Anderson et al., 1981a,b), 3–5 years (Crawley et al., 1999) and in college-aged adults (Anderson & Lorch, 1983; Burns & Anderson, 1993; Richards, 2000). However, a study of extended looking during television viewing has not been done over this entire age range. This chapter provides the opportunity to collate data from multiple experiments to investigate the age changes that may occur in looking at television.
The second reason for examining data from a wide range of ages is theoretical. Previously, we described the hazard function analysis as it applied to looking during television viewing (Anderson et al., 1987; Burns & Anderson, 1993; Choi & Anderson, 1991; Hawkins et al., 1991; Richards & Cronise, 2000; Richards & Gibson, 1997). This hazard function, shown for three studies in Figure 1, had an increase from 0 sec to a peak at some short interval (i.e., 1–2 sec), and then a decrease with increasing look duration. In other words, looking away was highly probable at very short intervals but much less likely at longer look intervals. This type of hazard function should result in a lognormal distribution for the look intervals (Section II.D). However, the presence of this distribution in looking duration data was tested with quantitative and statistical tests only in a few studies (Burns & Anderson, 1993; Richards, 2000; Richards, 2002; Richards & Anderson, 1999; Richards & Casey, 1992; Richards & Cronise, 2000; Richards & Gibson, 1997; Richards & Turner, 2001). We wished to apply a quantitative test of this distribution to some of these previous studies.

There are three important motivations for assessing the distribution of the look durations. First, as mentioned, the pattern of many short looks, an intermediate number of medium-length looks, and only a few long looks, has been used to infer that attentional inertia is occurring. This pattern leads to a characteristic distribution in a number of studies that have been done. This implies that the attentional inertia phenomenon is widespread in television viewing. We further examine the implications of this distribution with quantitative models that provide some theoretical mechanisms that aid in our understanding of attentional inertia. The second implication concerns the apparent similarity of these distributions across a wide age range despite changes in average look duration. This similarity suggests that the same cognitive process is guiding look duration at different ages. If we can characterize the quantitative properties of the distribution, we may be able to detail what changes in television viewing in young children. Finally, in Section III we present two quantitative models that account for extended looking during television viewing. These models account for the unique statistical distributions shown in Section II for look durations during television viewing. They also provide theoretical mechanisms that aid in our understanding of attentional inertia.

We combined data from several sources to examine developmental changes in extended looking at video across the preschool years in a single analysis. These studies included participants from ages of 3 months (Richards & Gibson, 1997) to 6½ years (Hawkins, Yong-Ho, & Pingree, 1991). Following this analysis, the combined data were examined for their fit to several hypothetical probability distributions that have been used to explain looking and reaction time in psychological research. Finally, we chose the best distribution that fits the data, the lognormal, and compared the parameter estimates for children at
different ages. We also fit and compared distributions for comprehensible and incomprehensible stimuli.

A. STUDY SELECTION

Five studies of extended television viewing with preschool children and infants were used: Anderson et al. (1981a,b), Crawley et al. (1999), Hawkins, Yong-Ho, and Pingree (1991), Richards and Cronise (2000), Richards and Gibson (1997). We also used two studies with college-age participants: Burns and Anderson (1993), Richards (2000). The characteristics of these studies are presented in Table I.

The selection of these studies was guided by several considerations. Each had an extended presentation of a television show, or other stimuli, on a TV. These presentations lasted for at least 20 min and as long as 120 min in one of the studies. Given the theoretical role for the effect of the comprehensibility of the material on television viewing (Introduction to Section I), each study also had stimuli that varied in level of comprehensibility. For the comprehensible stimuli, the studies by Richards (Richards, 2000; Richards & Cronise, 2000; Richards & Gibson, 1997) used the movie Follow that Bird that involves Sesame Street characters. The incomprehensible stimuli in those studies were computer-generated visual geometric patterns accompanied by computer-generated music clips. Two studies (Anderson et al., 1981a,b; Hawkins, Yong-Ho, & Pingree, 1991) used a special compilation of Sesame Street segments that included comprehensible normal segments, randomly edited segments, segments with backward speech, and segments with foreign language. These studies reported that looking was depressed in the presence of random edits and incomprehensible language. The remaining study with preschool children used a Nickelodeon Blues Clues episode and a Busy World of Richard Scarry episode. Because it received relatively low attention, this latter episode has been included in the analyses of the “incomprehensible” video stimuli. The studies with college-age participants used episodes of Magnum, P.I. and Cagney and Lacey (Burns & Anderson, 1993), or Seinfeld as well as portions of the movie Follow that Bird (Richards, 2000).

In each study, the participants were recorded on videotape. These videotapes were then viewed subsequently by observer(s) who judged when the participant was looking toward and away from the TV. The times of each look, and look away, were recorded with approximately one video frame (33 msec) resolution.

Some of these studies presented both “comprehensible” and “incomprehensible” stimulus presentations. The comprehensible presentations included cartoon characters or actors, dialogue, and a story that linked multiple segments of the presentation. The incomprehensible segments had no story line across shots, or the story line was obscured by incomprehensible language. In the studies of Richards (Richards, 2000; Richards & Cronise, 2000; Richards & Gibson, 1997)
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<tr>
<td>Richards &amp; Gibson, 1997</td>
<td>3, 4.5, 6 months</td>
<td>20 min</td>
<td><em>Follow that Bird</em></td>
<td>Stimuli repeated factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Computer-generated</td>
<td></td>
</tr>
<tr>
<td>Richards &amp; Cronise, 2000</td>
<td>6, 12, 18, 24 months</td>
<td>20–45 min</td>
<td><em>Follow that Bird</em></td>
<td>Stimuli repeated factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mixed: <em>Follow that Bird</em>, and computer-generated</td>
<td></td>
</tr>
<tr>
<td>Crawley <em>et al.</em>, 1999</td>
<td>3, 4, 5 years</td>
<td>22 min</td>
<td><em>Blues Clues</em>, 1 session</td>
<td>Stimulus between-factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Busy Town</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Blues Clues</em>, 5 sessions</td>
<td></td>
</tr>
<tr>
<td>Anderson <em>et al.</em>, 1981a,b</td>
<td>2, 3.5, 5 years</td>
<td>60 min</td>
<td><em>Sesame Street</em> Segments, comprehensible and incomprehensible</td>
<td>Single session</td>
</tr>
<tr>
<td>Hawkins <em>et al.</em>, 1991</td>
<td>3.5, 5, 6.5 years</td>
<td>27 min</td>
<td><em>Sesame Street</em> Segments, comprehensible and incomprehensible</td>
<td>Single session</td>
</tr>
<tr>
<td>Burns &amp; Anderson, 1993</td>
<td>College-age</td>
<td>2 h</td>
<td><em>Magnum, P.I.</em> TV show</td>
<td>Single session, computer games present</td>
</tr>
<tr>
<td>Richards, 2000</td>
<td>College-age</td>
<td>45 min</td>
<td><em>Seinfeld</em> TV show</td>
<td>Stimuli repeated factor, Seinfeld TV show session 1, Other stimulus session 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Follow that Bird</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Seinfeld</em>, scrambled scene sequences</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mixed: <em>Seinfeld, Follow that Bird</em>, computer-generated</td>
<td></td>
</tr>
</tbody>
</table>
the “incomprehensible” stimuli consisted of computer-generated audiovisual patterns. These stimuli were presented during the entire session in Richards and Gibson (1997), were intermingled with randomly presented segments of *Follow that Bird* in a 2:1 ratio of durations in Richards and Cronise (2000), and intermingled with *Follow that Bird* and *Seinfeld* in a 2:1:1 ratio of durations in Richards (2000). The incomprehensible stimuli in Anderson et al. (1981a,b); Hawkins, Yong-Ho, and Pingree (1991) were language-degraded or randomly edited segments of *Sesame Street*. The language-degraded segments had backward speech or foreign language tracks. The “incomprehensible” stimuli in these studies interfere with the accumulation of story-like meaning from the stimuli, and thus should produce patterns of looking different than those stimuli that are understandable media. The study of Crawley et al. (1999) did not use incomprehensible stimuli. However, this study used *Blues Clues*, which received high levels of looking as well as a *Busy World* episode that received less looking. The looking patterns to the *Busy World* episode parallel those found in the incomprehensible stimuli and were compared to those.

We should note at the outset that there were important methodological differences between the studies from Richards’ lab and the studies from Anderson’s lab. In Richards’ lab, participants were shown TV in a relatively impoverished environment—there was little to do or look at besides the television. Consequently, levels of looking toward the television were quite high. In Anderson’s lab, participants had a variety of other activities available, such as toys to play with. Consequently, the levels of looking toward the television were much lower. Comparisons of parameters across studies should be viewed in context of this methodological difference.

**B. LOOK DURATION**

The average look duration for the age groups is shown in Figure 3, separately for the comprehensible and incomprehensible stimuli (note that the relatively low-attention *Busy World* is being treated as “incomprehensible” for this analysis). Table II includes more detailed information for these studies. Infants at the youngest ages (3, 4½, and 6 months) had the same average look duration for the comprehensible and incomprehensible stimuli, whereas beyond this age average look duration increased with age toward the comprehensible stimuli, but not for the incomprehensible stimuli. In these data, the standard deviation increased with increases in mean look duration; consequently, there were roughly parallel increases in standard deviation with age and with comprehensibility. These look durations continue to increase in adult participants tested in a similar situation (Table II; Richards, 2000). So, an examination of the typical measures of look duration (average, standard deviation) shows relatively unchanging parameters in the first few months of
infancy followed by a steady increase in the duration with which children view television programs.

C. FREQUENCY DISTRIBUTIONS OF LOOK DURATIONS

The distribution of look durations that formed the data for this study are shown in Figure 4, separated for looks toward comprehensible stimuli (top figures) and looks toward incomprehensible stimuli (bottom figures), for both children (Crawley et al., 1999; Richards & Cronise, 2000; Richards & Gibson, 1997) and adults (Richards, 2000). The four distributions shown in Figure 4 do not appear to have a normal distribution, but have a clear skew and kurtosis typical of the lognormal distribution. Two obvious differences between looks toward the comprehensible and incomprehensible stimuli may be seen in these figures. One difference was a preponderance of very short look durations for the incomprehensible stimuli relative to that found for the looks toward the comprehensible stimuli. The second difference was the existence of a larger proportion of looks in the middle range of look durations (e.g., 15–60 sec) for the comprehensible stimuli and the several extended fixations (e.g., looks > 2 min). When data are plotted for individual participants, the group distributions clearly reflect individual distributions.

As presented previously (Section I.B), the hazard function for look duration has been plotted for participants across a wide age range. The particular hazard
function that was found should result in the type of distribution as shown in Figure 4. Thus, we should expect that these distributions are similar across these ages. Separating frequency distributions by age and type of stimulus produced very similar pictures to those shown in Figure 4. These functions are shown for children aged 3 months, 1, 2, 3, 4, and 5 years in Figure 5. Each distribution in this figure has the most looks occurring at very short intervals and only a few extended looks. What appears to be changing with age in these distributions is a small decrease in the number of very short looks, an increasing proportion of middle-duration (e.g., 15–60 sec) looks, and an increase in the number of very extended looks at the right-hand tail of the distribution. Our interpretation of the similarity of these distributions, and the associated hazard function for such distributions, implies that attentional inertia occurs at all of the ages we have studied. This similarity is consistent with the idea that the same cognitive process is guiding look duration at these different ages. We explore this in more detail in later sections (Section II.D, III.B, and III.C).

### TABLE II

<table>
<thead>
<tr>
<th>Age and experiment</th>
<th>Comprehensible</th>
<th>Incomprehensible</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months(^1)</td>
<td>12.50 (5.89, 468, 0.906)</td>
<td>11.92 (5.88, 496, 0.718)</td>
</tr>
<tr>
<td>4.5 months(^1)</td>
<td>10.04 (4.37, 536, 0.688)</td>
<td>7.89 (4.15, 341, 0.536)</td>
</tr>
<tr>
<td>6 months(^1)</td>
<td>11.89 (5.64, 402, 0.900)</td>
<td>11.42 (4.56, 332, 1.029)</td>
</tr>
<tr>
<td>6 months(^2)</td>
<td>10.93 (4.66, 1256, 0.572)</td>
<td>8.26 (4.43, 1293, 0.297)</td>
</tr>
<tr>
<td>12 months(^2)</td>
<td>18.22 (5.18, 813, 1.261)</td>
<td>11.49 (3.79, 1032, 0.668)</td>
</tr>
<tr>
<td>18 months(^2)</td>
<td>22.38 (5.78, 906, 1.320)</td>
<td>11.23 (3.5185, 1130, 0.574)</td>
</tr>
<tr>
<td>24 months(^2)</td>
<td>25.98 (7.81, 900, 1.474)</td>
<td>11.78 (3.65, 1318, 0.564)</td>
</tr>
<tr>
<td>24 months(^3)</td>
<td>8.63 (2.19, 3051, 0.359)</td>
<td>6.48 (2.39, 937, 0.390)</td>
</tr>
<tr>
<td>36 months(^5)</td>
<td>18.24 (3.60, 1099, 1.142)</td>
<td>12.21 (2.26, 764, 1.019)</td>
</tr>
<tr>
<td>42 months(^3,4)</td>
<td>10.44 (2.19, 4595, 0.364)</td>
<td>6.31 (2.09, 1478, 0.330)</td>
</tr>
<tr>
<td>48 months(^5)</td>
<td>20.74 (4.71, 1516, 1.114)</td>
<td>11.21 (2.167, 927, 1.105)</td>
</tr>
<tr>
<td>60 months(^3,4)</td>
<td>11.40 (1.80, 5502, 0.434)</td>
<td>6.19 (1.59, 1873, 0.299)</td>
</tr>
<tr>
<td>60 months(^5)</td>
<td>24.99 (5.98, 1104, 1.557)</td>
<td>14.47 (2.5, 852, 1.179)</td>
</tr>
<tr>
<td>78 months(^4)</td>
<td>11.07 (2.63, 1242, 0.726)</td>
<td>6.05 (2.24, 541, 0.451)</td>
</tr>
<tr>
<td>Adults(^6)</td>
<td>64.12 (18.50, 3372, 1.794)</td>
<td>39.54 (7.75, 1147, 2.310)</td>
</tr>
<tr>
<td>Adults(^7)</td>
<td>22.07 (4.78, 1912, 1.243)</td>
<td>–</td>
</tr>
</tbody>
</table>

*Note: median, N, and standard errors are presented in parentheses.*

3. Anderson et al., 1981a,b.
Fig. 4. Frequency distribution of looking toward the television for the comprehensible and incomprehensible stimuli, separate for the children and adult participants. These distributions are frequency histograms for 1-s intervals. The adult distributions were plotted as “Percent” since the comprehensible stimuli came from four sessions whereas the incomprehensible stimuli came from a single session.
D. HYPOTHETICAL DISTRIBUTIONS

The empirical data were compared against hypothetical distributions to determine the best fitting probability distribution type. There were several reasons to do this. First, the lognormal distribution has been reported to describe look durations (Anderson et al., 1981a,b; Burns & Anderson, 1993; Choi & Anderson, 1991; Hawkins, Yong-Ho, & Pingree, 1991, 1995; Richards, 2000; Richards & Cronise, 2000; Richards & Gibson, 1997) but only some studies

Fig. 5. Frequency distribution of looking toward the television for comprehensible stimuli, the Sesame Street movie, Follow that Bird, separately for children aged 3 months, 1, and 2 years (Richards & Cronise, 2000; Richards & Gibson, 1997), and for the Blue Clues television program for 3, 4, and 5 year old children (Crawley et al., 1999).
(Burns & Anderson, 1993; Richards, 2000; Richards, 2002; Richards & Anderson, 1999; Richards & Casey, 1992; Richards & Cronise, 2000; Richards & Gibson, 1997; Richards & Turner, 2001) have provided a quantitative comparison of distributions. Thus we wanted to confirm for all the studies that the lognormal distribution did provide the best fit to the empirical data. A second reason to do this is to make quantitative assessments of the experimental factors affecting look duration (i.e., age, stimulus comprehensibility) using parameters that explicitly acknowledge the underlying distributions of the dependent variables (see Section II.E).

The distributions that were tested were the beta, exponential, gamma, inverse Gaussian (Wald), lognormal, normal, Weibull, and a convolution of the exponential and Gaussian (ex-Gaussian; Heathcote, Popiel, & Mewhort, 1991). All but the ex-Gaussian are widely known statistical distributions (Johnson, Kotz, & Balakrishnan, 1994). All but the exponential have a value, \( \xi \), that is often called the “scale” of the distribution. The “scale” parameter primarily describes the range of numbers in the distribution, and is affected by the unit of time of the variable. All the distributions have at least one other parameter (\( \sigma, \lambda, \) or both), often called the “shape” of the distribution. The shape parameter often characterizes the extent of the positive skew of the distribution, and is unaffected by the unit of time. Many of these distributions are symmetrical like the normal distribution with small values of the shape parameter(s), and increase in skew with increases in the shape parameter(s). The lognormal, gamma, Weibull, and exponential also have a parameter, \( \theta \), called the “threshold” of the distribution, which is the minimum value of the distribution. For these look duration measures we set this value at 0.0 msec, although it could be set to the minimum look duration in the data.

The distributions were chosen based on three criteria. First, hypothetical distributions that had shapes characteristic of the looking times found in past studies were chosen. Thus, the distribution should be continuous, somewhat bell-shaped, with a probability density first increasing to a single peak (unimodal), and then decreasing to a long tail on the right of the distribution with a positive skew. The lognormal, gamma, beta, inverse Gaussian, Weibull, and ex-Gaussian distributions each have such shapes with appropriately chosen parameters. Second, distributions were chosen that have been used in previous studies of looking times, or reaction times, in psychological research. The lognormal (Bree, 1975; Hockley, 1984; Ratcliff & Murdock, 1976; Richards, 2000; Richards & Cronise, 2000; Richards & Gibson, 1997; Ulrich & Miller, 1993), ex-Gaussian (Ashby, 1982; Heathcote, Popiel, & Mewhort, 1991; Hockley, 1984; Hockley & Corballis, 1982; Hohle, 1965; Ratcliff, 1978, 1979; Ratcliff & Murdock, 1976; Ulrich & Miller, 1994; Van Zandt & Ratcliff, 1995), Weibull (Logan, 1988, 1992, 1995; Van Zandt & Ratcliff, 1995), and gamma (McGill & Gibbon, 1965; Ratcliff & Murdock, 1976; Van Zandt & Ratcliff, 1995) have been used to characterize fixation data and reaction time data. The normal and exponential distributions do
not have the characteristic shape for the looking times, but have been used widely in psychological research. Third, we chose the gamma and beta distributions because they are the “parent” distribution of several distributions used widely in psychological research (e.g., exponential, $\chi^2$, $t$ and $F$) and as such may successfully model this data. Several of these distributions are related (e.g., the exponential distribution is a special case of the gamma distribution, and a special case of the Weibull distribution; ex-Gaussian is the convolution of the exponential and normal distributions). Because of this, the comparisons of the hypothetical distributions with the empirical data should overlap. For example, the fit of the gamma distribution or the Weibull distribution should be better than the exponential distribution. The underlying hypothesis of the exponential distribution, as applied to duration data, is that the process that causes the duration to conclude is constant over time. That is, the hazard of termination is constant from one interval of time to the next. Attentional inertia, in contrast, implies that the hazard decreases with time. Nevertheless, the exponential distribution was included because it has been commonly used in other psychological research and represents a form of null hypothesis for a theory of attentional inertia.

E. COMPARISON OF EMPIRICAL AND HYPOTHETICAL DISTRIBUTIONS

The frequency distributions of look durations from the empirical data were compared to the hypothetical distributions. The details for estimating the parameters of these distributions from the empirical data are presented elsewhere (Richards, 2000; Richards & Anderson, 1999). First, the data from all children’s

$^1$The details for estimating the parameters of these distributions from the empirical data are presented elsewhere (Richards, 2000; Richards & Anderson, 1999). We used iterative minimization techniques based on maximum likelihood parameter estimates. A “quasi-Newton” technique known as the Broyden-Fletcher-Goldfarb-Shanno algorithm (Press et al., 1992) was used for the minimization. A by-product of this minimization method is the “inverse Hessian matrix,” which represents the covariance matrix of the fitted estimates. The inverse Hessian matrix also contains the standard error (SE) of each estimate for quantitative comparison of the parameter values (Press et al., 1992). The standard errors of the parameter estimates may be used to compare parameters obtained from different groups (i.e., ages, comprehensible, and incomprehensible stimuli). The fit of the hypothetical distribution and the empirical data was assessed with methods based on $\chi^2$. The null hypothesis in each case was that the hypothetical and empirical distributions did not differ. With large $N$ the null hypothesis of no difference between the hypothetical and observed distribution is easily rejected, so that very few comparisons would be “nonsignificant,” indicating a fit of the hypothetical and empirical distributions. Therefore, a measure of the closeness of the fit of the hypothetical distribution and the empirical distribution, the “root-mean-squared error of approximation” (RMSEA) was calculated for each of the tests. The RMSEA ranges from 0.0 to 1.0, with small values indicating a good fit of the data and the hypothetical distribution, and takes into account the $N$ of data used to estimate the $\chi^2$. A specific value for a “close fit” has been recommended as 0.05 (Browne & Cudeck, 1993; MacCallum, Browne, & Sugawara, 1996).
looks from the unrestricted presentation studies (Crawley et al., 1999; Richards & Cronise, 2000; Richards & Gibson, 1997) were compared separately for the comprehensible and incomprehensible stimuli (Figure 4). The comparison was made by estimating parameters of the hypothetical distribution with maximum likelihood techniques and comparing the empirical and hypothetical distribution’s $\chi^2$. The null hypothesis that the hypothetical distribution was not different from the empirical distribution of the looks toward the stimulus was rejected for all hypothetical distributions. However, this is typical of distributional analyses in which there is a great deal of statistical power. The frequency distribution of the look durations toward the comprehensible stimuli had the closest fit to the lognormal distribution, $\chi^2(146, N = 9000) = 475.76$, followed by the inverse Gaussian, $\chi^2(146, N = 9000) = 839.93$, Weibull, $\chi^2(146, N = 9000) = 1404.33$, and the gamma, $\chi^2(146, N = 9000) = 4612.31$. We also tested the beta, exponential, normal, and ex-Gaussian distributions. These latter distributions were extremely poor fits to the data. The frequency distributions for the looks toward the incomprehensible stimuli followed the same pattern as the comprehensible stimuli. The frequency distribution and the lognormal hypothetical distribution had the closest fit, $\chi^2(97, N = 8485) = 273.94$, followed by the inverse Gaussian, $\chi^2(97, N = 8485) = 362.07$, Weibull, $\chi^2(97, N = 8485) = 1113.96$, and the gamma, $\chi^2(97, N = 8485) = 15518.78$. In this case the gamma distribution, as well as the beta, exponential, normal, and ex-Gaussian distributions, were very poor fit to the empirical data.

A measure of fit of the hypothetical distribution and the empirical distribution, the RMSEA, was calculated for each of the tests. The RMSEAs for the comprehensible stimuli were 0.01584, 0.02298, 0.03094, and 0.05830 for the lognormal, inverse Gaussian, Weibull, and gamma distributions, respectively. Because of the large number of observations ($N = 9000$) the confidence intervals around these estimates were very small, and each was significantly different from the closest one. An RMSEA of 0.05 has been suggested as indicating a close fit of two distributions (Browne & Cudeck, 1993; MacCallum, Browne, & Sugawara, 1996). This would lead to the conclusion that the lognormal, inverse Gaussian and Weibull distributions were a close fit with the empirical distribution. The RMSEAs for all the other distributions were greater than 0.05, indicating a poor fit of those distributions and the empirical frequency histograms. The RMSEAs for the incomprehensible stimuli followed the same pattern. Richards (2000), using adult data, reported that the lognormal distribution fit the best, followed by the Weibull, gamma, and inverse Gaussian distributions.

The probability density functions for the lognormal, inverse Gaussian, Weibull, and gamma are shown in Figure 6 separately for the comprehensible and incomprehensible stimuli, and only for the children’s data. The lognormal and inverse Gaussian show the nonmonotonic peak near 1 sec and the decrease over the next 20 sec. The Weibull and gamma show a typical
Fig. 6. Probability density functions for children’s looking at comprehensible (solid line) and incomprehensible (dashed line) stimuli for the lognormal, inverse Gaussian (Wald), Weibull, and gamma theoretical distributions.
descending exponential-like function. The lognormal, inverse Gaussian, and Weibull have a higher peak for the incomprehensible stimuli, and the gamma function shows a slightly larger probability for looks from about 3 to 15 sec. This difference between the comprehensible and incomprehensible stimuli reflects the predominance of short duration looks for the incomprehensible stimuli (Figure 4). The lognormal, Weibull, and gamma also show a larger probability density at the long duration looks for the comprehensible stimuli.

In addition to comparing the fit of the empirical and hypothetical functions separately for the comprehensible and incomprehensible stimuli, we compared the fit only for the comprehensible data, but separately for each testing age. In this case the lognormal, inverse Gaussian, Weibull, and gamma distributions were compared to the frequency distributions at each age for the participant’s look duration toward the comprehensible stimulus. Approximately, the same pattern of results was obtained for the four hypothetical distributions (i.e., the lognormal was the best fit to the empirical data, followed by the inverse Gaussian, Weibull, and gamma.) However, in this comparison there were differences across the testing ages in the fit of the empirical and hypothetical distributions. Across all ages the lognormal distribution was a good fit to the data. However, in the preschool years (years 1–5) the lognormal and inverse Gaussian distributions fit the empirical distributions equally well, and for the 5-year-olds and adults the inverse Gaussian became a relatively poor fit to the empirical data. Conversely, throughout the childhood years the Weibull and gamma functions fit the empirical data poorly. However, at 5 years (Weibull) and for the adult data (Weibull, gamma) these two distributions were a very good fit for the empirical data.

The probability density functions of the theoretical distributions were examined by sequentially eliminating long duration looks (i.e., all looks, all looks < 120 sec, all looks < 60 sec, all looks < 30 sec, all looks < 15 sec). This was done to determine if the distributions would “scale down” from a session with extended viewing (e.g., studies with extended viewing sessions; Crawley et al., 1999; Richards & Cronise, 2000; Richards & Gibson, 1997) to one in which long duration looks were restricted because the video segments were relatively brief (e.g., studies that interspersed comprehensible and incomprehensible Sesame Street segments in a single viewing session, Anderson et al., 1981a; Hawkins, Yong-Ho, & Pingree, 1991). The probability density function for the lognormal distribution for the children’s looks toward comprehensible stimuli is shown in Figure 7. The basic shape of the function was retained over the five duration restrictions. This pattern of results was true for the inverse Gaussian, Weibull, and gamma functions as well (cf. hypothetical distributions in Figure 6). The four functions retained their relative order in the fit between the theoretical distribution and the empirical
Several conclusions may be drawn regarding the fits of the empirical distribution of look durations and the hypothetical distributions. First, the probability density function of the lognormal distribution was the best fit of the empirical data for all stimulus types and ages. This was true for infant, children, and adult participants, for comprehensible and incomprehensible stimuli in extended viewing situations, and for the restricted duration distributions (either restricted through sampling, as shown in Figure 7, or for the restricted duration data in Anderson et al., 1981a,b; Hawkins et al., 1991). This is the first time that a quantitative test of this distribution has been applied to all these studies. We are confident that the lognormal distribution is the best fit of these data.

The second conclusion we make from this analysis is an inference about the theoretical mechanism underlying look durations during television viewing.
Previously, we described the hazard function analysis as applied to television viewing (Section II.B). This function increases from 0 sec to a peak at a short interval (i.e., 1–2 sec) followed by a decrease in the hazard over time (Figure 1). This hazard function implies two things. First, a lognormal distribution will characterize the distribution of looking durations. That was the case in the analyses in this section. Second, this hazard function implies the probability relations among look times and the probability of continuing a look or looking away. Looks in progress for a short time have a high probability of ending. As looks at the television become longer, the probability of the look terminating becomes progressively less likely. The attentional inertia phenomenon implies this relation between look length and looking away. The viewer becomes progressively engaged in the television program over the course of a look and thus should be less likely to look away voluntarily or be distracted by events occurring in the environment. We also should note that the lognormal distribution forms the basis for the quantitative models developed later in this chapter (Section III).

Finally, our conclusion from the similarity of these distributions over the various testing ages is that the same cognitive process affects look duration at the different ages. The empirical properties of the look distributions imply that attentional inertia is controlling looking toward television. The similarity of the look duration distributions suggests that the processes controlling looking are similar for young infants, preschool aged children, and adults. By characterizing this distribution, we are in a better position to describe what changes in television viewing occur in young children. A theoretical understanding of the mechanisms generating these distributions (Section III) should lead to a better characterization of the developmental processes affecting television viewing in infants and young children.

F. PARAMETER COMPARISONS

A final goal for this section is to use the distributional properties of the look durations during television viewing to assess what changes in television viewing in young children. Almost all the studies of television viewing made quantitative assessments of their experimental factors using log-transformed variables with ANOVA-based methods. Alternatively, using the parameters that describe the lognormal distribution rather than parameters of the normal distribution (i.e., mean, standard deviation) would have the advantage of specifically acknowledging the underlying distributions. This should result in more appropriately sensitive and discriminative analyses for experimental factors than methods based on transformations (Heathcote, Popiel, & Mewhort, 1991; Levine & Dunlap, 1982, 1983; Ratcliff, 1993) or truncation of outliers that do not seem to fit the normal distribution (Miller, 1991; Ratcliff, 1993;
Van Selst & Jolicoeur, 1994; Ulrich & Miller, 1994). A distributional analysis of the look durations done previously (Section II.D) should not be regarded as a technique only to verify the distributional properties of looks. Rather, we choose the best distribution(s) that fit the data, and based on that distribution, should compare the parameter estimates for children at different ages, or for comprehensible and incomprehensible stimuli.

The parameters describing the theoretical distributions that fit the observed distributions were estimated with maximum likelihood techniques. The scale and shape parameters that were estimated for the lognormal probability density function were also analyzed by testing age and stimulus condition (comprehensible, incomprehensible). The data for this analysis were taken from the children that had the unrestricted viewing times (Crawley et al., 1999; Richards & Cronise, 2000; Richards & Gibson, 1997). The scale for the comprehensible stimuli was significantly larger (scale = 8.62, SE = 0.0165) than the scale for the incomprehensible stimuli (scale = 8.29, SE = 0.0151), $t(243) = 1.83, p < 0.05$, whereas shape parameters did not differ significantly for the two stimulus types (shape = 1.57, SE = 0.116, and 1.40, SE = 0.108, for the comprehensible and incomprehensible stimuli, respectively). The “scale” parameter primarily describes the range of numbers in the distribution and is related to the positive skew of the distribution, whereas the “shape” parameter represents the shape of the dispersion of the distribution. This suggests that the primary difference between the comprehensible and incomprehensible stimuli in these studies was the extended viewing durations found for the comprehensible stimuli and the preponderance of short viewing durations for the incomprehensible stimulus (Figures 4 and 5).

The scale and shape parameters were compared across the different ages, separately for the comprehensible and incomprehensible stimuli. As shown in Figure 8, the scale parameter did not change as a function of age for the incomprehensible stimuli but did change for the comprehensible stimuli $F(8, 610) = 2.33, p < 0.02$. (Table III includes more detailed information of the change in scale across age in these studies.) The parameter did not change from age 3 to 6 months, and then increased from 6 to 24 months. Due to methodological differences between studies, there were differences in the absolute value of the scale parameter between the Richards and Cronise (2000), Crawley et al. (1999), and Anderson et al. (1981a,b; see Table III) or Hawkins et al. (1991; see Table III) studies, as was found with the mean look duration.

The ANOVAs for the parameter comparison were determined by calculating the between-groups mean square from the parameters and the within-subject variance from the standard errors of the estimates obtained in the maximum likelihood optimization. The within-subject variance was obtained by transforming the standard errors into variance and calculating the pooled variance and mean squares from the variance obtained with the standard errors.
## Table III

Scale and Shape Parameters for the Lognormal Probability Density Functions

<table>
<thead>
<tr>
<th>Age and experiment</th>
<th>Comprehensible</th>
<th></th>
<th>Incomprehensible</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scale parameter</td>
<td>Shape parameter</td>
<td>df</td>
<td>Scale parameter</td>
</tr>
<tr>
<td>3 months$^1$</td>
<td>8.68 (0.059)</td>
<td>1.29 (0.041)</td>
<td>42</td>
<td>8.63 (0.057)</td>
</tr>
<tr>
<td>4.5 months$^1$</td>
<td>8.41 (0.054)</td>
<td>1.26 (0.038)</td>
<td>21</td>
<td>8.34 (0.062)</td>
</tr>
<tr>
<td>6 months$^{1,2}$</td>
<td>8.49 (0.031)</td>
<td>1.28 (0.022)</td>
<td>73</td>
<td>8.40 (0.030)</td>
</tr>
<tr>
<td>12 months$^2$</td>
<td>8.70 (0.050)</td>
<td>1.45 (0.035)</td>
<td>60</td>
<td>8.42 (0.041)</td>
</tr>
<tr>
<td>18 months$^2$</td>
<td>8.80 (0.052)</td>
<td>1.58 (0.037)</td>
<td>74</td>
<td>8.31 (0.042)</td>
</tr>
<tr>
<td>24 months$^2$</td>
<td>9.02 (0.054)</td>
<td>1.57 (0.037)</td>
<td>81</td>
<td>8.38 (0.038)</td>
</tr>
<tr>
<td>24 months$^{3,4}$</td>
<td>7.73 (0.030)</td>
<td>1.66 (0.021)</td>
<td>81</td>
<td>7.71 (0.050)</td>
</tr>
<tr>
<td>36 months$^5$</td>
<td>8.37 (0.052)</td>
<td>1.74 (0.037)</td>
<td>75</td>
<td>8.05 (0.056)</td>
</tr>
<tr>
<td>42 months$^{3,4}$</td>
<td>7.78 (0.025)</td>
<td>1.76 (0.018)</td>
<td>119</td>
<td>7.74 (0.037)</td>
</tr>
<tr>
<td>48 months$^5$</td>
<td>8.54 (0.044)</td>
<td>1.73 (0.031)</td>
<td>99</td>
<td>8.23 (0.049)</td>
</tr>
<tr>
<td>60 months$^{3,4}$</td>
<td>7.66 (0.025)</td>
<td>1.87 (0.017)</td>
<td>133</td>
<td>7.41 (0.039)</td>
</tr>
<tr>
<td>60 months$^5$</td>
<td>8.70 (0.053)</td>
<td>1.79 (0.047)</td>
<td>85</td>
<td>8.15 (0.054)</td>
</tr>
<tr>
<td>78 months$^{3,4}$</td>
<td>8.13 (0.040)</td>
<td>1.97 (0.028)</td>
<td>60</td>
<td>7.87 (0.052)</td>
</tr>
<tr>
<td>Adults$^6$</td>
<td>9.67 (0.032)</td>
<td>1.90 (0.023)</td>
<td>64</td>
<td>9.10 (0.038)</td>
</tr>
<tr>
<td>Adults$^7$</td>
<td>8.58 (0.038)</td>
<td>1.68 (0.027)</td>
<td>79</td>
<td>–</td>
</tr>
</tbody>
</table>

*Note: Standard errors are in parentheses.*

$^1$Richards & Gibson, 1997.


$^3$Anderson et al., 1981a,b.

$^4$Hawkins et al., 1991.

$^5$Crawley et al., 1999.


Overall, however, there was a systematic increase in the scale over the ages used in these studies. The shape parameter for both the comprehensible and incomprehensible stimuli did not change over the three youngest ages (3, 4½, 6 months; Figure 9). However, it increased steadily from 6 to 78 months for the comprehensible stimuli (Figure 9), $F(8, 610) = 2.83, p < 0.01$, but not for the incomprehensible stimuli. Although the overall age effect was not significant for the incomprehensible stimuli, Figure 9 illustrates some differences. Post hoc tests revealed that the shape parameter for the three youngest ages (3, 4½, 6 months), the three middle ages (12, 18, 24 months), and the oldest ages (3, 4, 5 years) were significantly different ($p < 0.05$). The shape parameter represents the shape of the dispersion of the distribution. The finding that the shape changed significantly over the testing ages for both the comprehensible and incomprehensible stimuli implies that there was a developmental process affecting shape dispersion that applied to both the comprehensible and incomprehensible stimuli.

The data from the studies in which the comprehensible and incomprehensible Sesame Street segments were interspersed within a single testing session were also analyzed (Anderson et al., 1981a,b; Hawkins et al., 1991). The results from this study differed in several respects from those with the stimuli presented in an extended viewing session. The scale and shape parameters did not differ significantly despite the fact that the children paid more
attention overall to the comprehensible stimuli. The scale parameters from the four testing ages differed significantly, $F(3, 438) = 8.61, p < 0.001$, such that the scale parameter for the oldest age group (6.5 years) differed from the scale parameters for the three youngest ages (2, 3.5, 5 years, see parameters in Table III).

The shape parameter for the comprehensible stimuli increased with age from $1.66 (SE = 0.021), 1.76 (SE = 0.018), 1.87 (SE = 0.017)$, to $1.97 (SE = 0.028)$, $F(3, 438) = 4.14, p < 0.01$, but did not change significantly for the incomprehensible stimuli, $F < 1.0$. The values of the shape parameter and their increase over the three testing ages for the comprehensible stimuli were very similar to the results for the stimuli presented in an extended viewing session (Figure 9). This suggests that the age differences in the shape parameter were relatively uninfluenced by stimulus type or the experimental procedure, whereas the scale parameter was highly sensitive to interactions between the age changes and the stimulus parameters.

The effect of the stimulus type on the scale parameter was further examined by sequentially eliminating long duration looks (i.e., all looks, all looks < 120 sec, all looks < 60 sec, all looks < 30 sec, all looks < 15 sec) from the studies with extended viewing sessions (Crawley et al., 1999; Richards & Cronise, 2000; Richards & Gibson, 1997). This was done to determine whether the difference between the comprehensible and incomprehensible stimuli found with restricting the look duration length was primarily due to long looks during comprehensible
stimuli. The results of this analysis confirmed this view. The probability value for the difference between the comprehensible and incomprehensible stimuli changed from 0.0333 with all look durations included, to 0.0503, 0.0782, 0.1435, 0.2515 for the looks < 120, < 60, < 30, and < 15 sec, respectively. Similarly, the value of $\omega^2$, an estimate of the strength of the hypothesis test, went from 0.30, 0.20, 0.13, 0.05, to 0.03 including all looks, looks < 120, < 60, < 30, and < 15 sec. This change in the level of statistical significance (or strength of the hypothesis test) implies that the differences between the look distributions in the comprehensible and incomprehensible viewing sessions were predominantly due to the long duration looks.

The examination of the parameters of the lognormal distribution helps to characterize how stimulus comprehensibility affects television viewing and characterize the changes in television that occur in young children. The primary difference between the comprehensible and incomprehensible stimuli was in the scale parameter, not in the shape parameter. The scale parameter is related to the positive skew of the distribution. The primary difference, therefore, between the comprehensible and incomprehensible stimuli in these studies is the extended look durations for the comprehensible stimuli and the preponderance of short duration looks for the incomprehensible stimuli. This is consistent with ideas presented earlier (Section I.A) that comprehensible stimuli are more likely to elicit the phase of viewing in which active and engaged processing of television program content occurs. Attentional inertia is more effective for such stimuli precisely because the comprehensible content allows the increasing engagement of attentiveness over the course of a look. This also implies that the large difference in scale between the studies using extended viewing sessions (Crawley et al., 1999; Richards & Cronise, 2000; Richards & Gibson, 1997) and those that interspersed comprehensible and incomprehensible Sesame Street segments in a single viewing session (Anderson et al., 1981a; Hawkins et al., 1991; see Table III) was primarily due to the truncation of the extended looks in the restricted duration studies.

The change in look durations over testing ages is more complex. There is a tendency to show more extended duration looks over the preschool ages (Figure 5), and the change in the scale parameter reflects this age change. The shape parameter also changed significantly over the testing ages for both the comprehensible and incomprehensible stimuli. This implies that some developmental process affects the overall shape of the frequency distribution in addition to the increasing preponderance of extended looks. Perhaps, some aspect of the shape parameter may be inferred from the quantitative models presented in the next section. The analysis of the parameters of the lognormal distribution gives a more fine-detailed description of the effect that comprehensibility plays in looks toward television, and the age changes in look duration, than did the simple changes in average look duration (Figure 3).
III. Quantitative Models

The third goal of this chapter is to present and evaluate two quantitative models of looking at television. A theoretical analysis of the studies has implied that attentional inertia is an important psychological process that affects looking in these contexts. We believe that a quantitative model that generates the lognormal distribution of looking might help to understand the individual psychological processes affecting attentional inertia. Such a model also might identify the process that shows development in young children.

Why might such modeling help our understanding of extended looking to television in young children? We argued in previous sections that the frequency distributions found in studies of looking implies that attentional inertia affects looking. The hazard function found in these studies (Figure 1), the finding that there is a decreasing distractibility as a look continues, and empirical studies showing better memory or less distractibility were taken to support the idea that there was an increasing attentional engagement over the course of a look. However, a process or mechanism that accounts for this increasing attentional engagement is not implied by these studies. The quantitative modeling of this phenomenon may provide a mechanism to account for attentional inertia.

A chief constraint in quantitative modeling of looks at television is that the model must generate data that conform at least approximately to the lognormal distribution. We know from the previous section and from several individual studies of looking that the lognormal distribution of looks occurs over a wide variety of testing ages and in several contexts in which extended looking occurs. Thus models that generate data that conform to the lognormal distribution are examined. These models were developed by Anderson in his studies of looking at television and play with toys (Burns & Anderson, 1993; Choi & Anderson, 1991), and by Richards in his studies of infant looking at audiovisual displays (Richards, 2000; Richards & Cronise, 2000).

A. ATTENTIONAL STRENGTH MODEL

Anderson developed a model based on a theory of attentional inertia that was fully described by Burns and Anderson (1993). The theory consists of seven principles (Burns & Anderson, 1993, pp. 779–780):

1. discourse processing occurs in a series of discrete cognitive units, each unit taking a discrete amount of time;
2. while processing a unit the person is highly resistant to distraction;
3. vulnerability to distraction occurs between processing unit boundaries because there is momentarily no focus of information processing;
4. inertial engagement is the strength of sustaining looking from one unit to the next, which is weak at the beginning of a look and strengthens over the course of a look;
5. increased inertial engagement results in decreased *distractibility*;
6. the increased inertial engagement also intensifies cognitive processing of the material to which processing is directed; and
7. inertial engagement is reset to an initial weak value at the end of a look, and does not carry over from one look to another.

For purposes of this chapter the quantitative model described by Anderson (Burns & Anderson, 1993; Choi & Anderson, 1991) will be referred to as the “attentional strength model.” The model assumes that the “attentional glue” that sustains looking across successive units of processing strengthens as more units are processed.

The attentional strength model contains five parameters, including the length of a comprehension act, which is assumed to come from a normally distributed set of possible lengths with a mean and standard deviation, and the initial probability of looking away following the first comprehension act. The most theoretically important is the inertia parameter, $i$. The probabilities of looking away at the completion of successive units of cognitive processing are described as $p_t = ip_{t-1}, 0.0 < i < 1.0$. The degree to which the inertia value is less than 1.0 represents how quickly the tendency to continue looking at the television becomes strengthened over time; that is, the probability of looking away, between comprehension units, is driven down over time.

Burns and Anderson (1993) estimated parameters from the adult participants in their study. The length of a comprehension unit was estimated to be approximately 1 sec, the inertia parameter, $i$, was about .9, and the initial probability of looking away following the first comprehension unit was about 0.3. Simulations of the model produced data that matched the observed data quite well.

For the present chapter, this model was tested with quantitative techniques that allowed us to determine the model’s fit to a number of data sets. A model was developed according to the parameters outlined by Burns and Anderson (1993). We used quantitative techniques for estimating the fit of the model similar to techniques used in previous sections (i.e., Section II.E and II.F; see Footnotes 1 and 2, and more details in Richards, 2000; Richards & Anderson, 1999). These techniques provided a measure of fit of the quantitative model and the empirical data, separate fits for comprehensible and incomprehensible stimuli and for the testing ages, and parameters that could be compared across these factors. Modeling of the observed look durations was moderately successful. First, the studies with unrestricted viewing sessions were modeled (Crawley *et al*., 1999; Richards & Cronise, 2000; Richards & Gibson, 1997). The look durations from all testing ages were combined and the model parameters were estimated separately for the
comprehensible and incomprehensible stimuli. The fit between simulations and the observed look duration data was satisfactory for the comprehensible stimuli, $\chi^2(185, N = 9000) = 2728.40, RMSEA = 0.0390$, and for the incomprehensible stimuli, $\chi^2(131, N = 8485) = 2460.24, RMSEA = 0.0457$, indicating adequate fits. The inertia parameter was 0.981 ($SE = 6.606 \times 10^{-5}$) for the comprehensible stimuli and 0.968 ($SE = 2.869 \times 10^{-5}$) for the incomprehensible stimuli. These inertia parameters did not differ significantly, $t(303) = 1.31, p < 0.10$. It is not clear whether one would expect attentional inertia to change with type of content or whether it represents a parameter of the individual viewer, changing with age, perhaps. In terms of the model, one might expect the attractiveness of content to be captured in the initial probability of maintaining attention across the first content boundary, $p_0$.

The parameters of the attentional strength model were also estimated separately for each of the testing ages and the stimulus types. These parameters were estimated on the data including all look durations. The RMSEA fit index was often larger than 0.05 for these analyses indicating unsatisfactory fits. This was true for the data from the children aged 12 months to 5 years, in which the RMSEA was larger than 0.05 for each analysis (0.054–0.102). Further explorations indicated that although the attentional inertia model fit the overall observed data satisfactorily it did not account for developmental differences well and was not particularly sensitive to the experimental manipulations.

We suspect that this model did not fit the data well for two reasons (Richards, 2000). First, the underlying model does not explicitly generate output that is distributed lognormally. It is able to fit the data satisfactorily, but may not be intrinsically matched to the lognormal distributions of the look duration data. Second, the model fares poorly with truncated datasets (Figure 7). Thus for subsets of data for individual ages, some of which have shortened looking times compared to others, the model may be inadequate to provide satisfactory fits (Richards, 2000). A model that explicitly generates the lognormal distribution may therefore be a better quantitative approximation of attention inertia.

**B. ATTENTION ENGAGEMENT GROWTH MODEL**

Several models in biology, economics, and the social sciences produce outcome variables with lognormal frequency distributions (Crow & Shimizu, 1988). An attractive metaphor for present purposes is a model of active biological growth (Koch, 1966, 1969; Mosimann & Campbell, 1988; also see “partial-output model” of Ulrich & Miller, 1993). This model posits that growth at a previous stage actively contributes to production of new growth at the next stage. For example, the production of tissue at time 1 depends on the tissue existing at time 0; the production of tissue at time 2 depends on the production of tissue at time 1, and therefore also on the production of tissue at time 0. The processes
combine in a multiplicative manner before a response (e.g., reaction time, look duration, tissue mass, body weight, brain size) is output or measured. The multiplicative relation between growth at the various stages leads to a lognormal distribution of measurements. Note that if a model posited a simple accretion of tissue at various stages, independent of previous stages, the model would be additive, producing a normal distribution.

A model consistent with the growth model and with the idea of attentional inertia might posit that viewing of complex audiovisual stimuli consists of a chain of discrete cognitive activities (e.g., “comprehension units”) such as sequentially understanding the parts of a story. The initial cognitive activity is some brief comprehension unit such as initial recognition of the characters or setting currently presented on the screen (similar to the attention strength model described above). Unlike the strength model, the result of this comprehension affects the following comprehension unit by increasing its length, such as following an action or dialogue as it unfolds in time. Subsequently, the viewer may see that the action or dialogue is part of an unfolding narrative that can be considered at a higher level of abstraction, but which takes even more time to process. These discrete cognitive activities affect each other in a multiplicative growth relation, resulting in an expanding activation of attention, ultimately leading to the lognormal distribution of look durations. Alternatively, the expanding activation can be thought of as simply produced by prior engagement with a medium and not necessarily due to processing of larger and larger blocks of content. Rather, attention is engaged for increasingly longer periods of time in a multiplicative manner. In other words, even though the viewer may or may not be processing larger units of content, the progressive increase in attention activation will cause the viewer to maintain attention even when the content changes, as has been found by Anderson and Lorch (1983) and Burns and Anderson (1993).

Several variables must be estimated in the attention engagement growth model (for derivations of this class of model see: Koch, 1966; Mosimann & Campbell, 1988; Richards & Anderson, 1999; Ulrich & Miller, 1993). The level of activation at any given time is a multiplicative function of the level of activation at previous times. Therefore, the most important parameter of this model for this paper is the multiplicative parameter. For example, the level of activity after the first comprehension activity is \( A_1(t) = k_1 \), after the second comprehension activity, \( A_2(t) = k_2 A_1(t) \), or \( A_2(t) = k_2 k_1 \), and finally the level of activation at any point in time is therefore, \( A_n(t) = \prod_{i=1}^{n} k_i \). Although the model specification allows values of \( k_i \) to vary randomly from a normal distribution with a mean and variance, these multiplication constants may be modeled with a single value, as was done in the present analyses, reducing the number of parameters to be estimated. The looks away from the television occur when the activation level of the environment outside of the television (the viewing room and its associated
distractions) exceeds the activation level to the television. The activation produced by the nontelevision environment is assumed to vary randomly according to a normal distribution with a mean and variance. Because the look begins with a low level of activation, there is a much larger chance that the look will terminate early than when the look has already survived to become a longer look and consequently has a much greater level of activation. Details of the model are presented in Richards (2000) and Richards and Anderson (1999).

An advantage of the attention growth model is that it explicitly generates look durations that are distributed lognormally. Consequently, the modeling of the observed look durations with the attention engagement growth model was successful. First, the data from the studies with unrestricted viewing sessions were examined (Crawley et al., 1999; Richards & Cronise, 2000; Richards & Gibson, 1997). The look durations from all testing ages were combined and the model parameters were estimated separately for the comprehensible and incomprehensible stimuli. The simulated look durations fit the data well for the comprehensible stimuli, $\chi^2(199, N = 9000) = 633.17$, RMSEA = 0.0155, and for the incomprehensible stimuli, $\chi^2(139, N = 8485) = 496.02$, RMSEA = 0.0173. The RMSEA for both types of stimuli was substantially (and significantly) less than 0.05, indicating a very close fit of the data and the model. These RMSEA values, not surprisingly, were similar in magnitude to the fit of the lognormal distribution and the empirical data (0.01584). The multiplicative constant that related successive comprehension activities was 2.91 ($SE = 0.0019$) for the comprehensible stimuli and 2.53 ($SE = 0.0033$) for the incomprehensible activities, and these values differed significantly, $t(348) = 5.21, p < 0.001$. One interpretation of this value is that each comprehension act nearly tripled (increased by a factor of 2.91) in duration over the course of attention engagement growth within a look for the comprehensible stimuli. An alternative way to express this is that as a look is maintained, attention activation grows such that the look is likely to continue through time according to a logarithmic metric (base 2.91). The growth of attention engagement for the incomprehensible stimuli was not as large, suggesting that the activation parameter captures the attentional value of the stimulus as well as the tendency of the individual viewer to sustain attention.

The parameters of the attention engagement growth model were also estimated separately for the testing ages and the stimulus types. The attention activation parameter, $k$, is shown in Figure 10 for the different stimulus conditions (detailed information is presented in Table IV). The parameter for the comprehensible stimuli did not change from age 3–6 months (Richards & Cronise, 2000; Richards & Gibson, 1997), but increased from 6–24 months, $F(8, 549) = 23.18, p < 0.001$. The parameter for the incomprehensible stimuli did not change significantly from 6–24 months of age (data from Richards & Cronise, 2000). The RMSEA value for the ages and stimulus types ranged from 0.007 to 0.038,
and in each case the RMSEA value was significantly less than 0.05, indicating a close fit of the model for each of the tests. As with the mean look duration (Figure 3) and other indices from these studies, the absolute value of this parameter decreased between the Richards and Cronise (2000) and the Crawley et al. (1999) studies. However, in the Crawley et al. (1999) *Blues Clues* study, the parameter increased with age between 3 and 5 years. Analyzing look duration at

**TABLE IV**

<table>
<thead>
<tr>
<th>Age and experiment</th>
<th>Comprehensible</th>
<th>Incomprehensible</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months(^1)</td>
<td>2.951 (0.0254, 38)</td>
<td>2.915 (0.0031, 38)</td>
</tr>
<tr>
<td>4.5 months(^1)</td>
<td>2.750 (0.0019, 36)</td>
<td>2.803 (0.0098, 26)</td>
</tr>
<tr>
<td>6 months(^1,2)</td>
<td>2.851 (0.0116, 69)</td>
<td>2.781 (0.0018, 59)</td>
</tr>
<tr>
<td>12 months(^2)</td>
<td>2.962 (0.0040, 55)</td>
<td>2.808 (0.0087, 53)</td>
</tr>
<tr>
<td>18 months(^2)</td>
<td>3.076 (0.0086, 64)</td>
<td>2.696 (0.0064, 56)</td>
</tr>
<tr>
<td>24 months(^2)</td>
<td>3.139 (0.0061, 66)</td>
<td>2.703 (0.0047, 63)</td>
</tr>
<tr>
<td>36 months(^3)</td>
<td>2.583 (0.0038, 65)</td>
<td>2.201 (0.0211, 45)</td>
</tr>
<tr>
<td>48 months(^3)</td>
<td>2.791 (0.0083, 82)</td>
<td>2.185 (0.0215, 42)</td>
</tr>
<tr>
<td>60 months(^3)</td>
<td>2.923 (0.0001, 74)</td>
<td>2.379 (0.0119, 42)</td>
</tr>
<tr>
<td>Adults(^4)</td>
<td>3.437 (0.0219, 61)</td>
<td>3.093 (0.0094, 78)</td>
</tr>
</tbody>
</table>

*Note: Standard error and df are in parentheses.*

\(^1\) Richards & Gibson, 1997.


\(^3\) Crawley et al., 1999, *Busy Town*.

\(^4\) Richards, 2000.

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Fig. 10. The multiplicative parameter of the attention engagement growth model, separately for the comprehensible and incomprehensible stimuli and for each testing age, for the experiments with unrestricted viewing exposures.
the relatively low attention stimulus *Busy World* from Crawley *et al.* (1999), however, there was no increase from 3–5 years of age.

The attention engagement growth model parameters were examined by sequentially eliminating long duration looks (i.e., all looks, all looks < 120, all looks < 60, all looks < 30, all looks < 15 sec) from the studies with extended viewing sessions (Crawley *et al.*, 1999; Richards & Cronise, 2000; Richards & Gibson, 1997). This was done to determine if the model parameters and fit needed the extended viewing session or would be affected by restricting the range of looks to those that could occur in studies that used brief video segments. The fit for all models restricting looks up to 30 sec was excellent (i.e., RMSEAs < 0.031, significantly < 0.05), and the model for all looks less than 15 sec was only satisfactory (RMSEA = 0.052 and 0.046 for the comprehensible and incomprehensible stimuli). The multiplicative parameter changed little for the models (comprehensible stimuli, 2.91, 2.85, 2.86, 2.78, 2.62 for all looks, < 120, < 60, < 30, < 15 sec, respectively; incomprehensible stimuli, 2.53, 2.64, 2.71, 2.67, 2.50, respectively), dropping off primarily for the looks less than 15 sec. The difference in the multiplicative value between the comprehensible and incomprehensible stimuli was statistically significant for all looks, looks less than 120 sec, and looks less than 60 sec, but was not significant for looks less than 30 sec and looks less than 15 sec. These results imply that the attention engagement growth model fit the data of all durations well, and that the model parameters were sensitive to the experimental manipulations for the moderate and extended duration data.

Having established that the growth model accurately characterizes data based on short video segments, parameters were estimated from the studies in which the comprehensible and incomprehensible *Sesame Street* segments were interspersed (Anderson *et al.*, 1981a,b; Hawkins *et al.*, 1991). This was done to determine if the distributions would “scale down” from a session with extended viewing to one in which long duration looks were restricted because the video segments were relatively brief. The fit of the model and the observed data was excellent for each model that was tested (RMSEA values range from 0.0071 to 0.0363, all significantly less than 0.05). However, the results differed in several respects from the results with the stimuli presented in an unrestricted viewing session. The multiplicative attention engagement parameter for these data was larger for the incomprehensible stimuli (1.75, \( SE = 0.0074 \)) than the comprehensible stimuli (1.66, \( SE = 0.0019 \)) but this difference was not statistically significant, \( t < 1.0 \). These values were substantially less than the values estimated for the sessions with unrestricted viewing times (e.g., 2.91, 2.53). There was a significant effect of testing age on the multiplicative parameter for the comprehensible stimuli sessions, \( F(3, 336) = 58.96, \ p < 0.001 \), as well as for the incomprehensible stimuli sessions, \( F(3, 167) = 19.55, \ p < 0.001 \). Unlike the age effects on the parameter for the data from the unrestricted viewing session studies, there was no
clear increase over age, and the distinction in the parameter between comprehensible and incomprehensible stimuli found for the 2- and 3 \( \frac{1}{2} \)-year-old children was not found at 5 and 6 \( \frac{1}{2} \) years of age. This lack of change is likely due to the restriction of the extended looks in the procedure due to the interspersing of the comprehensible and incomprehensible stimuli. It suggests that an important factor changing over age is the presence of these very long duration looks during extended television viewing.

One reason the attention growth model fits the data so well is that the underlying multiplicative model explicitly generates look durations that are lognormally distributed. Figure 11 presents the best lognormal distribution for the modeled data and the observed data, separately for the comprehensible and incomprehensible stimuli. The model produced a probability density function that was similar in shape and size to the observed distributions for looks to both

Lognormal PDF for Model and Empirical Data

Fig. 11. The hypothetical probability density functions for the best-fitting lognormal function for the data generated by the attention engagement growth model (dashed lines) and for the observed data (solid lines). The data are shown combined across all testing ages. The comprehensible stimuli for the model and the data had the lowest density at the short durations and higher density at the long durations.
comprehensible and incomprehensible stimuli. The relative differences in the probability distribution function between the comprehensible and incomprehensible stimuli sessions for the observed data were preserved in the best fitting distribution for the model-generated data. This fit between the distribution of the simulated data from the modeling and the observed data from the experiments reflects the small RMSEAs for the attention growth model.

C. SUMMARY OF MODELING RESULTS

What is the significance of this modeling for our understanding of attentional inertia, and the development of extended looking to television in young children? The inertia parameter of the attentional strength model (Burns & Anderson, 1993) represents how quickly the tendency to continue looking at the television becomes strengthened over time. The implication of this model is that the primary process driving attentional inertia is related to resistance to distraction and continued looking. This model fits the overall data but did poorly for smaller datasets. There also was no significant age change in the inertia parameter. If we accept this model as an adequate description of the processes underlying attentional inertia, it would imply that the distractibility/continued looking process does not change significantly in infants and preschool aged children.

The attention growth model (Richards, 2000; Richards & Anderson, 1999; Richards & Cronise, 2000) fits the data more closely than the attentional strength model. This likely was due to the fact that the underlying mechanics of the model (Koch, 1966; Mosimann & Campbell, 1988; Richards & Anderson, 1999; Ulrich & Miller, 1993) uses a multiplicative relation between successive comprehension units, thereby explicitly generating lognormally distributed output data. This model posits that the comprehension occurring at a specific time affects subsequent comprehension activities by increasing their length. That is, the viewer might make an initial recognition of something in the program, and subsequent action or dialog is comprehended more fully and for a longer period of time. The engagement with comprehensible material in the program leads to a progressive increase in attention activation and the viewer maintains attention even when the content changes.

This model implies that the change in looking duration in the preschool children tested in this study is directly linked to a growing effect of comprehension on looking. The multiplicative parameter relating successive comprehension units increased significantly for the comprehensible stimuli but not for the incomprehensible stimuli. This suggests that what develops over this age is the viewer’s ability to use the initial recognition of program content to control the subsequent engagement with the program. The maintenance of looking toward the stimuli is progressively strengthened over this age period.
The results of this model fitting also point to two developmental invariants. One, the success of the model for accounting for looking durations over all testing ages implies that the mechanism controlling this progressive attention growth is similar at all testing ages. Developmental changes occur in processes other than look duration control, perhaps increases in language, familiarity with television, or general cognitive advancement. Second, the response to incomprehensible stimuli does not vary significantly over ages. The response to the incomprehensible stimuli is similar to comprehensible stimuli in the earliest ages (Figure 3), but the response to the incomprehensible stimuli remains the same at the same time that the response to comprehensible stimuli is growing.

IV. Questions for Future Research

Although theorists have argued for the existence of something like attentional inertia since James (1890), its discovery in a research context is relatively recent (Anderson et al., 1979). Prior to the mid-1970s, recording and quantifying the stream of behavior, including the onset and offset of a child’s look at television, was very difficult. With the advent of affordable video technology interfaced to microcomputers, the quantitative study of the vicissitudes of looking became practical. Consequently, the statistical properties of large numbers of episodes of attention (looks at TV, toy play episodes) could be determined. Those statistical properties, in the form of hazard of look termination functions, led to the hypothesis that attention becomes increasingly engaged as a look or toy play episode is sustained. Despite early skepticism (Mendelson, 1983), that hypothesis has been affirmed by experiments showing sustained heart rate deceleration, decreased vulnerability to distraction, increased reaction times to secondary tasks, and increased information processing. A quantitative model that is based on the idea of a progressive growth in attentional activation fits the observed data well. All these findings are consistent with the hypothesis of increased attentional engagement over time.

Complex comprehension activities are not necessary for the existence of attentional inertia. This comes from the fact that very young infants show attentional inertia and that attentional inertia is found with incomprehensible audiovisual stimuli. This helps explain the observation that attentional inertia serves to drive attention across content boundaries in television such as from programs to commercials. The cognitive processes that are involved in comprehending the program (e.g., the contents of short-term memory, the functioning of the ongoing narrative schema) surely have to be reset as the viewer attends to the entirely different commercial.

Does this mean that attentional inertia is an automatic “dumb” attentional process only indirectly related cognition? Apparently not, insofar as the analyses
presented in this chapter show that attentional inertia increases with age, but only for comprehensible audiovisual content from about 6 months of age and older. Kaleidoscopic computer-generated images or fragmented incomprehensible TV programs produce attentional inertia, but not as much as programs that can engage higher cognitive processes. Attentional inertia seems to be a primitive attentional process that appears early on but with development comes to work in the service of higher cognition. We have a hint from the work with ADHD children (e.g., Lorch et al., 2004) that attentional inertia may also be a significant factor in individual differences in attentional abilities as well as in narrative comprehension abilities.

Although attentional inertia appears to be a real phenomenon, we have much to learn about it. What causes attentional inertia? In what situations is it minimized, and in what situations is it maximized? Is it an automatic consequence of maintaining a look at a dynamic audiovisual stimulus or of maintaining a toy play episode? Is attentional inertia found in other domains of behavior such as reading, writing, and computer game playing? After a person becomes deeply engaged, what causes attention episodes (or play episodes) to end? That is, what factors ultimately negate attentional inertia? Richards (e.g., Richards & Casey, 1992) has observed that heart rate shows clear evidence of attention termination 3 or 4 sec before a look actually ends. Sometimes the termination response occurs without a look termination, and a reengagement process occurs (Lansink et al., 2000). How do we reconcile these observations with the apparently inexorable increase in engagement as a look is sustained?

What is the relation of attentional inertia to habituation? For example, if an infant has been engaged in a long look at television, and if a static image is then displayed on the TV screen, would habituation to that image be slowed? Are attentional inertia and habituation opponent processes?

Answering these questions requires a great deal of more experimental and descriptive research. For example, because attentional inertia appears to occur in toy play, dynamic audiovisual stimulation apparently is not a necessary condition for its presence. Are there behavioral domains other than TV viewing and toy play in which attentional inertia might occur? Consider reading. When people read, they may continuously read for several minutes and then pause, looking away from the page briefly or for a more extended period of time, and then resume reading. Analysis of reading episode lengths by Imai et al. (1992) revealed hazard functions that are remarkably similar in form to those found for television viewing. If the same experimental procedures were applied to reading episodes as we have applied to TV viewing and toy play, would we find evidence for increased attentional engagement the longer a reading episode was in progress? That is, as a reading episode continued, would the reader become progressively less distractible, slower to respond to a secondary task, show progressively decelerated heart
rate, be more likely to keep reading into a new and different unit of content, and show better memory and comprehension?

Even within the domain of television viewing where we know attentional inertia occurs there is a great deal to learn. For example, must TV viewers be freely in control of looking patterns for attentional inertia to emerge? Imagine that we could put look onsets under experimental control. This could happen, for example, if we gave a viewer some task that required attention to a computer screen, and then at some experimentally determined time point required the viewer to turn to another screen to watch an audiovisual stimulus, manipulating the length of time that stimulus was on before the stimulus was turned off, signaling the viewer to turn back to the computer screen. Would attentional inertia still be found as the look was sustained, as indexed by decreased distractibility, relatively slow reaction time to a secondary task, progressively improved memory for the audiovisual content, and so on?

If we could thus put attentional inertia somewhat under experimental control, we could begin to ask questions about changes in the brain as a look is sustained. Both electrophysiological and functional imaging techniques could reasonably be applied to answer such questions. Tucker and Williamson (1984) suggested that through dopaminergic prefrontal activation, a person is able to sustain an activity even as the momentary focus of attention changes. They argued that the activation is predominantly located in the right hemisphere in dorsolateral prefrontal areas. They contrasted this to the system that activates momentary foci of attention to specific stimuli, which they associated with a norepinephrine-based activation system located predominantly in the left hemisphere. If such patterns of activation could be confirmed, it would be interesting to see if the dopamine-based system followed the time course of attentional inertia.

What kinds of video stimuli do or do not produce attentional inertia? We are fairly certain that single static images would not, and would instead produce habituation. Would sequences of still images produce attentional inertia? If so, how frequently would they have to change? These questions can be multiplied and it is clear that parametric experimental research on the issue is possible.

Attentional inertia did not evolve so that people could watch TV commercials. It is obviously functional in ordinary human (and perhaps animal) perception and cognition. It may be an important bootstrap mechanism of cognitive development, insofar as it may keep a child attending to a source of discourse or other temporally structured information even when comprehension temporarily fails. For example, consider a young child listening to her parents talk. Other things being equal, the child will not pay much attention if the conversation concerns topics, such as politics, that are incomprehensible. If, instead, the parents are talking about an upcoming birthday party, the topic is both interesting and understandable and the child will pay extended attention. If the parents shift topics, they may use vocabulary that is unfamiliar to the child, and because
the conversation is difficult to comprehend, would ordinarily lose the child’s attention. But having paid extended attention for some time, attentional inertia causes the child to continue to pay attention and devote more cognitive resources to trying to understand the conversation. In this way, the child may expand her lexicon as she hears words used in context, and may expand her general understanding as she processes discourse she might otherwise ignore. In this way, attentional inertia may be an essential enhancer of learning in formal as well as informal settings. In our view, it is quite worthy of future research and theory.

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UNDERSTANDING CLASSROOM COMPETENCE: THE ROLE OF SOCIAL-MOTIVATIONAL AND SELF-PROCESSES

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IV. FUTURE DIRECTIONS AND CONCLUSIONS

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Being successful at school requires children to perform a range of social as well as academic competencies. In addition to mastering subject matter, developing effective learning strategies, and performing well on tests, children also must work to maintain and establish interpersonal relationships, strive to develop social identities and a sense of belongingness, observe and model standards for performance displayed by others, and behave in ways that are valued by teachers and peers (Wentzel, 2003). Research on children’s school-related competence typically is focused on three sets of general outcomes: academic skills, displays of social competencies (e.g., cooperative or compliant behavior, positive relationships with peers), and the absence of negative or maladaptive behavior (e.g., aggressive, inattentive, or disruptive actions). Educators and policy makers also endorse these outcomes; the development of social competencies as well as scholastic achievements has been stated as an
explicit objective for public schools in almost every educational policy statement since 1848 (Wentzel, 1991c).

Despite this general consensus concerning what students should achieve at school, few models of social or academic competence have been proposed to guide thinking about what healthy functioning at school entails or how it develops and can be supported within a classroom environment. The purpose of the current chapter, therefore, is to propose a situated definition of classroom competence (Section I) and describe a model of social influence whereby social-motivational and self-processes jointly contribute to students’ competent functioning (Section II). Empirical support for the model also will be presented (Section III), followed by suggestions for further theory development and research (Section IV).

I. Defining Classroom Competence

The nature of competence has been described from a variety of perspectives, ranging from skill development to adaptation within a particular setting (e.g., Sternberg & Kolligian, 1990). In the present chapter, classroom competence is defined as a set of context-specific outcomes, reflecting the degree to which students are able to meet the social demands of the classroom as well as pursue their own personal goals. Support for a definition of healthy classroom functioning as “competence within context” can be found in the work of several theorists (e.g., Bronfenbrenner, 1989; Eccles & Midgley, 1989; Ford, 1992). Bronfenbrenner (1989) argues that competence can only be understood in terms of context-specific effectiveness, being a product of personal attributes such as goals, values, self-regulatory skills, and cognitive abilities, and of ways in which these attributes contribute to meeting situational requirements and demands. Bronfenbrenner further suggests that competence is also, in part, a product of contextual supports that provide opportunities for the growth and development of personal attributes as well as for learning what is expected by the social group. Ford (1992) expands on this notion of person–environment fit by specifying four dimensions of competence that reflect personal as well as context-specific criteria: the achievement of personal goals; the achievement of goals that are situationally relevant; the use of appropriate means to achieve these goals; and the accomplishment of goals that result in positive developmental outcomes for the individual.

The application of these perspectives to the realm of classroom functioning results in a multi-faceted description of children who are competent and well-adjusted students. First, competent students must achieve goals that are personally valued as well as those that are sanctioned by their teachers and peers. Second, the goals they pursue should result in social integration as well as
in positive developmental outcomes for the self. Socially integrative outcomes are those that promote the smooth functioning of the social group (e.g., appropriate classroom behavior) and are reflected in levels of social approval and social acceptance; self-related outcomes promote healthy development of the self (e.g., perceived competence, feelings of self-determination) and feelings of emotional well-being (Bronfenbrenner, 1989; Ford, 1992). Therefore, a full appreciation of how and why students thrive or fail to thrive at school requires an understanding of a student’s personal goals, as well as those that contribute to the stability and smooth functioning of the classroom.

In addition, these perspectives provide insight into the nature of competence development within the classroom. Specifically, competence should be supported by personal attributes of students as well as contextual supports. Examples of personal attributes, or self-processes, that can make critical contributions to a student’s pursuit of personal and socially valued goals, are the ability to coordinate multiple goals and concomitant social-cognitive skills. Self-processes such as personal efficacy, autonomy, and emotional well-being also make important contributions in this regard. In addition, opportunities and affordances of the classroom can support and promote goal pursuit as well as the development of these self-processes. In the current chapter, opportunities provided by teachers and peers will be discussed. The mechanisms whereby teacher and peer provisions might influence student competence are referred to as social-motivational processes. A description of a model of classroom competence based on these notions of goal pursuit, supportive self-processes, and social motivational processes is presented in the following section.

II. A Model of Classroom Competence

If the situational demands of the classroom require children to pursue and accomplish specific goals in order to be competent and well-adjusted students, explanatory models of classroom competence must consider the social as well as personal factors that facilitate goal pursuit. A model depicting such factors is presented in Figure 1. Based on social developmental (e.g., Grusec & Goodnow, 1994; Maccoby, 1992) and motivational (e.g., Eccles, Wigfield, & Schiefele, 1998; Ford, 1992) perspectives, this model suggests that specific social, psychological, and affective processes regulate the extent to which students will actively pursue goals. As depicted in Figure 1, provisions of instrumental help, clear expectations and opportunities for goal pursuit, safety and responsivity, and emotional support from teachers and peers reflect social motivational processes that support goal pursuit in conjunction with self-processes in the form of efficacy, control beliefs, reasons for goal pursuit, and affect. In this section, the nature of goal pursuit and its relation to classroom
competence will be described first, followed by a discussion of social motivational processes and then self-processes that support goal pursuit.

A. CLASSROOM GOAL PURSUIT

What are goals, and what are the classroom-specific goals that competent students pursue? A basic tenet of motivational theories is that people set goals for themselves and that these goals can be powerful motivators of behavior (Austin & Vancouver, 1996; Bandura, 1986; Dweck, 1991; Pervin, 1983). Although theorists generally define goals as cognitive representations of desired future outcomes, educationally relevant goals have been studied from two fairly distinct perspectives. First, goals have been construed as motivational orientations that guide children’s behavioral responses to opportunities and challenges (Dweck, 2002; Dweck & Leggett, 1988; Nicholls, 1984). These goal orientations are hypothesized to result in the interpretation of situations as either providing opportunities for positive evaluation or gaining social approval (performance goals) or providing opportunities to learn or develop task-related skills (learning goals). For the most part, these more global goal orientations are believed to function independently of context (see Dweck, 2002).

Second, goals have been studied with respect to their content, and the degree to which their pursuit is related to situation-specific accomplishments (Ford, 1982; 1992; Wentzel, 1991a,b, 1993a, 2002b). Researchers who focus on the content of students’ goals typically examine the frequency of efforts to pursue specific goals and the relation of goal pursuit to social and academic competencies at school. As noted in the previous section, competence requires the achievement of goals that have social as well as personal value. Examples of school-related goals that reflect socially desirable outcomes are social goals, such as to establish personal

Fig. 1. Social-Motivational and Self-Processes that contribute to classroom competence.
relationships with teachers or peers, to gain approval from others, or to behave cooperatively and responsibly with classmates, and academic goals that are task-related, such as to master subject matter or to meet a specific standard of performance or proficiency, or more cognitive, such as to engage in creative thinking or to satisfy intellectual curiosity or challenge (see Ford, 1992).

In my own work, I also define goals with respect to their content, that is, as a cognitive representation of what an individual is trying to achieve in a given situation. In particular, I have focused on students’ pursuits of social goals to behave in a prosocial (to help, share, and cooperate) and socially responsible manner (to follow rules, keep commitments), as well as their pursuit of academic goals to learn and to perform well. These goals have been of particular interest given the increasing recognition among scholars that children’s overall competence and success at school requires a willingness as well as ability to meet social as well as academic challenges (Hinshaw, 1992; Ladd, 1989; Wentzel, 1991b, 1993b). Moreover, these goals have been related directly to positive aspects of adjustment. As would be expected, pursuits of goals to be prosocial and to be socially responsible have been related consistently and positively to displays of prosocial and responsible behavior (Wentzel, 1991a, 1994a), and efforts to learn and perform well have been related to academic grades (Wentzel, 1993a). In addition, students who pursue these social goals at school also succeed academically; pursuit of goals to be prosocial and socially responsible is related to classroom grades as well as IQ (Wentzel, 1989, 1991a, 1993a, 1996, 1997, 1998).

B. SOCIAL-MOTIVATIONAL PROCESSES

Although children try to achieve goals for many reasons, the question of what leads them to actively engage in the pursuit of goals that are valued by others as well as those that are valued by themselves lies at the heart of research on socialization (e.g., Grusec & Goodnow, 1994; Maccoby, 1992). Models of socialization suggest at least two general mechanisms whereby social experiences might influence goal pursuit. First, ongoing social interactions teach children about themselves and what they need to do to become accepted and competent members of their social worlds. Within the context of interpersonal interactions, children develop a set of values and standards for behavior and goals they should strive to achieve (see Grusec & Goodnow, 1994). Second, the qualities of children’s social relationships are likely to have motivational significance. When their interpersonal relationships with adults are nurturant and supportive, children are more likely to adopt and internalize the expectations and goals that are valued by these adults than if their relationships are harsh and critical (see Grusec & Goodnow, 1994; Ryan, 1993).
When applied to the social worlds of the classroom, these models suggest that teachers and peers also should hold the potential to provide optimal contexts within which positive goal setting takes place. Specifically, relationships with teachers and peers are likely to have motivational significance if they create contexts that make students feel like they are an integral and valued part of the classroom. If this is true, what are the critical aspects of classroom climate that contribute to a sense of social support and relatedness and therefore, pursuit of valued social and academic goals? One strategy for addressing this question is to extend our understanding of the underlying belief systems that are reflected in a sense of social relatedness. In this regard, Ford (1992) described a set of evaluative beliefs about social relationships and settings that can influence decisions to engage in goal pursuit. Specifically, Ford argues that within specific situations, individuals evaluate the correspondence between their personal goals and those of others, the degree to which others will provide access to information and resources necessary to achieve one’s goals, and the extent to which social relationships will provide an emotionally supportive environment for goal pursuit.

Based on this formulation, students should engage in positive social and academic activities when they perceive the classroom as a place that provides opportunities to achieve social and academic goals; as a safe and responsive environment; as a place that facilitates the achievement of goals by providing help, advice, and instruction; and a place that is emotionally supportive and nurturing. Few researchers have explored links between these multiple dimensions of classroom contexts and students’ positive goal setting. However, ample support exists for characterizing the opportunities provided by teachers and peers along dimensions of instrumental help, clear expectations and opportunities for goal pursuit, safety and responsivity, and emotional support.

1. Providing Help, Advice, and Instruction

Teachers and peers routinely provide children with resources that promote the development of social and academic competencies. These resources can take the form of information and advice, modeled behavior, or specific experiences that facilitate learning. In the classroom, teachers play the central pedagogical function of transmitting knowledge and training students in academic subject areas. During the course of instruction, teachers also promote the development of behavioral competencies by way of classroom management practices (see Doyle, 1986), and by structuring learning environments in ways that make certain goals more salient to students than others (Ames & Ames, 1984; Cohen, 1986; Solomon, et al., 1992).

In addition, students provide each other with valuable resources necessary to accomplish academic tasks (Sieber, 1979). Students frequently clarify and interpret their teachers’ instructions concerning what they should be doing.
and how they should do it, provide mutual assistance in the form of volunteering substantive information and answering questions (Cooper, Ayers-Lopez, & Marquis, 1982), and share various supplies such as pencils and paper. Classmates provide each other with information by modeling academic competencies (Schunk, 1987), and with normative standards for performance by comparing work and grades (Butler, 1995; Guay, Boivin, & Hodges, 1999). Positive interactions with peers also tend to promote the development of perspective-taking and empathic skills that serve as bases for prosocial behavior (e.g., Youniss, 1994; Youniss & Smollar, 1985).

2. Providing Expectations and Opportunities

Researchers rarely have asked teachers directly about their specific goals for students. However, teachers have expressed their ideas concerning what well-adjusted and successful students are like. In one study (Wentzel, 2000), middle school teachers mentioned three types of desirable outcomes when describing their “ideal” students: socially integrative characteristics such as sharing, being helpful to others, and being responsive to rules; motivational qualities related to learning such as being persistent, hard-working, inquisitive, and intrinsically interested; and performance outcomes such as getting good grades, being informed, and completing assignments. In other research, teachers have indicated a core set of behavioral expectations for their students, including impulse control, mature problem solving, cooperative and courteous interaction with peers, involvement in class activities, and recognition of appropriate contexts for different types of behavior (Brophy & Good, 1974; Feshbach, 1969; Helton & Oakland, 1977; Trenholm & Rose, 1981). Moreover, teachers actively communicate these expectations to their students, regardless of their instructional goals, teaching styles, and ethnicity (Hargreaves, Hester, & Mellor, 1975).

Little is known about ways in which peers communicate values and behavioral expectations. However, the larger peer group can be the source for behavioral standards, as well as the mechanism whereby classroom rules are monitored and enforced. This is especially the case when students as a group are held accountable for the behavior of the group’s members or when teachers use peer group leaders to monitor the class when they must leave their classrooms (Sieber, 1979). Students also have been observed to monitor each other by ignoring non-instructional behavior and responses during group instruction and by private sanctioning of inappropriate conduct (Eder & Felmlee, 1984; Sieber, 1979).

3. Providing a Safe and Responsive Environment

Although school-level violence can have an enormous impact on students (Elliott, Hamburg, and Williams, 1998), researchers have not often focused on physical safety in the classroom as a primary influence on student competence and adjustment. However, researchers have examined ways in which teachers can
be responsive to students’ needs. In particular, responsive teachers are those who provide consistent enforcement of rules, age-appropriate expectations for self-reliance and self-control, and solicitations of children’s opinions and feelings (e.g., Grolnick and Ryan, 1989; Skinner & Belmont, 1993; Wentzel, 2002a). Moreover, when teachers are taught to provide students with warmth and support, clear expectations for behavior, and developmentally appropriate autonomy, their students develop a stronger sense of community, increase displays of socially competent behavior, and show academic gains (Schaps, Battistich, & Solomon, 1997; Watson, et al., 1989). Although it is reasonable to assume that peers can play a central role in creating safe and responsive classroom environments, few studies have examined this aspect of classroom functioning.

4. Providing Emotional Support

In conjunction with providing safe and responsive contexts, teachers and peers also create a climate of emotional support for students. Research on this aspect of classroom context has been more frequent. For instance, perceiving teachers to be emotionally supportive and caring has been related to positive motivational outcomes, including the pursuit of goals to learn and to behave prosocially and responsibly, educational aspirations and values, and positive self-concept (Goodenow, 1993; Harter, 1996; Midgley, Feldlaufer, & Eccles, 1989; Wentzel, 1994a, 1997). Students who perceive that their peers support and care about them also tend to be more engaged in positive aspects of classroom life than are students who do not perceive such support. Perceived social and emotional support from peers has been associated positively with prosocial outcomes such as helping, sharing, and cooperating, and it has been related negatively to antisocial forms of behavior (Wentzel, 1994a). Young adolescents who do not perceive their relationships with peers as positive and supportive also tend to be at risk for academic problems (e.g., Goodenow, 1993; Midgley et al., 1989; Phelan, Davidson, & Cao, 1991).

C. SELF-PROCESSES THAT SUPPORT GOAL PURSUIT

Theories of social development (see Grusec & Goodnow, 1994) and motivation (Eccles et al., 1998) also have identified a common set of self-regulatory processes that facilitate goal pursuit across multiple domains of functioning. Of primary interest for the model shown in Figure 1 are efficacy beliefs, control beliefs, reasons for goal pursuit, and affect. These self-processes are central components of the model for several reasons. First, they represent attributes of the self that are indicators of competent, healthy adjustment in their own right. Efficacy beliefs reflect beliefs about one’s ability to accomplish a task. Beliefs about autonomy and control (e.g., “I do well in algebra because of my own efforts”) provide students with a lens for
interpreting past events and with a basis for developing expectations for the future (Deci & Ryan, 1991; Weiner, 1985). Emotions and affective arousal (e.g., pride, excitement) provide energy to sustain goal pursuit over time (see Ford, 1992; Weiner, 1985).

The reasoning that underlies students’ efforts is an additional process that contributes to their goal pursuit. For instance, some goals might be pursued for strictly social reasons (e.g., to please others or to avoid punishment), whereas other goals might be pursued for their own sake without the need for external prompts or rewards. These latter reasons are often believed to reflect the internalization of a goal in that they reflect intrinsic interest in the process of achieving a goal, or an acquired value attached to goal attainment (e.g., Ryan, 1993). In general, theorists propose that internalized values and norms are reflected in beliefs that behavior is motivated and controlled by the self (beliefs of internal control and self-determination) rather than perceptions that behavior is controlled by external or even unknown forces (Grusec & Goodnow, 1994; Ryan, 1993).

In addition, these processes have been related directly to engagement in goal pursuit. Efficacy beliefs are related to choice of activities and to persistence at certain tasks and not others (Bandura, 1986; Eccles, 1993). More specifically, the stronger a student’s beliefs about personal efficacy and competence, the more likely he or she is to engage in goal pursuit (Wentzel, 1996; Wentzel & Filisitti, 2003). Similar to efficacy beliefs, control beliefs also have been related to students’ pursuits of social and academic goals (Wentzel, 1996, 1997, 2002a). Negative affective responses to failure have been associated with withdrawal and disengagement from goal pursuits (Dweck & Leggett, 1988), and a generalized sense of emotional distress has been associated with infrequent pursuit of positive classroom goals (Wentzel, 1997, 1998). Positive relations of emotional well-being to pursuit of goals to behave in a prosocial and socially responsible manner also have been documented (see Wentzel & McNamara, 1999).

Finally, these self-processes are likely to serve as pathways by which social motivational processes influence goal pursuit. Researchers have documented that teachers and peers can influence a wide range of self-processes, including self-efficacy (e.g., Schunk, 1987) and beliefs about autonomy and control (e.g., Skinner, Zimmer-Gembeck, & Connell, 1998). Research that relates supportive relationships at school to distress and emotional well-being has been less frequent. Similarly, few studies have identified links between socialization experiences at school and students’ adoption and internalization of goals. However, studies of parent-child relationships have established that supportive interpersonal relationships are associated negatively with depression and depressive affect in young adolescents (Cumsille & Epstein, 1994; Kaplan, Robbins, & Martin, 1983; Wenz-Gross, Siperstein, Untch, & Widaman, 1997),
and positively with internalized reasons for engagement (Grolnick, Gurland, Jacob, & Decourcey, 2002).

D. SUMMARY

What does school-related competence entail and how might it be supported with the classroom context? I have argued that classroom competence reflects the degree to which students are able to meet the social demands of the classroom as well as pursue their own personal goals; the achievement of these dual sets of goals reflects the psychological and emotional growth of the student and it promotes the smooth functioning of the classroom. A model of classroom competence that describes ways in which social motivational processes (teacher and peer provisions) and self-processes combine to influence students’ engagement in goal pursuit also was discussed. In the following section, I present research that provides support for this model.

III. Empirical Support for the Model of Classroom Competence

In my research, I have examined students’ experiences with teachers and peers and how these experiences relate to social and academic competence at school. This work has documented relations between various teacher provisions and academic outcomes in the form of classroom grades, standardized test scores, academic interest, goal pursuit, academic effort, and control beliefs, and social outcomes in the form of prosocial goal pursuit (e.g., to help, share, cooperate) and social responsibility goal pursuit (e.g., to follow rules, keep commitments), prosocial and socially responsible behavior, and emotional distress. I also have examined relations between peer provisions and these same academic and social outcomes. In the following sections, I describe findings directly relevant to the model of classroom competence.

A. CLASSROOM GOAL PURSUIT

Do students really try to achieve positive social and academic goals at school? Based on a goal content perspective, I have assessed goal pursuit by asking students to report how often they try to achieve specific social and academic outcomes while at school. In general, students report quite frequent efforts to behave appropriately and to learn and perform well. Initial work in this domain revealed that 62% of high school students reported always trying to be dependable and responsible and 42% reported always trying to be helpful to others, with girls reporting more frequent efforts to be helpful significantly than boys (Wentzel, 1989). These students reported similar levels of effort in
pursuit of academic goals to learn new things (61%) and to understand subject matter (57%).

In a series of follow-up studies with middle school students, social goal pursuit was operationalized more specifically as students’ self-reported efforts to help, share, and cooperate with teachers and peers (prosocial goal pursuit) and to follow rules and keep interpersonal promises and commitments (social responsibility goal pursuit). Academic goal pursuit reflected efforts to learn new things and master content (learning goal pursuit) and to receive positive evaluations of performance and ability (performance goal pursuit). Students were asked how often they tried to achieve these outcomes on a continuum of “never” to “always.” When assessed in this manner, 44% of students reported frequent academic goal pursuit (they tried “almost always” or “always”) and 37% reported frequent social goal pursuit. However, the average frequency with which these social goals were pursued decreased from sixth to eighth grade (Wentzel, 1997). Similar to high school students, girls in middle school reported more frequent pursuit of goals to be prosocial and socially responsible than did boys (Wentzel, 1991a, 1994a).

As noted earlier, research also provides support for the notion that social goal pursuit plays a central role in supporting academic as well as social competence at school. In fact, pursuit of prosocial and social responsibility goals predicts academic effort over time, even when past effort and self-processes such as mastery goal orientations, self-efficacy, and intrinsic interest in learning are taken into account (Wentzel, 1996). These significant relations between social and academic competencies led to additional examinations of social goal pursuit as part of a coordinated effort to achieve multiple classroom goals. In an initial study, high- and low-achieving high school students were distinguished on the basis of the sets of social and academic goals they pursued or did not pursue at school (Wentzel, 1989). Descriptive analyses revealed that 84% of the highest achieving students reported always trying to be a successful student, to be dependable and responsible, and to get things done on time, whereas only 13% of the lowest achieving students reported always trying to achieve these three goals.

Moreover, although the highest achieving students reported frequent pursuit of academic goals (i.e., to learn new things, to understand things), less frequent pursuit of these goals did not distinguish the lowest achieving from average achieving students. Rather, an unwillingness to try to conform to the social and normative standards of the classroom uniquely characterized the lowest achieving students. These low-achieving students also reported frequent pursuit of other types of social goals such as to have fun and to make and keep friendships. In subsequent studies of middle school students, young adolescents who reported frequent pursuit of goals to be prosocial and to be socially responsible, as well as frequent pursuit of learning and performance goals, earned
higher grades than students who reported less frequent pursuit of either the social or academic goals (Wentzel, 1993a).

These early studies documented that adolescents actively pursue positive social and academic goals at school. An implicit assumption guiding these studies was that competent students pursue socially valued goals because they have an understanding of what others would like them to achieve and are able to coordinate their efforts so they can achieve personal as well as socially valued goals. In a later study (Spera & Wentzel, in press), we examined this possibility by first identifying the goals set by students and the goals set for students by their teachers, then determining the level of congruence between the two sets of goals, and finally, assessing the relation of goal congruence to other aspects of student motivation, including students’ interest in class, their beliefs about personal control and ability, and their perceptions of social support from teachers.

Two sets of findings from this study are particularly noteworthy. First, when asked to indicate their frequency of efforts to achieve prosocial, social responsibility, learning, and performance goals, ninth-grade students reported pursuit of social responsibility goals most frequently, followed by pursuit of prosocial goals and then learning goals. Students reported least frequent pursuit of performance goals. In contrast, students reported that their teachers placed most emphasis on learning goals, then social responsibility goals, and least emphasis on performance and prosocial goals. Teachers also indicated they encouraged student pursuit of learning goals most frequently and pursuit of performance goals least frequently. Thus, we found general consensus among students and teachers that pursuit of goals to perform well was least important. However, students and teachers differed in their priorities for social and learning goals.

Of additional interest were findings that levels of congruence between students’ and teachers’ goals had implications for other aspects of student motivation. In particular, students’ interest in class and perceived support from teachers were related to the degree to which students’ goal pursuits were congruent with those they believed to be encouraged by teachers. Specifically, when students’ own levels of prosocial and social responsibility goal pursuit were high and they believed their teachers’ expectations to pursue these goals also were high, they were more interested in class and perceived more support from their teachers than when there was a mismatch between their goals and their perceptions of teachers’ goals.

B. SOCIAL MOTIVATIONAL PROCESSES AND STUDENT GOAL PURSUIT

Given the importance of pursuing positive social and academic goals for successful adjustment to school, are there classroom-related experiences that can facilitate the pursuit of these goals? The model of classroom competence
described in this chapter predicts that students are likely to adopt the goals and values of teachers and peers if four basic provisions are available: instrumental help, clear expectations and opportunities for goal pursuit, safety and responsivity, and emotional support. In this section, I present evidence of the relevance of these provisions for understanding students’ pursuit of positive social and academic goals.

1. Direct Evidence

Research on provisions from teachers and peers has yielded the most consistent findings in support of a link between social and emotional support from teachers and peers and classroom goal pursuit. My work in this area has documented significant, positive relations between middle school students’ pursuit of goals to be prosocial and socially responsible and teacher and peer provisions of social and emotional support (e.g., Wentzel, 1991a, 1994, 1997, 1998, 2002a). Pursuit of goals to learn also has been associated positively with social and emotional support from teachers and peers (Wentzel & Looney, 2003). In these studies, support was assessed from the perspective of teachers and peers, including teacher reports of preference for students and classmate reports of social acceptance, as well as from the students’ perspective, as indexed by reports of teachers and peers as being supportive and caring. Although many of these studies included assessments of either teacher or peer support, when both sources of support were examined in the same study, each contributed unique, positive variance to students’ reports of goal pursuit (Wentzel, 1994a, 1998; Wentzel & Asher, 1995; Wentzel, Battle, & Looney, 2000). In addition, although much of this work has examined concurrent relations between social support and goal pursuit, longitudinal studies have provided evidence that perceived support from teachers and peers predicts student goal pursuit across the middle school years (Wentzel, 1997; 2003a,b).

In addition, I have documented the significance of other teacher and peer provisions for understanding student goal pursuit. Initially, a model of effective teaching was developed that defined teacher support and care giving in terms of Baumrind’s (1971, 1991) dimensions of effective parenting: control as reflected in consistent enforcement of rules and provision of structure to children’s activities; maturity demands as reflected in expectations to perform up to one’s potential, and demands for self-reliance and self-control; democratic communication as reflected in the extent to which adults solicit children’s opinions and feelings; and nurturance as reflected in expressions of warmth and approval as well as conscientious protection of children’s physical and emotional well-being. These dimensions are close approximations of the teacher and peer provisions described in this chapter.

Results of a study of middle school students from two schools that differed in racial composition (one predominantly Caucasian and one predominantly
African-American) confirmed that these teaching dimensions can explain significant amounts of variance in students’ pursuit of classroom goals. Specifically, students’ reports of their teachers’ expectations (maturity demands) were a significant, positive predictor of their social goal pursuit, and reports of negative feedback (lack of nurturance) were a significant, negative predictor. A methodological strength of this study was the examination of teacher dimensions and student outcomes at the classroom level. In other words, characteristics of a specific teacher were related to student outcomes in that teacher’s classroom. This situated approach to assessment allows clear conclusions concerning the relations of an individual teacher’s provisions to student competence in a specific class. Of particular interest in this regard is that students’ reports of the various teaching dimensions differed significantly across the 17 teachers in the study, but did not differ as a function of school.

Subsequent studies have focused on student goal pursuit in relation to the four teacher and peer provisions shown in Figure 1: classroom-level expectations for social and academic goal pursuit, instrumental help in achieving these goals, emotional support, and safety and responsiveness. In a study of sixth, seventh, and eighth grade students (Wentzel et al., 2000), we examined the joint contribution of these provisions to students’ social goal pursuit and interest in class. As shown in Table I, peer provisions of expectations for social goal pursuit, safety, and emotional support, and teacher provisions of expectations for social goal pursuit and emotional support predicted student pursuit of prosocial and social responsibility goals (a combined score); each of the teacher and peer

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Social goal pursuit</th>
<th>Interest</th>
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<tbody>
<tr>
<td>Peer provisions</td>
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</tr>
<tr>
<td>Expectations and values</td>
<td>.12*</td>
<td>.20***</td>
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<tr>
<td>Safety</td>
<td>.10*</td>
<td>.02</td>
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<tr>
<td>Instrumental help</td>
<td>–.02</td>
<td>-.18***</td>
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<tr>
<td>Emotional support</td>
<td>.17**</td>
<td>.05</td>
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<tr>
<td>Teacher provisions</td>
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<td></td>
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<tr>
<td>Expectations and values</td>
<td>.11*</td>
<td>.37***</td>
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<tr>
<td>Safety</td>
<td>–.08</td>
<td>–.12*</td>
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<tr>
<td>Instrumental help</td>
<td>–.08</td>
<td>.17***</td>
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<tr>
<td>Emotional support</td>
<td>.31***</td>
<td>.16**</td>
</tr>
<tr>
<td>Total $R^2$</td>
<td>.36***</td>
<td>.56***</td>
</tr>
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</table>

Note: Standardized beta weights are shown. No classroom or grade-level effects were found. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. 
provisions (except peer safety) was a significant predictor of interest in class. The regression models explained 36% and 56% of the variance in social goal pursuit and interest, respectively.

In a second study of middle school and high school students, teacher and peer social support, instrumental help, and values explained significant amounts of variance in students’ pursuit of academic goals to learn (Wentzel & Looney, 2003). In this study, we expanded the model to include self-processes (e.g., efficacy for learning, control beliefs, reasons for learning) as well as parenting factors (parents’ reactions to poor performance in the form of encouragement, punishment, or undermining feelings of self-worth). Teacher and peer provisions remained significant predictors of academic goal pursuit, even when these other factors were taken into account.

C. INDIRECT PATHWAYS: SELF-PROCESSES AS MEDIATING VARIABLES

Although these studies have established direct, significant relations between teacher and peer provisions and students’ goal pursuit, the mechanisms by which these provisions influence student motivation have not been examined in any systematic fashion. As depicted in Figure 1, however, social-motivational processes might also influence goal pursuit indirectly, by way of self-processes that support goal pursuit. I have examined two of these processes, psychological distress and the internalization of goals, as potential links between provisions from teachers and peers and goal pursuit. As noted earlier, little is known about how teachers and peers might influence these two self-processes.

1. Distress

Although evidence is still limited, emotional distress appears to be an important correlate of unsupportive relationships with peers. For example, we have documented significant, negative relations between emotional distress and social acceptance from peers (Wentzel & Caldwell, 1997), and perceived social support from peers (Wentzel, 1998; Wentzel & McNamara, 1999). These findings are in line with other evidence that children without friends and who are not accepted by their peers tend to report higher degrees of loneliness and less positive perceptions of self-worth than children who enjoy more positive relationships with peers (e.g., Harter, 1990; Parker & Asher, 1993). In support of a mediational hypothesis, emotional distress also has been related negatively to academic performance (Wentzel et al., 1990) and positively to frequent displays of inappropriate classroom behavior (see Wentzel, 1994b).

In contrast, however, strong evidence linking perceived support from teachers to levels of emotional distress has not been forthcoming (see Wentzel, 1997; 1998; Wentzel & Filisitti, 2003). In fact, in a study of perceived teacher and peer support, young adolescents’ prosocial and social responsibility goal pursuit,
Whereas perceived support from teachers was related positively to students’ interest in school and pursuit of goals to be socially responsible, perceived support from peers was related negatively to psychological distress and positively to pursuit of goals to behave prosocially and responsibly. Of particular relevance is that psychological distress served as a mediator between perceived support from peers and interest in school; this was not the case for teacher support and interest.

These findings are intriguing in at least two respects. First, they confirm the significant and important influence that peers can have on young adolescent students’ personal well-being as well as adjustment to school. Although children are interested in and even emotionally attached to their peers at all ages, they exhibit increased interest in their peers and a growing psychological and emotional dependence on them for support and guidance as they make the transition into adolescence (Steinberg, 1990; Youniss & Smollar, 1989). One reason for this growing interest is that many young adolescents enter new middle school structures that necessitate interacting with larger numbers of peers on a daily basis. In contrast to the greater predictability of self-contained classroom environments in elementary school, the relative uncertainty and ambiguity of multiple classroom environments, new instructional styles, and more complex class schedules often result in middle school students turning to each other for information, social support, and ways to cope.

In addition, an increased dependence on peers at this stage of development could be due to heightened levels of mistrust between teachers and students, students’ perceptions that teachers no longer care about them, and a decrease in opportunities for students to establish meaningful relationships with teachers often associated with the transition from elementary to middle school (Eccles, 1993; Harter, 1996). Given these many changes associated with early adolescence, perceptions of support from peers are likely to be a critical factor that contributes to students’ overall sense of well-being and consequently, to their motivation to engage in the social and academic activities of the classroom.

The lack of significant relations between teacher support and students’ emotional distress also suggests that relationships with teachers, because they do not typically involve emotional investment on the part of students, might be able to offset the negative effects of distress associated with peer relationships. A study of children without friends in middle school (Wentzel & Asher, 1995) supports this notion in that being liked by teachers was related more strongly to the adoption of school-related goals than a high level of peer acceptance. Moreover, children who had few friends and were neither well-liked or disliked by their peers (sociometrically neglected children), were the most highly motivated students and most well-liked by their teachers. In a subsequent
longitudinal study, Wentzel (1998) found that these sociometrically neglected children remained academically and socially well-adjusted over the course of the middle school years.

Although merely suggestive, these findings provide support for future research that focuses on the possibility that peer relationships play a unique role in the emotional well-being of adolescent students. In this regard, the possibility that relationships with teachers serve as protective buffers for the student who might otherwise suffer from the potentially debilitating emotional effects of peer rejection also deserves further study.

2. **Internalization**

The degree to which a student has internalized a goal reflects the extent to which goal pursuit is motivated by internal as opposed to external reasons. In this regard, Ryan (1993) has suggested a hierarchical model of internalization, proposing that goals can be pursued either because of perceived external controls (e.g., threats of punishment), to please others and therefore, enhance feelings of self-worth (referred to as introjection), or because the goal has been internalized and therefore, holds personal value or relevance to the individual (referred to as identification) or because it is simply intrinsically motivating to do so (Ryan & Connell, 1989). Similarly, Csikszentmihalyi and Nakamura (1989) suggested that goals can be categorized according to the degree to which they are dictated by social demands, reflect valued outcomes identified through interactions between the self and others, or are discovered through experience to be uniquely rewarding and intrinsically enjoyable. These two perspectives are similar in that each identifies reasons for goal pursuit that focus either on consequences to the self (rewards or punishment, positive or negative affect related to self-worth) or characteristics of the task (importance and value, enjoyment). In both models, reasons for engagement that focus on task characteristics rather than the self are considered to be the most desirable, internalized form of motivation.

The issue of internalization is particularly important when using a goal content perspective because knowing the contents of students’ goals does not offer insight into why they are trying to achieve them. Therefore, students’ reasons for goal pursuit are potentially important self-processes for explaining the extent of students’ efforts to achieve classroom goals. Indeed, it is reasonable to expect that relations between social motivational processes and goal pursuit might be explained in part, by levels of internalization—that is, the degree to which students’ reasons for their actions are self-focused or task-focused. For instance, reasons that focus on consequences to the self (the external end of the internalization continuum) are likely to be fairly stable, developing over time in response to experiences with parents and other socialization agents. Therefore, relations of teacher and peer provisions to self-focused reasons might be minimal.
In contrast, reasons that focus on the task at hand (more internalized reasons) might be more susceptible to contextual influence.

In addition, Ryan (1993) proposed that within the context of positive, secure relationships with others, children internalize socially prescribed goals and values and learn to value new experiences and challenges. In contrast, children who do not experience secure relationships tend to enter new situations with detachment or high levels of emotional distress. With respect to social motivational processes, this perspective implies that the degree to which teachers and peers express clear values and expectations and provide a safe and supportive environment for goal pursuit will be related to students’ adoption of goals valued by teachers and peers as well as a sense of emotional well-being at school. In light of these possibilities, I incorporated the construct of internalization into my work on students’ pursuit of social and academic goals.

In our first study of sixth through eighth grade middle school students (Wentzel & Filisitti, 2003), social-motivational as well as self-process variables were examined as predictors of prosocial goal pursuit and behavior. Social-motivation variables included students’ perceptions of teachers’ social support, of teachers’ and peers’ expectations for prosocial behavior, and help from teachers; self-process variables included levels of internalization for prosocial behavior, emotional distress, empathy, and self-concept. Of interest for the current discussion is that levels of internalization reflected self-focused reasons for behaving in a prosocial manner, including external (“so I won’t get into trouble”), social approval (“so others will like me”) and self-worth (“so I won’t feel guilty”), as well as task-focused reasons (“because it’s important”).

Results of multiple regression analyses revealed that along with self-concept, empathy, and perceived expectations for prosocial behavior from teachers and peers, levels of internalization were significant predictors of prosocial goal pursuit; social approval was a significant, negative predictor and task-focused and external reasons were significant, positive predictors. The model explained 47% of the variance in goal pursuit. Of additional interest was evidence for an indirect pathway from teacher and peer provisions to goal pursuit by way of self-processes. Specifically, teacher and peer provisions predicted reasons for prosocial behavior which in turn, predicted social goal pursuit. In support of our hypotheses that contextual variables would be stronger predictors of task-focused reasons than of self-focused reasons, teacher and peer provisions accounted for 23% of the variance in task-focused reasons in contrast to 11, 13, and 12% of variance in guilt, social approval, and external reasons, respectively (see Figure 2).

Because each of the four levels of internalization was assessed independently and therefore, students could report reasons across all four levels, we identified 59 students (approximately 20% of the sample) who could be categorized as reporting primarily task-focused or self-focused (external) reasons based on
scores at the top and bottom tertiles of the distribution. Comparisons of these groups revealed that students with task-focused reasons for behaving prosocially reported more frequent pursuit of prosocial goals than did students with external reasons. In support of Ryan’s model, students in the task-focused group reported perceiving higher expectations for prosocial behavior from teachers and peers, and higher levels of emotional well-being. In addition, boys in the task-focused group reported significantly more frequent pursuit of prosocial goals and higher levels of social support from their teachers than did boys in the external group; however, this was not the case for girls.

In a second study (Wentzel & Looney, 2003), we focused on middle and high school students’ pursuit of goals to learn. In this case, sex and grade level, students’ perceptions of parental reactions to poor academic performance, and teacher and peer provisions explained 31% of the variance in goal pursuit; self-processes, including levels of internalization and efficacy for learning, explained an additional 25% of the variance. Task-focused reasons for learning (e.g., intrinsic: because it’s fun, and value: because it’s important) were significant, positive predictors of reported efforts to learn.

We also examined our hypotheses that teacher and peer provisions are related to goal pursuit by way of levels of internalization and that these provisions contribute primarily to students’ task-focused reasons for goal pursuit. To do so, we conducted additional analyses in which teacher and peer predictors of the various levels of internalization were entered into regression models after taking
into account parental reactions to poor performance. Results, also shown in Figure 2, show that teacher and peer provisions have the potential to make a significant contribution to students’ pursuit of goals by way of task-focused reasons for goal pursuit. Specifically, teacher and peer provisions explained 26% and 8% of the variance in intrinsic and value-related reasons for learning, after accounting for parental reactions to poor performance, and sex and grade level. In contrast, teacher and peer provisions did not explain significant variance in self-focused reasons. In this case, parental reactions to poor student performance explained 15% of the variance in external reasons and 18% of the variance in self-worth reasons for engagement.

The findings of these studies are noteworthy in at least two respects. First, they provide evidence that social motivational processes are related to students’ goal pursuit in part, by way of self-processes. Second, they support a hypothesis that teacher and peer provisions have the potential to influence students’ internalized reasons for goal pursuit, more so than external, self-focused reasons. At one level, these latter findings seem contradictory to the notion of internalized goals as those which are perceived as emanating from the self. Indeed, Ryan (1993) posed the intriguing hypothesis that the foundations for internalization can only be laid within the context of early socialization experiences and that later social interactions outside the family are likely to have little influence in this regard.

However, when internalization reflects personal values or intrinsic interest in a task, reasons for goal pursuit might be perceived as belonging to the self but are also inextricably linked to the characteristics of the task. In other words, internalized reasons for goal pursuit focus on the qualities of task engagement (it’s fun or important) rather than its consequences, such as rewards or a positive view of oneself. From this perspective, it is reasonable to expect that teachers and peers might play a central role in supporting internalized reasons of goal pursuit. They have the potential to provide the most proximal input concerning whether engaging in a task is important, fun, or interesting.

IV. Future Directions and Conclusions

As noted at the beginning of this chapter, theoretically based models of classroom competence are not well developed. In particular, the role of context as it interacts with individual differences and psychological processes needs careful and systematic consideration. As a first step in considering the joint influence of social motivational and self-processes, I have described a model of classroom competence along with partial empirical support for the model. The work presented in this chapter, however, raises additional issues and questions yet to be resolved.
At the most general level, expanded models must focus on the multiple sources of influence that contribute to definitions of competence. For instance, we need to address the possible ways in which children and the various social systems in which they develop, including home, peer groups, and schools, interact to create definitions of school-related competence (see Bronfenbrenner, 1989). In this regard, models that incorporate children’s, parents’, and teachers’ lay theories of what it means to be successful at school, and beliefs concerning how success is achieved are essential (see Ogbu, 1985; Sternberg & Kolligian, 1990). How these beliefs change as children develop and ways in which they contribute to children’s choice and pursuit of school-related goals should be a primary target of researchers’ efforts. Continued research on the organizational culture and climate of schools (Maehr & Midgley, 1991) also can inform our understanding of how the broader social institutions and contexts within which learning takes place can motivate children to learn and behave in very specific ways.

Issues concerning cause and effect also necessitate continued focus on underlying psychological processes and skills that promote the development and display of competent outcomes. For example, an important question for understanding person-environment fit concerns how students coordinate their own social and academic goals with those prompted by teachers or peers. Some students who try to pursue multiple goals might be unable to coordinate the pursuit of their goals into an organized system of behavior and as a consequence, become distracted or overwhelmed when facing particularly demanding aspects of tasks that require focused concentration and attention. An example of this problem is when students want to achieve social goals and academically related goals. Students who are unable to coordinate these goals might opt to pursue social relationship goals with peers (e.g., to have fun) in lieu of task-related goals such as to complete class assignments. Students with more effective goal coordination skills would likely find a way to achieve both goals, for instance, by doing homework with friends. An identification of specific self-regulatory strategies that enable students to accomplish more than one task at a time seems essential for helping students coordinate demands to achieve multiple and often conflicting goals at school.

If the achievement of socially valued goals is indeed a critical component of classroom competence, investigations of appropriate goals and expectations also must be conducted within a developmental framework, taking into account the age-related capabilities of the child. Issues of developmentally appropriate practices have been addressed primarily at the level of preschool education. However, a consideration of developmental issues is critically important for students of all ages. To illustrate, Grolnick and her colleagues (Grolnick, Kurowski, & Gurland, 1999) argue that children face normative motivational challenges as they make their way through school, with issues of social integration defining the transition to school, the development of self-regulatory
skills and positive perceptions of autonomy and competence defining the elementary years, and flexible coping and adaptation to new environments marking the transitions into middle school and high school. The undertaking and mastery of these developmental tasks as they relate to school activities need to be incorporated into definitions and models of classroom competence and recognized as a core set of skills that children need to achieve as they progress through their school-aged years.

A developmental focus also is necessary for understanding the demands on teachers of students of different ages. Researchers (e.g., Brophy & Good, 1974; Eccles & Midgley, 1989) have observed that teachers treat students differently and focus on different tasks and goals depending on the age of their students. For instance, teachers of early elementary and junior high school students tend to spend more of their time on issues related to social conduct than do teachers at other grade levels (Brophy & Evertson, 1978). At this point, we do not know whether changing developmental needs of students or normative and societal expectations for children at different ages drive these differences. However, if we are to understand the nature and requirements of classroom competence, a critical look at the abilities of children at different ages as well as the normative requirements for competent classroom functioning is necessary.

In addition, the contribution of various socialization agents to the development and internalization of goals and values might also change with age. Whereas parents and teachers might impart a sense of enjoyment and value to task engagement to young children, peers might play an increasingly important role as children reach adolescence. It is likely that developmental influences and changes that orient children to either adults or peers for guidance are central to explanations of context-specific goal pursuit, and to the question of how the content of students’ goals changes with age. One obvious direction for future research would be an examination of changes in the degree to which adult and peer norms are complementary or compatible with each other as well as with students’ personal goals (e.g., Phelan et al., 1991).

Given that social situations are inherently ambiguous and ill-defined, a major social-cognitive challenge for children at school is to discern which goals they should pursue in order to be socially accepted and to avoid conflict with others (see Parkhurst & Asher, 1992). Therefore, interest in students’ goal setting, especially as it is influenced by teachers and peers, requires greater integration of models of motivation and social development with models of social-information processing (Dodge, 1986; Crick & Dodge, 1994; Ford, 1984). Current models of social information processing (Crick & Dodge, 1994) suggest that goals are derived from past experiences with specific individuals or situations. Therefore, as part of an individual’s history of social interactions, goals have a motivational function in that they predispose individuals to interpret information and act on it in certain ways. Goal setting is described further as a component process of social
decision making that acts in tandem with other social-cognitive processes, including encoding and interpretation of social cues, and generation and evaluation of possible responses, to eventually determine behavior.

How might a social information processing perspective inform our understanding of classroom competence? First, we often assume that students understand how they are supposed to behave and what it is they are supposed to accomplish while at school; incompetent behavior typically is viewed as failure to comply with these expectations. However, for some students these expectations are not always immediately obvious. For instance, young children who are just beginning school and students who are raised in cultures with dissimilar goals and values to those espoused by American educational institutions might need explicit guidance with respect to the school-related goals they are expected to achieve (Ogbu, 1985). In addition, teachers do not always communicate clearly their own goals for their students. In two studies of middle school students, almost half the participants reported that teachers did not have clear rules for them to follow and did not explain clearly what would happen if rules were broken (Wentzel, 2000; Wentzel et al., 2000). Therefore, factors that influence communication, encoding, and interpretation of social cues from teachers and peers should be a central focus of continued work in this area.

Similarly, we need to focus on understanding characteristics of students that facilitate their attention to and acceptance of teachers’ communications. Factors such as students’ beliefs regarding the fairness, relevance, and developmental appropriateness of teachers’ goals and expectations would be important to investigate in this regard (e.g., Smetana & Bitz, 1996). In addition, the literature on peer relationships suggests that children who are socially rejected tend to believe that others are out to harm them when in fact they are not, and they choose to pursue inappropriate and often antisocial goals in social situations (see Dodge & Feldman, 1990; Erdley, 1996). Over time, these children develop relationships with their peers marked by mistrust and hostility. Similar research has not been conducted on student–teacher relationships. However, it is possible that students who believe that teachers do not like them might also be perceiving and interpreting these adult relationships in ways that are biased and unfounded. Therefore, efforts to promote perceptions that peers and teachers are caring and supportive are likely to be most successful if students themselves are targets of intervention.

In conclusion, becoming a competent and well-adjusted student is a multifaceted and complex process. As described in this chapter, classroom competence involves the achievement of goals that are valued and interesting to the student as well as those that are valued by teachers and peers. Students’ goal setting can be viewed as a response to how they perceive and understand their social worlds at school. Most often these perceptions reflect the social and academic demands of the classroom and a student’s understanding of which personal goals can and
cannot be accomplished given situational constraints and affordances. It is likely that students then use this knowledge to choose goals that will allow them to satisfy to some degree the expectations of others as well as their own personal needs. These choices are likely to be motivated by beliefs about abilities to achieve these goals in a particular classroom, beliefs about control, self- or task-focused reasons for goal pursuit, and emotional well-being. Choices also are likely to be motivated by the degree to which students perceive their teachers and peers as expecting them to pursue these goals, willing to help in achieving them, providing a safe and responsive classroom environment, and offering social and emotional support.

The important point is that if we are to understand children’s competence at school, multiple levels of influence must be acknowledged: what kinds of goals and needs does the individual child bring to the classroom, and which goals do teachers and peers expect students to achieve? Moreover, we need to consider the extent to which students have developed self-processes that will motivate the pursuit of positive social and academic goals as well as enjoy positive supports from teachers and peers that can facilitate their efforts. How and why these social motivational and self-processes develop is not well understood. Indeed, the most basic descriptive research has just begun. However, we have gained some initial insights into adolescents’ goal setting and their experiences with teachers and peers within classroom contexts. These insights can serve as a foundation for further examination of the social and psychological antecedents and supports of academic and social competence at school.

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CONTINUITIES AND DISCONTINUITIES IN INFANTS’ REPRESENTATION OF OBJECTS AND EVENTS

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IV. SUMMARY AND CONCLUSIONS

REFERENCES

I. Introduction

Even a casual review of the literature on infants’ representation of objects and events suggests that striking discontinuities exist in the interpretation of the data. The large body of literature beginning in the mid-1980s from the laboratories of Spelke and colleagues (Spelke, 1991; Spelke et al., 1992) and Baillargeon and colleagues (Baillargeon, 1993; Baillargeon et al., 1990; Baillargeon, Spelke, & Wasserman, 1985) gives detailed reports of very young infants’ capabilities in responding to “surprising” or “inconsistent” physical events. Infants of 3 to 4 months of age looked longer at visual displays that violated physical laws of continuity, solidity, and other principles.
To discriminate between displays that did and did not violate physical laws, infants had to represent out-of-sight objects and events. These findings struck down the Piagetian theoretical view of the infant as a non-representational being for whom out-of-sight objects no longer exist (Piaget, 1952, 1954).

Although this new view of infant cognition has been widely discussed in major textbooks (e.g., Butkatko & Daehler, 2001; Kail, 2004; Siegler, DeLoache, & Eisenberg, 2002) and review chapters (Bremner, 2001; Mandler, 1998), it is not without controversy. As the mountain of evidence from preferential looking studies grew, explanations abounded for the discrepancy, or even “crisis” as Meltzoff and Moore (1998) termed it, between the new view of infant cognition versus the classic Piagetian view. Meltzoff and Moore (1998, 1999) proposed that the preferential looking data are based on simpler processes than reasoning about physical laws. They would not give young infants the knowledge of physical events and objects suggested by Spelke and Baillargeon, but instead give the infant “representational persistence,” which does not entail knowledge of object permanence or the object’s location. Rather, representational persistence precedes object permanence in development and allows the infant access to information about an absent object or event. Response to discrepant events and deferred imitation are two examples of representational persistence given by Meltzoff and Moore (1998).

Other critics questioned the conclusions drawn from preferential looking studies on methodological grounds. Haith (1998) pointed out that the looking paradigm answers questions in a dichotomous fashion, which limits its ability to illuminate underlying processes. He noted that preferential looking is well suited to answering questions such as whether infants discriminate this shape or color from that shape or color, but the paradigm is too limited to answer questions involving deeper understanding of concepts. To draw conclusions about broader physical knowledge one must make a hazardous leap from dichotomous data to inferences about conceptual processes. For example, if infants look longer when a ball appears to have passed through a solid wall than when it does not (a dichotomous difference), Haith (1998) would say that this should not be interpreted to mean that they understand the physical laws governing motion. In other words, even assuming that young infants have some knowledge of solidity, one should not assume that this knowledge is indicative of a higher level cognitive construct.

Other critics made a sharper attack on the preferential looking methodology itself by using it to arrive at disparate conclusions. An entire issue of Infancy (2000, Volume 1, No. 4) was devoted to a collection of articles on object permanence that concluded infants’ looking time at visual displays was based on novelty and familiarity preferences rather than anything to do with
the knowledge of physical laws (Bogartz, Shinsky, & Schilling, 2000; Cashon & Cohen, 2000; Schilling, 2000). Several commentaries in the same issue tempered and refuted these claims on many grounds. Aslin (2000), Baillargeon (2000), and Munakata (2000) all noted that the replication studies deviated from the original stimuli and procedures of Baillargeon in significant ways. In addition, an important point was made independently by all three commentators: the critics never mentioned that the original study (Baillargeon, Spelke, & Wasserman, 1985) and Baillargeon (1987) included a critical control group that dealt with the issue of perceptual preferences for the familiar event. In this chapter, although not denying the importance of considering non-conceptual accounts, we accept the infant data from preferential looking studies as “real” and not the result of faulty experimental design or an artifact of procedure. We attempt to see how our data with toddlers presented in this chapter constrains and reinterprets the infant data.

Taken at face value, several studies with toddlers and preschoolers appear to outright refute the view of the infant as having knowledge of physical laws. Hood’s study (1995) of 2-year-olds was the first to show that children beyond infancy appear not to know the same physical laws to which infants were responsive. In Hood’s (1995, 1998) work, children failed to search correctly for a ball that had been dropped down a twisted tube and stopped in a cup not directly underneath where the children saw the ball released. The children searched directly underneath the hole where they saw the ball disappear, ignoring the fact that there was no physical connection between release point and the cup directly below, thus violating the law of continuity, which says objects cannot pass from one location to another without moving through the intervening space. Hood termed this mistake a “gravity error,” because children consistently searched where gravity would dictate the ball should fall without the tube’s intervention.

Following this initial study, additional reports appeared that further documented toddlers’ seeming ignorance of physical laws. Berthier et al. (2000) and Hood, Carey, and Prasada (2000) studied search behavior in tasks requiring children to use the solidity principle (namely, that one solid object cannot pass through another) in order to solve a problem. Objects were either dropped from above (Hood, Carey, & Prasada, 2000) or rolled horizontally (Berthier et al., 2000) and disappeared behind an opaque screen. The object was stopped by a barrier, which was partially visible beyond the screen. Neither 2- nor 2 1/2-year-olds succeeded on a 4-choice problem (Berthier et al., 2000); 2 1/2-year-olds but not 2-year-olds succeeded on 2-choice problems (Hood, Carey, & Prasada, 2000).

The perplexing issue is why infants appear to have knowledge of physical laws that seems to be absent in toddlers. In one sense this issue reiterates the earlier one: why do infants of 3–4 months show knowledge of object

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permanence and physical laws when much older infants fail to search in the classic Piagetian search task? The hidden object task was Piaget’s acid test of object permanence, with failure indicating that the out-of-sight object had ceased to exist for the infant. Years before the results from preferential looking studies had called Piaget’s view into question, Harris (1983) had declared that the real issue for the infant was not object permanence, but the inability to search correctly. The 8-month-old who does not uncover the object in Piaget’s task knows the object still exists, but does not know where to search for it. This insight appears to capture the problem for the toddler as well. By 2 years of age the child is beyond Piaget’s sensorimotor stage and object permanence is no longer an issue, but where to search for a hidden object remains a problem. The studies described in this chapter are efforts to determine what makes the search task difficult for the young child. The problem seems very simple and straightforward on the surface, but study after study has shown that this is not the case.

To set these studies appropriately in the literature and examine conflicting points of view, we need to step back and see how we got here. The complex stimulus situations used in most of the relevant studies involve interplays among perception, action, and cognition. We feel that these issues have not been fully addressed in most of the individual articles, including our own. In this chapter, we discuss issues of visual tracking and catching of moving objects. Our studies on visual anticipation and catching of moving objects in 9-to 10-month-old infants are reviewed (Section II), followed by studies of search and looking behavior in toddlers between 2 and 3 years of age (Section III). We review behavioral and neuroscientific data on eye movements and motor control of upper limbs (Section II). We comment on the cognitive issues of representation when a moving object is occluded for a portion of its trajectory or a barrier is placed in its path (Sections IIC and III). We conclude with a discussion of our infant and toddler data in the context of others’ data to arrive at an interpretation that clarifies and integrates the findings (Section IV).

II. Moving Object Studies with Young Infants

Over two decades ago, von Hofsten showed that young infants readily reached for moving objects (von Hofsten, 1980, 1983; von Hofsten & Linghagen, 1979). These reaches appear soon after infants first reach for stationary objects (von Hofsten & Linghagen, 1979) and by the second half of the first year of life infants consistently contact objects moving below 30 cm/sec (von Hofsten, 1983). This success at grasping objects moving at such a high rate of speed is remarkable given the apparent difficulty of the task.
Research since the early studies of von Hofsten has largely focused on two sets of questions. The first set addresses performance issues: What sort of ability do young infants possess to grasp moving objects and how does this ability improve with age? What perceptual information is important in infants’ success at grasping moving objects? Are infants able to adjust to the removal of direct perceptual information of portions of the movement trajectory?

A second set of questions deals with issues involving mental representation and prediction. Do infants anticipate the motion of the object? Do infants explicitly predict future positions of the moving object? Do infants represent the target object in conditions of occlusion? Do experiments involving grasping moving objects reappearing from visual occlusion inform us about the development of Piagetian object concept? Is the fact that infants succeed at the task of grasping moving objects evidence that infants know about the Newtonian laws of motion?

The performance questions historically arose before the conceptual questions. In our review, we follow the same sequence and consider data from developmental psychology, motor control, and neuroscience in attempting to give the best answers possible to these questions. By considering these larger literatures we hope to not only constrain and ground psychological theorizing about representation but also to consider wider views about the nature of representation.

A. VISUAL TRACKING AND REACHING FOR MOVING OBJECTS

Infants, children, and adults visually track and reach for moving objects. Given the ubiquity of these behaviors in humans, it is surprising that there is a lack of consensus on how they are accomplished. For example, McBeath, Shaffer, and Kaiser (1995) suggested that adults learn to catch a batted ball by running along a path that maintains a linear optical trajectory for the ball, but this conclusion was so controversial that publication of the paper elicited seven follow-up commentaries and experiments. To fully explain how adults and children succeed at catching moving objects we must understand the behavior as a perception–action behavior that involves vision, proprioception, and attention as well as understand the neural circuits that are involved in its execution.

As mentioned previously, even young infants successfully grasp moving objects. In von Hofsten’s initial work (von Hofsten, 1980, 1983; von Hofsten & Linghagen, 1979) an object moved along an arc in a horizontal plane at the infant’s shoulder height. The angular speed of the object was constant within a trial, but could be varied across trials. Infants found this situation engaging and irresistible, generating many reaches for the object in a single experimental session. From about five months of age, infants were able to reliably contact the object if the object was moving up to about 30 cm/sec. Later work showed
similar success for objects moving out of occlusion (van der Meer, van der Weel & Lee, 1994) and for moving, glowing objects in the dark (Robin, Berthier, & Clifton, 1996).

Besides demonstrating the remarkable ability of young infants to control their reaching movements, the literature on moving objects is of major interest because it seems to show that young infants make predictions about the future positions of moving objects. An overriding problem in tracking or intercepting moving objects is the delay imposed by the perceptual and motor systems (von Hofsten, 1993). If an actor generates a motor command to reach for the current position of a moving target, the time required to execute that reach command (usually assumed to be in the order of 100–150 msec in adults; Brenner & Smeets, 1997) leads to the movement being directed behind the actual position of the target. The ability to anticipate the movement of the object and direct actions towards that position has been most clearly demonstrated for the development of the ocular smooth pursuit system (Aslin, 1981). Visual smooth pursuit develops over the first two or three months of life, developing from tracking using saccades, to relatively accurate smooth pursuit with catch-up saccades, and finally to accurate smooth pursuit. The main event underlying the transition to accurate smooth pursuit is the elimination of the temporal delay with which the eye follows the target, a delay that matches the time it takes the nervous system to process sensory information and generate motor commands that control eye position.

The neuroscientific literature on the visual tracking of moving targets in primates shows that objects are tracked in naturalistic conditions by a combination of saccades and smooth pursuit. This combination of eye movements is evident in our and others’ data from human infants (Berthier et al., 2001; van der Meer, van der Weel, & Lee, 1994). In primates, visual target information is processed in extrastriate cortical areas to provide signals that are used to control saccadic movements and pursuit tracking. Areas of importance are medial temporal cortex, medial temporal cortex for smooth pursuit and the frontal eye fields and lateral intraparietal area for saccadic eye movements. These areas are richly interconnected to coordinate visual tracking. Churchland and Lisberger (2001) discussed models of visual smooth pursuit and suggest that temporal derivatives of image motion are used as signals that compensate for motor delays and allow for prospective control. They suggest that one function of medial temporal cortex is to provide such information. It makes sense that Aslin (1981) found that elimination of smooth pursuit phase lag was found relatively late in human infant development, if that elimination depends on later developing cortical systems such as the medial temporal region.

Another indication that visual tracking involves higher-level cortical pathways is the finding that tracking depends on the perception of object motion, not on low-level retinal signals. Krauzlis and Stone (1999) summarized research on smooth pursuit of objects when the psychological perception of object motion is
opposed to retinal image motion. They concluded that humans track illusionary motion and ignore direct retinal signals in some instances when the signals are opposed. These results suggest that tracking of object motion is driven by cortically based perceptions and is not simply the result of lower level, perhaps brainstem, control processes.

Dealing with the motor delays in reaching is more difficult than the delays in eye movement because the motor delay times in reaching are longer than those in eye movement. To deal with these long delays, infants aim ahead of a moving object so as to intercept the object instead of chasing or waiting for the target (von Hofsten, 1979, 1980, 1983; von Hofsten & Linghagen, 1979; Robin, Berthier, & Clifton, 1996). The neural circuits that mediate anticipatory reaching for moving objects follow parallel pathways to that of the smooth pursuit system with extrastriate visual areas projecting dorsally to posterior parietal cortex and intraparietal areas and subsequently projecting to premotor areas of frontal cortex (Gallese, 1997, 2002; Rizzolatti, Fogassi, & Gallese, 1997, 2002). The observation that predictive reaching for moving targets appears developmentally after accurate smooth pursuit is expected given the increased dynamical difficulty of controlling one’s arms relative to one’s eyes.

Whatever the neural basis of the systems that control visual tracking and reaching for a moving object, those systems are clearly functional before six months of age and they are robust to the elimination of certain information about the trajectory of the object. Van der Meer, van der Weel, and Lee (1994) assessed the ability of young infants to reach for objects that moved back and forth out of occlusion. In their study, an object moved along a straight path in a frontal plane and was available to the infant in an 18-cm wide gap between two visual occluders. On different trials the object moved at a variety of different speeds. In van der Meer et al.’s first study, 11-month-old infants shifted their gaze to the object’s emergence point and initiated their reach at a constant time (approximately 1 sec) before the object reappeared from occlusion independent of the speed of the target object. This means that infants adjusted the timing of their reaches so that they reached earlier in trials for more rapidly moving objects. The fact that infants’ gaze shifted and reaching was initiated a second before reappearance of the moving object means that the prospective behavior was initiated just before or at the time the moving object went into occlusion. This means that infants accurately guided their reaches largely in the absence of direct visual information about the target object because the object could not be seen during the bulk of the reach.

In a second experiment, van der Meer, van der Weel, and Lee (1994) longitudinally tested two infants from 16 to 48 weeks of age. Consistent with earlier work, infants as young as 20 weeks of age were successful in catching the moving object. These early reaches differed from reaches occurring at older ages in three ways. First, the tight temporal coordination seen in older infants between
gaze shift and hand movement was not observed in infants younger than 6 months of age. Large temporal lags were seen between the gaze shift and the start of the reach, suggesting that the looking–reaching behavior was not a coherent whole but was disjointed and relatively uncoordinated in the youngest infants. Second, although gaze shifts were timed in anticipation of the reappearance of the object from behind the occluder, start of the reach did not consistently anticipate reappearance until about 32 weeks of age. Finally, reaches by young infants differed from those of older infants in that instead of initiating their reach at a certain time before reappearance of the object, young infants started their reaches when the object was at a particular point in space.

Robin, Berthier, and Clifton (1996) similarly challenged infants by restricting visual information about the motion of the moving object by having infants reach for a glowing object in complete darkness. This manipulation forces infants to reach without sight of the hand or visual surround. The object was made to glow by luminescent paint, and infrared video and motion analysis technology was used to assess the infant’s behavior. As in von Hofsten’s studies the object moved back and forth along an arc at shoulder height. Robin, Berthier, and Clifton (1996) found that 5- and 7\(\frac{1}{2}\)-month-old infants were only slightly less likely to reach in the dark than in the light, and that reaching in darkness did not lower their likelihood of contacting the object relative to reaches under full illumination. Detailed kinematic analysis of reaching did not show any differences with age or with lighting condition for measures such as hand speed, duration, and straightness. Using three measures of hand aiming, Robin, Berthier, and Clifton (1996) found that infants at both ages in both lighting conditions aimed ahead of the moving object. They concluded that sight of the hand and visual surround is not used to a significant extent by infants reaching for moving targets, and that sight of the target itself is the critical sensory input guiding reaching in early infancy.

We (Berthier et al., 2001; Keen et al., 2003) investigated the importance of vision of the target object during the terminal phases of reaching by having infants reach for an object reappearing after a short period of occlusion. We tested 9-month-old infants reaching for a ball that rolled down a ramp and behind a small occluder. Because of the way the infant was seated, the infant could only obtain the ball as it emerged from occlusion. In two studies, the properties of the occluder was varied. In the study of Berthier et al. (2001) the occluder was a solid screen made of wood and painted gray, and in the study of Keen et al. (2003) the occluder was clear Plexiglas. In comparing reaching with opaque and transparent occluders, we found that complete vision of the ball’s trajectory was not necessary for the reaches to be initiated at an appropriate time. Infants correctly initiated their reaches on 42% of the opaque occluder trials and 43% on the transparent occluder trials. However, direct visual information about the trajectory of the moving object during the last portion of the reach was important.
because the rates of contact with the object were much lower on trials with opaque (40%) versus completely clear (65%) occluders. This emphasizes that the trajectory information leading up to the disappearance of the moving object was the critical information for initiating the reach, but that complete visual information about the trajectory of the moving object was valuable for ongoing control of the reach.

A second study by Robin (1996) showed that not only is the sight of the object the most important of all the sensory information in guiding reaching for moving objects, but that attention is focused on the moving object and that other features of the task are not necessarily monitored by the infant. Robin tested 7½-month-old infants reaching for a moving object with the apparatus shown in Figure 1, which was similar to that used by van der Meer, van der Weel, and Lee (1994). Objects moved horizontally back and forth in a frontal plane in both full illumination and in complete darkness. The object was lighted internally so that it would glow in the dark condition. Five groups of infants were assigned to different conditions in which they reached for the object when it appeared in the central region of the apparatus. In two conditions that did not involve the use of the occluding panels (no-occluder conditions), infants reached for the internally lit, moving object in the light and dark. In two other conditions infants reached for the object in the presence of the occluding panels in the light and the dark. In the final condition infants reached for the glowing object in the dark without

Fig. 1. Photograph of the Robin (1996) apparatus showing the infant’s view of the moving object (Plastic Big Bird). The object moved back-and-forth in front of the child from the extreme left or right disappearing and reappearing from behind the two screens. Because of the position of the infants, they could only reliably obtain the toy when it was in the central gap. Sight of the object was manipulated by removing the screens and darkening the room.
the occluding panels, but the internal light blinked off at the time when the object would have been behind the panel on occluder trials.

Infants reached on over 40% of the passes of the object in the light and dark, independent of the presence of the occluding panels and illumination. However, although reaching rates were comparable across conditions, success rates as measured by percent of reaches that resulted in contact differed dramatically. In the two no-occluder conditions, infants contacted the moving objects in about 70% of the trials, suggesting that sight of the complete trajectory was critical for contact. When occluders were present success was only about 30% in the light and about 15% in the dark. The most frequent reason for failure in the occluder conditions was that the infant’s hand hit the occluding panel while reaching. These data suggest that in this demanding situation that infants focus their attention on the moving object and either do not remember or do not take into account the presence of an occluding panel that blocks reaching along certain paths. This hypothesis was supported by results from the dark no-occluder blink condition, where performance was more than twice as successful compared to the dark-occluder condition. With no physical occluder to obstruct the hand, the infant was able to succeed in grasping the object similarly to performance in the light with an occluder blocking sight of the trajectory.

We have challenged infants even more by requiring them to reach for a ball moving out of visual occlusion, but with a barrier blocking the path of the object on half of the trials. This manipulation required the infants to notice on each trial whether the barrier was placed on the track or not. In four experiments we measured visual tracking in 6- and 9-month-olds and reaching in 9-month-olds (Berthier et al., 2001). Infants as young as 6 months old showed predictive visual tracking of the moving object in that they looked to the reappearance point prior to the reappearance of the moving object’s reappearance. On trials with the hidden barrier, these infants showed small, but significant, delays in their orientation to the reappearance point, suggesting that they took the hidden barrier’s presence into account in visual tracking.

The effects of the hidden barrier on reaching were more dramatic. First, on many barrier trials infants reached to the right of the occluder as if expecting the moving object to emerge (the ball always rolled from left to right). Figure 2 shows an infant’s behavior on trials with and without a barrier behind the occluder. These two reaches, which are representative of all participants, were kinematically identical on the two types of trials. Second, even though all infants reached on some barrier trials, reaching was less frequent when the barrier was present than when it was not. Thus, infants seemed to take into account the hidden barrier on some trials, but on others ignored its presence and reached as if the object would reappear. This finding is similar to the study of Robin’s (1996) in providing another example of infants being so intent on catching a moving object that they lose track of other important features of the task.
How then do infants reach for moving objects? All the results reviewed in the previous section emphasize that visual attention to the moving object is paramount (Berthier et al., 2001; Robin, 1996; von Hofsten, 1983). In contrast,
vision of the surround and the hand do not seem to play a major role in grasping moving objects in young infants. Robin, Berthier, and Clifton (1996) showed that the reach kinematics of 5- and 7 1/2-month-old infants do not differ significantly when they reach for moving objects in full illumination and for glowing moving objects in complete darkness. In the latter condition, vision of the surround and the approaching hand are not available to the infant. Perhaps, as has been hypothesized by Clifton et al. (1994), vision of the surround and hand become important in reaching for moving objects when the infant’s control improves and processing power becomes available to appreciate these important visual cues.

Given the importance of direct visual information about the motion of the target object, there is consensus that manual catching of moving objects in adults involves on-line corrections to hand movement using perceptual cues (Brenner, Smeets, & de Lussanet, 1998; Wann, 1996). The studies of Berthier et al. (2001) and Keen et al. (2003) showing an approximately 50% increase in contact rates when information about the full trajectory of the moving object is available relative to a condition where the last part of the motion was occluded suggest that infants use information from the end of the trajectory to correct their reaches on-line as the adults do.

The mechanisms by which humans catch moving objects are not well understood. Neuroscientifically, estimation of target velocity by extrastriate cortical areas plays a critical role in removing tracking delays in visual smooth pursuit. How those velocity signals are derived and used is a matter of active investigation (Churchland & Lisberger, 2001). In regards to the psychological mechanisms involved in the catching of moving objects by infants, the only specific suggestion was made by van der Meer, van der Weel, and Lee (1994) who suggested that infants use tau (a measure that is derived from target velocity) to guide the hand to contact. The tau hypothesis is largely untested in infants.

The possibility remains that infants, especially the youngest infants, are not learning to predict the motion of the moving object in order to intercept it in any real sense. Perhaps, infants are simply learning when to act in a particular situation. Berthier (1997) investigated whether infants need to make explicit and accurate predictions about the future positions of moving objects in the catching task by simulating infant reaching. His simulations employed a simple learning algorithm that involves interaction of an individual with the environment. As a class, these algorithms use selection and variation to determine which motor responses are best for a particular task. In operation, the algorithms store the current best responses in a data structure, which is often a neural network. Berthier’s simulations made minimal assumptions and simply asked whether reaches for a moving object could be successfully executed with only information about current target position. The results showed that over a range of target object speeds, individuals successfully obtain the target object by timing the initiation of the reach appropriately to get the hand to the region of space where the target
would be in the future. Terminal corrections could then be made to contact the target. Such a strategy is experience based, does not require explicit prediction about future location of an object, but succeeds by correctly timing reach onset based on current target position and speed.

Berthier’s (1997) theoretical result is consistent with the results of van der Meer, van der Weel, and Lee (1994), who found that infants before 32 weeks of age consistently initiated their reaches for moving objects when the object was at a particular location in space independent of the speed of the object. In contrast, older infants reach earlier for more rapidly moving objects. von Hofsten (1980, 1983) and Robin, Berthier, and Clifton (1996) found that infants typically reached for moving objects by bringing the contralateral hand to intercept the object.

In all these studies, infants may catch moving objects by learning particular strategies for particular situations, such as using the contralateral hand to catch the object, or using on-line control mechanisms to bring the hand to the object by matching velocity or by reducing some error metric. Observed infant reaching strategies do not include the strategy of simply bringing the hand up into the path of the moving object and waiting (Robin, Berthier, & Clifton, 1996; Spelke & von Hofsten, 2001; von Hofsten, 1983). To explain the success of infants in reaching for moving objects we need not make the assumption that infants early in the trial explicitly extrapolate the future position of the moving object and aim their reaches towards that position.

C. REPRESENTATION AND REACHING FOR MOVING OBJECTS IN YOUNG INFANTS

Related to the question of how infants successfully reach for moving objects is the question of whether infants’ reaching for moving objects emerging from occlusion can be taken as evidence for object representation and permanence. Initially, researchers tested whether infants visually oriented to the point of emergence prior to the appearance of the object, or whether visual orientation to the object was initiated after the object actually reappeared. Early work showed that infants from about 6 months of age do show predictive visual orientation (Moore, Borton, & Darby, 1978; Meicler & Gratch, 1980; Meltzoff & Moore, 1998; Nelson, 1971; Nelson, 1974), although repeated exposure to the emerging object was often required before predictive behavior appeared at the youngest ages. The investigators in these early studies concluded that the predictive orientation of infants was evidence that infants represent occluded moving objects starting as early as 6 months of age.

Von Hofsten and colleagues investigated the ability of 6-month-old infants to represent, track, and reach for a temporarily occluded object (Jonsson & von Hofsten, 2003; Munakata et al., 1996; von Hofsten, Feng & Spelke, 2000; von Hofsten et al., 1998; Spelke & von Hofsten, 2001). These studies all used an
apparatus composed of a computer-controlled plotter in which the object’s speed and direction was accurately controlled in two dimensions. The infant sat in front of a large, vertically mounted, sheet of white painted aluminum upon which the object moved. The initial study of von Hofsten et al. (1998) tested infants looking and reaching for objects that either moved along a top-to-bottom, straight, diagonal path or along a path that changed diagonals at the center of the workspace. Because of the novelty of the situation, this first study did not involve visual occlusion of the target object. von Hofsten et al. (1998) found that the infants anticipated the continued motion of the object along the straight path as previous work had shown. On trials where the object stopped and changed direction at the center point, infants required about 200 msec to adjust to the change in direction, a delay that is consistent with Berthier and Robin’s (1998) estimate of 200 msec to correct the direction of a reach to a target that is shifted in mid-reach.

In a subsequent study, Spelke and von Hofsten (2001) investigated reaching with this apparatus when the infant’s view of the object’s path was partially occluded. They found that infants initiated reaches on about 60% of the trials for horizontally moving objects without an occluder, a rate that is what would be expected given the 77% reaching rate found by Robin (1996) who tested slightly older, 7½-month-old infants. When Spelke and von Hofsten (2001) tested infants with diagonally moving objects without an occluder, the rate of reaching decreased to 34%. When Spelke and von Hofsten (2001) tested infants with an occluder on the diagonal path, reaching dropped substantially with infants reaching on fewer than 4.8% of trials. They concluded that the low level of reaching in the occluder condition was due to weak object representation by 6-month-olds.

This low rate of reaching by 6-month-olds in the von Hofsten apparatus with an occluder was confirmed by Jonsson and von Hofsten (2003) who tested infants with a horizontally moving object. In a baseline condition with the object’s movement fully visible infants reached on about one-third of the trials, a rather low rate compared to other studies with horizontally moving objects (e.g., 5-month-olds in Robin, Berthier, & Clifton, 1996, reached on 65 of 75 trials and contacted the moving object on about half of those reaches). Six groups of infants were exposed to different experimental conditions in which the time of occlusion was crossed with the method of occlusion, either an occluding panel or by blackout of the room. The results indicated that the occluding panel more severely disrupted reaching than simple blackout of the room (about 7% reaching in the occluder condition versus about 14% in the blackout condition), and that the degree of disruption increased with the length of occlusion. Visual tracking was better in the occluder condition relative to the blackout condition, perhaps because the edge of the occluder provided a target for the eye to move for in the occluder condition. Jonsson and von Hofsten (2003) concluded that reaching
performance is better in the blackout condition because the representation of the physical occluder does not interfere with the infant’s mental representation of the moving object.

Jonsson and von Hofsten’s (2003) conclusion does not accord with Robin’s (1996) findings that 7 1/2-month-olds reached for a horizontally moving object reappearing from occlusion on 49% of the trials in the light with a physical barrier, but 42% of trials in the dark where there was no barrier and the lighted object blinked off, and 24% of trials in the dark when the moving object went behind a barrier. The differences in results could be due to the younger age at which Jonsson and von Hofsten (2003) tested their infants, but Robin’s (1996) baseline reaching was also much higher (77%) so that the results of Jonsson and von Hofsten (2003) may partially be due to floor effects. We can conclude that in 7 1/2-month-olds blackout does not result in more reaching than physical occlusion and that sight of the physical occluder does not significantly interfere with mental representation of the moving object.

Whereas the von Hofsten studies of 6-month-olds show very low rates of predictive reaching when the path of the moving object is temporarily occluded, they show very good levels of visual tracking. After some initial training experience or warm-up (Berthier et al., 2001; Jonsson & von Hofsten, 2003; van der Meer, van der Weel, & Lee, 1994; von Hofsten et al., 2000), 6-month-olds consistently look to the emergence point at the side of the occluder. What is the reason for this divergence of looking and reaching? van der Meer, van der Weel, and Lee (1994) showed that older infants tightly coupled their looking and reaching behavior, initiating reaching and gaze shift at the same time, but in contrast 6-month-old infants showed substantial delays between the gaze shift to the emergence point and the initiation of the reach. Perhaps, 6-month-old infants depend on the initial saccade to the reemergence point to initiate or modulate the reach that follows. So at 9 months, when the saccade and reach become tightly coupled, more robust predictive reaches are seen because they occur contemporaneous with the initial saccade.

The disruption of on-line control of the reach that occurs with 6-month-olds might be similar to the decrease seen in 9-month-olds’ reach success rate from 65 to 40% when a clear occluder is replaced by an opaque occluder (Berthier et al., 2001; Keen et al., 2003). In these studies, we attempted to more directly assess 9-month-old infants’ representation of hidden objects by placing a barrier on the track of an object moving behind an occluder. The top third of the barrier was always visible. If infants represented the object moving out of sight and reasoned that it would be stopped by the barrier, they would not expect the object to emerge. We found that although infants were less likely to reach on barrier trials, they nevertheless often reached to the right of an occluder when a clearly visible barrier had been placed on the moving object’s path behind the occluder. The reaching to the right of the occluder is perhaps
not so surprising because of the attentional focus of the infant on the moving object, but what was surprising was that infants could not retrieve the object stopped to the left of the barrier behind the occluder. In fact, in open-ended search infants were successful in locating the object on barrier trials only once in 77 trials. The failure was not one of failing to execute indirect reaches because the infants made numerous indirect reaches, but to the wrong side of the occluder.

To explain this pattern of results Berthier et al. (2001) hypothesized that infants were so focused on the relatively difficult task of reaching for a moving object coming out of occlusion that other knowledge about the situation was lost. Although infants were less likely to reach on barrier trials, once the reach was initiated we hypothesized that infants concentrated on the perceptual-motor act in order to time and direct their reaches appropriately. As discussed previously, the fact that infants direct attention to the moving object and lose track of surrounding objects was shown by Robin (1996), who found that the major reason reaches failed in the light was that infants’ reaching hands hit the clearly visible, opaque occluding panel. Because of this intense focus on the moving object, Berthier et al. (2001) suggested that when the moving object did not reappear from behind the occluder on barrier trials, infants were confused and did not remember the relevant features of the task and so could not correctly reason about where the moving object may have stopped. This hypothesis is closely related to a proposal of Boudreau and Bushnell (2000) that cognitive capacity limitations lead to a trade-off between action and cognition, such that when either one becomes more difficult, the other suffers.

A subsequent study by Berthier and Carrico (2003) supported this hypothesis. In this study, the authors repeated the task used by Berthier et al. (2001) with the change that infants simply viewed the event and were not allowed to reach for the moving object until after it stopped behind the occluder. After watching the ball disappear, infants were allowed to search for it. In contrast with the Berthier et al. (2001) study, in which only 1 of 16 infants ever contacted the hidden object and then only once, Berthier and Carrico (2003) found that 7 of 15 infants found the ball on over 50% of the trials. Although removing reaching for the moving object did substantially improve performance, infants still found the task difficult. Nevertheless, reducing the demands of the situation by not having the infants reach for the moving object substantially improved subsequent search performance.

A growing literature shows that attention can be object-directed as well as spatially-directed (Egly, Driver, & Rafal, 1994) and that when attention is directed towards objects in an action setting many aspects of the task are not processed deeply. For example, Triesch et al. (2003) found that adults required to pick up an object and place it in a different location in a virtual reality
environment usually did not notice a substantial change in size of an object they were visually fixating and grasping when the change in size was not task relevant. Adults noticed the size change in a condition where the size of the grasped object was task relevant. Similarly, Hayhoe et al. (2003) suggested that representations and plans are developed “just-in-time” and that attention and processing of visual features is limited to the task at hand and that visual information that is not directly relevant is only processed to a limited extent. If this adult literature extends to infants, it would not be surprising that infants reaching for a moving object focus their attention on that object and do not deeply process other visually obvious features. In this explanation, infants do not take into account a partially visible barrier wall because their concentration on other aspects of the task has left out the wall as vital to the solution.

Few would deny that 9-month-olds have object permanence and their vigorous search showed that the infants clearly knew the object still existed. The failure seems to be the result of a lack of ability to reason about the relation of the moving object to the wall and the occluder and, given that information, an inability to use it in planning a reach to obtain the hidden object. This view is supported by the findings of a subsequent study by Keen et al. (2003) in which a window placed in the occluder allowed the infant to see the full length of the barrier. Performance improved substantially: 7 of the 18 infants retrieved the hidden object on several trials whereas in the original study only 1 of the 18 infants ever touched the hidden object on a single trial. Clearly, the addition of information about the presence of a barrier and its location and extent improved performance considerably.

In sum, the overwhelming bulk of the data shows that infants, from about 5 or 6 months of age, show gaze shifting and reaching for moving objects that have undergone occlusion. Clearly, infants represent these moving objects at some level. Failures of action have been observed but they seem likely to be due to an inability to coordinate looking and reaching in young infants (van der Meer, van der Weel, & Lee, 1994), general difficulty of the task (Jonsson & von Hofsten, 2003), or directing search in the context of a difficult motor action (Berthier et al., 2001; Berthier & Carrico, 2003).

III. Toddlers’ Reaching and Search for Objects that have Undergone Hidden Movement

Many of the same search problems seen in 9-month-olds (Berthier et al., 2001; Keen et al., 2003) are surprisingly still evident in toddlers between 2 and 3 years of age. When the task is to search for a moving object that has disappeared behind a screen, as we pointed out previously, children well beyond infancy appear to be at a loss (Berthier et al., 2000; Hood, Carey, &
Prasada, 2000). True, the apparatus is more complex, with a larger screen and multiple hiding places, and search involves choosing a correct door to open. But the major cue to the ball’s location is the same—a barrier on the ball’s track that protrudes beyond the screen to remind the child of its presence. That plus the direction of the ball’s movement are all an individual needs to know to succeed. In the infant studies it was sufficient to know whether the ball was to the left or right of the barrier because the screen was so small that the infant could simply peer around one side and see the ball. In the toddler studies more reasoning about the ball’s trajectory was necessary because multiple hiding places demanded exact knowledge of the ball’s location rather than simply knowing it was to the left or right of the barrier. It is striking that parallel problems in searching for the ball emerged at both ages. We describe the original study (Berthier et al., 2000), followed by variations that attempted to unravel toddlers’ puzzling behavior.

A. CAN 2-YEAR-OLDS FIND A BALL BEHIND A SCREEN, USING A VERY OBVIOUS CUE?

Based on the infant preferential looking studies, we assumed toddlers had knowledge of object solidity and its effect on motion. In the initial study (Berthier et al., 2000), we posed the question: can toddlers use such knowledge to find a ball that rolled out of sight? Imagine a ramp with a barrier positioned at one point on its slope. A white wooden screen with four doors is lowered over the ramp, concealing a large portion of it. The top of the barrier sticks up several centimeters above the screen and is painted a contrasting color (green) to make it stand out. This barrier is aligned with the side of one door. (see Figure 3 for a view of the apparatus and a child opening the correct door). Next, imagine that a child seated in front of the apparatus catches an experimenter attracts his/her attention to a ball at the top of the ramp, then releases it to roll down out of sight behind the screen. The child’s task is to open the correct door and find the ball. Our initial expectation was that even very young children would realize that the barrier stopped the ball and that it could be found behind the door spatially associated with the barrier.

We began pilot testing with 12-month-olds, and progressively increased the age until the majority of children were solving the problem. This turned out to be 3 years, with children below this age performing at chance. Three age groups were presented in the published study: 16 children each at 2, 2 1/2, and 3 years of age (Berthier et al., 2000) The children received an elaborate orientation to the game in which they first opened each door to make sure they knew what response to make. Then the experimenter opened a door and hid a toy behind it. Children were invited to find the toy and they could do this. Finally, they saw the ball
The children were invited to find the ball. Data for all age groups are shown in Figure 4, in which each circle represents the proportion of trials correct for an individual child. At 2 years of age no children were above chance; at 2 1/2 years there were 3 out of 16 and at 3 years there were 13 out of 16 above chance. The cause of failure did not appear to be a misunderstanding about how the ramp worked or how to open the doors. The children were eager to search for the hidden ball, readily opened doors, and were willing to play for many trials.

The initial study raised a large number of questions that we have pursued in two directions. One series attempted to assess the level of knowledge responsible for the success of the 3-year-olds; specifically, do they understand the physical constraints of the situation, or do they solve the problem by simply associating the left side of the wall with the ball because they had seen it in that position several times during familiarization? A second series of studies attempted to facilitate performance of the younger children by systematically varying aspects of the apparatus and procedures. These series are described in the next two sections.
B. DO 3-YEAR-OLDS SOLVE THE “DOOR” PROBLEM THROUGH AN ASSOCIATIVE STRATEGY?

We conducted two studies that tested the limits of 3-year-olds’ successful performance on the “door” task (Sylvia et al., 2004). In the study of Berthier et al. (2000) we argued that the older children’s success was based on understanding the physical laws of solidity and continuity. That is, the top of the wall signified a barrier at that point in the ball’s trajectory; therefore, the ball could be found
behind the door in front of the wall. In that study, we tested this assumption by giving additional trials to successful children in which two walls were placed on the track. If children understood the physical laws governing the event, they would open the door at the first wall. If they were using an associative strategy the presence of two walls should disrupt their performance because picking a door to the left of the far wall would be wrong. The 3-year-olds given this post-test did sustain their high performance, but this evidence was suggestive rather than conclusive. Because the ball continued to roll from left to right, children might have simply extended the associative strategy by continuing to open the door to the left of the first wall their scan encountered after they watched the release of the ball. They may have ignored the second wall completely.

To address these concerns, the apparatus was modified so that the ramp’s slope could be reversed. This enabled us to roll the ball from left to right for the first block of trials (called pre-shift trials) and from right to left for the second block (called post-shift trials). If children were using an associative strategy they might perform well during pre-shift trials, but would be incorrect on post-shift trials when the ball would be on the opposite side of the wall. Group performance actually increased slightly from pre-shift (mean proportion correct = 0.59) to post-shift (0.68). Of 24 children, 13 performed above chance on pre-shift trials whereas 16 were above chance on post-shift trials. Of more interest, there was considerable continuity within individual children, with only one child who was above chance on pre-shift trials and below chance on post-shift trials. We interpreted these findings as supporting our hypothesis that 3-year-olds who were successful in solving the “door” task did not rely on a simple associative rule, but appeared to reason about the position of the wall in relation to the directions of the ball’s movement. Children who performed below chance in this study often chose one of the two doors adjacent to the wall, suggesting they were following an associative rule.

In a second study, Sylvia et al. (2004) investigated the extent to which 3-year-olds used the visual cue of the wall showing above the screen by taking it away completely. Children saw the experimenter place the wall on the track, obstructing the path of the ball, but the wall was too short to show above the screen. This is a further test of the hypothesis that children who solve the problem are not doing so by using an associative rule. We expected performance to drop a small amount due to extra memory load of remembering the wall’s presence, but performance should drop precipitously if children were dependent on an associative rule because the cue has disappeared.

Again, the 3-year-olds received pre-shift and post-shift trials in which the ball rolled first from the left for 8 trials, then after the ramp was rotated, 8 trials from the right. The wall was out of sight on all trials when the child chose a door to open. Overall accuracy was 47%, with 8 out of 16 children choosing the correct door above chance. Compared to performance on the first rotating ramp study
with the partially visible wall, accuracy was lower (0.47 versus 0.63), but performance did not fall completely flat as would be expected if children were relying totally on the visibility of the wall as a cue. In conclusion, when 3-year-olds were challenged by changing the ball’s direction of movement, and by being deprived of sight of the wall, half or more of the children tested still chose the correct door to find the ball. Hood, Carey, and Prasada (2000, Experiment 4) also used the manipulation of rolling a ball from both directions and found that 2½-year-olds could solve a 2-door problem. After children are performing above chance, they apparently understand the constraints put on the ball’s movement by physical laws, shown by their ability to use direction of movement to predict which side of the wall will stop the ball.

C. WOULD PROVIDING ADDITIONAL VISUAL INFORMATION HELP 2-YEAR-OLDS SOLVE THE PROBLEM?

Understanding why the 2-year-olds fail at the “door” problem has been an interesting challenge. We have completed seven studies using various manipulations of apparatus and procedure which rule out several possible explanations. To determine if hidden movement of the ball behind the screen was the problem, we permitted intermittent views of the ball’s trajectory in one study, and revealed the entire trajectory in second study. To determine if knowledge of solidity was the stumbling block we eliminated this aspect of the problem. In other studies, we made the wall’s appearance more prominent, we made the doors more distinct and unique, we attempted to increase motivation by giving a reward each time the ball was found, and we tried to separate the knowledge of solidity issues from the difficulties imposed by having critical events occur out of sight. Finally, we converted the “door” task from one requiring active search into a looking-time task where the child passively observed a puppet who opened the doors and discovered the ball in a location consistent or inconsistent with physical laws. This last study was an attempt to create a task highly similar to that experienced by young infants in preferential looking studies. A firm, definitive answer about the toddlers’ failure to solve the “door” problem eludes us. We regard it as highly likely that no single element is the issue, but rather that a multitude of developments must take place and come together for children to succeed at this task.

In two studies, visual access to the ball’s movement was increased, with the expectation that hidden movement of the ball might be a critical problem for 2-year-olds. In a study by Butler, Berthier, and Clifton (2002) the ball’s movement was made intermittently visible by substituting a clear Plexiglas screen (shown in Figure 5) for the opaque wooden screen in Berthier et al. (2000). In solving this task, in addition to the wall, the children also had the cue of the ball’s failure to emerge from behind the correct door. Although 2½-year-olds
greatly benefited from increased visibility of the ball’s movement, with 83% of the group performing above chance, 2-year-olds were not helped. Despite tracking the ball correctly to the point of disappearance, they often chose a door before or after the door with the wall. Only if children kept their gaze fixed on the place of disappearance did seeing more of the ball’s trajectory seem to help them.

In a second study that increased visual information (Mash, Keen, & Berthier, 2003), children were given full view of the ball’s motion until it came to rest at the wall. The opaque screen was then lowered to obscure the view of the stationary ball, and the child was asked to find the ball. Note that in addition to providing complete visibility of the ball’s movement, this procedure also eliminated the child’s need to reason about the solid wall stopping the ball. The ball was in place when the screen was lowered, so the child did not need to represent the hidden event of a wall stopping the ball’s motion. Nevertheless, this additional information did not noticeably help 2-year-olds. Again, if children kept their eyes on the ball as the screen was lowered, they were more likely to open the correct door. However, often gaze was broken away. In such cases children appeared to lose track of the ball’s position and then opened an incorrect door. They apparently did not use the top of the wall as a marker for the ball’s location. Only 2 out of 18 children were above chance in finding the ball, and 2 and 3/4-year-olds were only a little better (7 out of 18 above chance). Thus, both efforts to facilitate performance by providing more information about the ball’s movement and eliminating the need to reason about solidity did not appear to aid 2-year-olds. Such measures did benefit 2 and 1/2-year-olds somewhat, especially the ball’s failure to emerge from behind the correct door in the transparent screen study (Butler, Berthier, & Clifton, 2002).
In two other studies various aspects of the apparatus were made more prominent to determine whether directing visual attention to relevant cues would make a difference. The presence of the wall was enhanced by having a section overhang the screen (Figure 6). We reasoned that seeing a portion of the wall extend all the way down to the track would more forcibly remind children of its presence, and its ability to block the passage of the ball (Poirier et al., 2000). Thus the correct door was demarcated by this overhanging portion of the wall. Otherwise, the procedure and apparatus were like that in the original study. Only 2\(\frac{1}{2}\)-year-olds were tested in this wall configuration. Overall accuracy was 38% correct, with 4 of 21 children tested performing above chance. We concluded this added visual cue did not help, because 3 out of 16 of the 2\(\frac{1}{2}\)-year-olds in the original study were above chance (Berthier et al., 2000).

In a second effort at enhancing critical parts of the apparatus, decal pictures of common familiar animals (e.g., dog, cat) were placed on each door to make them visually unique and nameable (Bausch, 2003). As part of the usual familiarization procedure, children were asked to name each animal, and no child had trouble with this. We hypothesized that making the four doors more distinct, rather than identical as in all previous studies, would help prevent children from losing track of the critical door. Another change in this study was allowing variation in response. In our previous studies children were asked to find the ball by opening a door. The mode of response may have interfered with the children’s ability to express their knowledge of the ball’s location. In contrast, in the present study children could select a door by speaking, by pointing, or by opening a door. Asking the child to name or point to the door concealing the ball might put fewer demands on the child and possibly enhance their choice. For example, in Berthier et al. (2000) many children adopted a favorite door (usually door 2) and went

Fig. 6. The apparatus from Poirier et al. (2000) that made the barrier more prominent. We altered the wall to create an overhang so that it was visible down the entire front of the occluder. This apparatus differed from the original apparatus, shown in Figure 3, only in the extension of the barrier over the front of the occluder.
back to that same door on more than half the trials. It is unclear whether this was
due to a tendency to repeat a particular motor act, to a cognitive strategy of
avoiding the extreme doors, or some other process. In any event, if opening the
same door repeatedly had some motor origin, then having the child choose a door
by naming an animal or simply pointing might release the child to adopt a more
flexible and accurate choice.

But the uniquely decorated doors had no effect, nor did manner of
response. Proportion correct was 0.25 for doors chosen by speaking, 0.28 by
pointing, and 0.29 by reaching and opening a door. As always, chance was
0.25 on any particular trial and these proportions are very close to that of
0.22 for 2-year-olds in the original study. Only 11 children participated in
Bausch’s study, but there was no hint in the data that the new manipulations
had any effect.

In summary, our efforts to aid performance by giving more information about
the ball’s movement or enhancing the wall’s or the doors’ appearance in order to
draw attention to these elements all failed for 2- and 2½-year-olds. The one
exception was that 2½-year-olds seemed to notice the non-emergence cue in the
transparent screen. The data for all of these studies are summarized in Table I,
along with results from Hood, Cole-Davies, and Dias (2003) using a similar
apparatus.

D. SIMPLIFYING THE TASK BY REDUCING SOME REQUIREMENTS

In analyzing the task requirements imposed by the search problem with
the door apparatus, Keen (2003) enumerated the following necessary
components:

– knowledge of physical laws concerning solidity and continuity; that is, the
  role of the barrier in stopping the ball;
– prediction of the ball’s location;
– use of an indirect cue to indicate location of the ball—the top of the barrier
  is an indirect cue because the critical juncture of barrier and track is not visible;
– spatially connecting the barrier and the ball with the correct door;
– using knowledge of the ball’s location to implement an appropriate search
  plan to obtain the ball.

When one compares this list to task requirements for preferential looking
experiments, it is obvious that much less is demanded when looking is the
response. In those experiments the infant compares one visual display to another,
and expresses discrimination by looking longer at the display inconsistent with
physical laws. To make this perceptual discrimination the infant needs to have
some understanding of physical laws governing objects and events, but this may
<table>
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<th>Study</th>
<th>Manipulation</th>
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<th>2(\frac{1}{2})-year-olds</th>
<th>3-year-olds</th>
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<td>0.34</td>
<td>0.74</td>
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<td>Hood, Cole-Davies, and Dias (2003)</td>
<td>Reaching, opaque occluder</td>
<td>–</td>
<td>0.40</td>
<td>0.68</td>
</tr>
<tr>
<td>Bausch (2003)</td>
<td>Vocal/pointing/reaching response</td>
<td>Vocal: 0.25, Pointing: 0.28, Reaching: 0.29</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Mash et al. (2003)</td>
<td>Opaque occluder</td>
<td>Pointing exp 1: 0.39, Pointing exp 2: 0.20</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Mash et al. (2003)</td>
<td>No hidden movement</td>
<td>0.37</td>
<td>0.52</td>
<td>–</td>
</tr>
<tr>
<td>Poirier et al. (2000)</td>
<td>Overhanging barrier wall</td>
<td>–</td>
<td>0.38</td>
<td>–</td>
</tr>
<tr>
<td>Butler, Berthier, and Clifton (2002)</td>
<td>Transparent occluder</td>
<td>0.39</td>
<td>0.71</td>
<td>–</td>
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These results were estimated from Figure 4 (p. 65).
not extend beyond recognizing an anomalous situation (Diamond, 1998; Willatts, 1997). Considering the differences in requirements between preferential looking and search tasks, there is little reason to expect agreement between the infant and toddler data.

We designed an experiment in which the basic requirement of both the search task and preferential looking was retained (i.e., the knowledge of solidity and continuity), and other requirements were eliminated. In other words, we turned the “door” task into a looking time task, very much like that used with infants in Spelke et al. (1992). Two-year-old children watched passively as a puppet opened doors to find the ball (Mash, Keen, & Berthier, 2004). On standard trials the puppet opened the correct door and found the ball. On test trials interspersed among standard trials, the puppet always failed to find the ball. On trials consistent with physical laws the puppet opened an incorrect door, and the screen was then raised to reveal the ball resting at the barrier. On trials inconsistent with physical laws the puppet opened the correct door, and when the screen was lifted the ball was beyond the barrier, apparently having rolled through it, just as in the Spelke et al. (1992, Experiment 3) study.

Children had two chances to show they detected something wrong. When the puppet opened a door and found no ball, if they had predicted in advance where the ball would be, they should look longer on inconsistent trials. They did, although this indication of prediction only approached significance ($p < 0.07$). On the portion of the trial after the screen was lifted and they viewed the completed event, they did look longer at the inconsistent event. Thus, toddlers appeared to appreciate that the barrier should stop the ball.

In a similar experiment that also converted the search aspect of the door task into a looking-time task, Hood, Cole-Davies, and Dias (2003) found that 2-year-olds looked longer at inconsistent events. In their study the experimenter rolled the ball, then opened both doors simultaneously on either side of the barrier. Children looked longer when the ball was on the wrong side. Results from both studies converged on the conclusion that when 2-year-olds are faced with two highly similar events, they look longer at the physically incongruous event, just as infants do.

Although reassuring to find that infants and toddlers behave similarly when task requirements are similar, we are left wondering which of the remaining requirements imposed by the search task may be the critical ones. To further explore the limits of 2-year-olds’ understanding, we put the prediction requirement back in, but not search (Kloos & Keen, in press). Still using the door apparatus, we removed the screen to display all elements of the task to the child during problem solving. A small doll called Lorie was introduced and the experimenter explained that Lorie liked to catch a ball that rolled down the track. The experimenter demonstrated that to be successful Lorie had to stand just in
front of the barrier on the side from which the ball was rolled. The child’s task was to place Lorie on the track at the right place to catch the ball. When the ball was rolled, children could see whether their placement was correct because if Lorie was ahead of the barrier the ball knocked her down, and if Lorie was behind the barrier the ball stopped at the barrier, leaving Lorie empty handed. The rotating ramp apparatus was used so that the experimenter demonstrated various placements and familiarized the child with the game with the ball rolling from one direction. Test trials featured the ball rolling from the other direction so that the child could not imitate the experimenter’s placements with respect to the correct side of the barrier.

Note that this task does not involve search for a hidden object, but it does involve prediction about the ball’s movement and stopping; being able to see all elements of the problem (ramp, barrier on the track, ball, and Lorie) was expected to facilitate performance. Children were scored as correct if they placed Lorie within 4 cm of the barrier on the correct side. Unlike the previous studies, chance performance for individual children could not be calculated because their choice of placement was not constrained to 1 of 4 doors. Lorie could be placed anywhere on the track.

Children seemed to understand this task because they placed Lorie correctly on 87% of the familiarization trials, but as pointed out previously, this could have been imitation of the experimenter’s placement. On test trials the group proportion correct was 0.49; in other words, children placed Lorie very close to the barrier on the correct side about half the trials after the slope was reversed. Of note was the wide variation in performance among individuals. Nine of the 17 children were correct on 0.40 or fewer test trials, with the most frequent error being putting Lorie back in the previously correct position. Eight children were above 0.50 and four were above 0.75 correct. Two children achieved perfect performance, immediately switching Lorie to the correct side of the barrier when the slope changed. The variability in performance suggests a transition period around 2 years of age.

The Lorie study was an attempt to see if young children could predict where the ball would stop with the search requirement stripped away and all elements of the task in view. The results are best described as “mixed success” because many children were not able to place the doll correctly. Although some children predicted the ball’s motion with respect to the barrier, the majority of 2-year-olds did not. Prediction required reasoning about future events, using knowledge of solidity to make the prediction. The variability in the group indicates that these processes are difficult to apply in this task for the 2-year-old. Hood, Cole-Davies, and Dias (2003) also pointed out that prediction may be one of the critical elements that make preferential looking easier than search tasks.
IV. Summary and Conclusions

Bringing together the data from our studies of visual and motor behavior in 9-month-olds and 2- to 3-year-olds, we can resolve any seeming discrepancy with data from very young infants using the violation of expectancy paradigm (Baillargeon, 1993; Spelke et al., 1992). When task requirements in our studies were reduced to engaging in anticipatory tracking (Berthier et al., 2001, Experiments 2–4) or detecting a perceptual anomaly (Mash, Keen, & Berthier, 2004), infants and toddlers showed knowledge of solidity. In the former study, infants visually anticipated the ball’s emergence from behind a screen when the track was clear but not when a barrier was blocking the way. In the latter study, after observing a puppet open a door and find no ball, toddlers looked longer when the ball had apparently passed through a barrier on the track, a finding corroborated by Hood, Cole-Davies, and Dias (2003). As one would predict from studies by Baillargeon (1993) and Spelke et al. (1992), children at all ages tested appeared to take the barrier into account by realizing that it would block the ball’s movement. Studies of 2-year-olds that showed no recognition of the barrier’s effect involved prediction of the ball’s exact location plus active search (Berthier et al., 2000; Butler, Berthier, & Cliffton, 2002; Hood, Carey, & Prasada, 2000). Further evidence that knowledge of solidity was not the key cause of toddlers’ failure in the search task comes from Mash, Keen, and Berthier (2003) who found that removing this requirement did not help performance.

What then do we understand about infants’ representation of hidden moving objects? As Haith (1999) has noted, the term representation has meanings at many different levels and thus does not refer to a unitary phenomenon. The term can and has been used to refer to the activity of neurons in the retina and primary sensory areas as well as to much higher-level, explicit conceptions. Neurally, visual processing proceeds along dorsal and ventral streams. Strong evidence exists that visually based action is mediated by medial temporal, medial superior temporal, posterior parietal, and intraparietal areas of the dorsal stream. The function of dorsal areas is influenced by object features and kind information produced by the ventral stream, but is not absolutely dependent on that information.

In considering what action tells us about representation, Crick and Koch (1998) concluded that the dorsal, “on-line control” system responsible for visual tracking and reaching is unconscious, whereas the ventral “seeing” system is conscious and responsible for detecting identifying object properties. As an example Crick and Koch (1998) cited Milner and Goodale’s patient (Milner & Goodale, 1995) who was able to catch thrown objects, but not identify them. Even more remarkable are the results of Triesch et al. (2003), who used a virtual reality apparatus to change the properties of an object that normal participants were manipulating without their noticing.
Rossetti (1998) elaborated these ideas and suggested that action requires the on-line treatment of the situation and goal and that the resulting representations only require information necessary for successful action. These pragmatic representations need not be long-lived and do not bind object properties into a conscious percept. Rossetti (1998) strongly contrasts these types of pragmatic representations with those that are explicit, conscious, and semantic. Morton and Munakata (2002) similarly argued for two types of mental representations: a latent representation of objects in the world based on parietal cortex as well as an “active” representation based in prefrontal areas. The latter would be explicit and declarative and could be used in active thought, but the former could support visual tracking and reaching on its own. Thus, effective action is not sufficient evidence for explicit perception or conscious knowledge of object properties.

These neuroscientific results of skilled action in situations that require spatiotemporal tracking of objects without the explicit representation of object properties are paralleled by work by psychologists. In work that grew out of findings on attention to objects (as opposed to spatial location), Scholl (2001) showed that adults can attend to a small number of moving targets among moving distractors, even when those targets move in or out of occlusion. Significantly, this work has shown excellent spatiotemporal tracking without encoding of object properties so that adults fail to notice that a tracked object changes properties upon emerging from occlusion (Scholl, 2001).

The possibility that infants might be able to successfully track objects through visual occlusion without any encoding of the properties of that object is supported by several studies. Although Moore, Horton, and Darby (1978) showed some sensitivity of 5-month-old infants to changes in features upon reappearance of an object, this was not found by Goldberg (1976) in several conditions that controlled for novelty and familiarity. Later work by Xu and Carey (1996) found that even 10-month-olds failed to detect object properties while tracking objects that moved behind an occluder.

The finding that adults and children tracked moving objects through occlusion without knowledge of or attention to objects’ features led Scholl and Leslie (1999) to conclude that there is an intermediate representational system. In considering early representation they rejected both the “maximally perceptual” (representation as perceptions or simple images) and the “maximally central” (representation as belief, theories, principles) positions. They argued that early mechanisms and processes underlying discrimination are best characterized between these two extremes. Carey and Xu (2001), in reviewing the infant cognition literature, concluded that early representation underlying object individuation is a system that indexes and tracks objects on the basis of spatiotemporal information. Features may or may not be bound to these indexical representations, but they play a secondary role in the representation.
Spatiotemporal information may have a privileged role in recruiting attention in infancy and early childhood. It is noteworthy that the only manipulation that substantially increased performance in the “door” task was making the screen transparent so that the ball’s motion was visible as it traveled between doors (Butler, Berthier, & Clifton, 2002). In addition, this manipulation allowed infants to use the simple strategy of searching for the ball where they saw it last disappeared. This last strategy appears to be the dominant one for non-human primates in a highly similar task (Klitzing, deBlois, & Novak, 2003). In contrast to the spatiotemporal information provided by the moving ball, the partially visible barrier was a stable part of the visual array that had to be recognized as a solid object in the ball’s path, an object property detected by the ventral stream. Through more than half a dozen studies, there was no evidence that this solidity property was used by toddlers searching for the ball, although other evidence indicates that changing the task structure might enable them to do so.

Mareschal and colleagues (Mareschal & Johnson, 2003; Mareschal, Plunkett & Harris, 1999) have proposed that manual retrieval difficulties in infants are not due to a privileged spatiotemporal representational system, but due to poor integration of spatiotemporal and featural information. They argued that the spatiotemporal and featural representational systems develop at approximately the same rates and that the two systems are roughly equal in their ability to represent objects. Mareschal and Johnson (2003) have shown that young infants encode the spatiotemporal qualities of objects when they are manipulable, but not when target objects do not afford action. However, in the case of non-manipulable objects, featural qualities of objects are encoded. Although the research reviewed in the present chapter involves somewhat older children than those of Mareschal and colleagues, the failures observed in the reviewed studies could well be the result of the action and object feature systems functioning in an incoherent and uncoordinated manner.

Apart from the question about the level at which infants are able to represent dynamic events, infant behavior in quasi-naturalistic tasks depends on the interplay of perception, action, and cognition. Our studies with older infants and toddlers, in which there is no question of ability to represent unseen objects, abound with examples where situational effects determine performance. Nine-month-olds show anticipatory tracking and successfully search for a hidden ball when they are not allowed to reach for it while it is moving (Berthier et al., 2001; Berthier & Carrico, 2003). Two-year-olds perform quite well in the door task, if they are allowed to maintain fixation on the stopping location of the ball, but not if they break fixation (Butler, Berthier, & Clifton, 2002; Mash, Keen, & Berthier, 2004). When observing another actor engage in search, 2-year-olds react by looking longer at a display revealing the ball in the wrong location (Hood, Cole-Davies, & Dias, 2003; Mash, Keen, & Berthier, 2004). These differences in performance can be explained by assuming that key elements of a situation may
be ignored under certain circumstances where task demands are high. When the child is engrossed in difficult catching, reaching, or search, these high action demands may interfere with deep processing of obvious features such as the barrier on the track. When such demands are lifted, these elements are again recognized and processed as central to the situation. This process is not unlike a driver failing to see a stop sign when emotionally upset or distracted by overly fascinating conversation. We hypothesize that a toddlers’ failure to search appropriately in the door task reflects, in part, a difficulty in allocating attentional resources rather than a lack of understanding the effect of the barrier.

These types of effects led Thelen and Whitmyer (in press) to also emphasize that infant and toddler behavior is highly sensitive to the context and to play down the importance of mental representation in infants. Thelen and Whitmyer used a dynamic field model to show how various sensory inputs and biases might interact to drive search and other behaviors. This model can be thought of as a field of highly interconnected neurons whose activations evolve over time to an attractor. The exact settling point of the network is determined by the structure of the interconnections and by the initial conditions of the simulation. The settling point of the network predicts the infant’s search location. Thelen and Whitmyer’s model was generally successful in capturing the salient features of our door studies as well as some preferential looking studies. We note that although Thelen and Whitmyer seemingly reject the notion of representation, the activation fields triggered by sensory inputs in their model are a persisting representation of the world similar to our suggestion that mid-level representations are mainly used in our tasks by infants.

While being sympathetic to the role context plays in determining the behavior of infants as suggested by Thelen and Whitmyer (in press), we have two challenges. First, because of non-linearity, dynamic field models predict surprising changes in behavior with small changes in the context. Thelen and Whitmyer (in press) predicted that changes in the distance between the doors and the salience of the doors would lead to dramatic differences in predicted behavior, and yet our studies show that changing the distance between doors and their saliency have no measurable effect on 2-year-olds’ behavior (Bausch, 2003). Although our results can probably be accommodated by alterations in the parameters of the model, a principled way of predicting when small changes will have an effect and when they will not is required for dynamical models to be successful.

A second challenge is for Thelen and Whitmyer (in press) to model the mechanisms of development. Our studies show a dramatic transition between two and three years in children’s ability to reason and search for objects in space. How would their model account for this dramatic increase in children’s ability? Are dynamic field models appropriate for the 3-year-olds’ striking
success in our task? At what, if any, age does it become necessary to assume that children solve tasks such as ours using reasoning?

From the numerous failures we reported here in attempting to facilitate 2-year-olds’ performance on the search task, we clearly do not fully understand the complex processes underlying the planning and execution of successful search for hidden objects. We have been able to eliminate certain aspects of the situation as the critical factor limiting toddlers’ performance (e.g., tracking the moving ball, hidden movement behind the screen), but single factors probably interact with others to produce interference. In addition to factors discussed above, Keen (in press) proposed that a failure to spatially integrate several visual features (ball, wall, track, door) and toddlers’ limited ability to predict future outcomes were candidates for causing their search failures. Clearly, further research is needed on many aspects of the perceptual and cognitive processes underlying search before we can develop a comprehensive theory of toddlers’ behavior.

In conclusion, we have shown that a careful analysis of task requirements and processing demands clarifies the seeming discrepancy between the infant preferential looking data and the toddler data from search tasks. Following a review of visual tracking and reaching for objects that move in and out of occlusion, we conclude that moving object studies inform us about representation in the cortical systems underlying action, but by themselves provide only limited information about higher level representation (explicit, conceptual representation) in infants. This suggests that the behavior of infants in certain situations will appear erratic or inappropriate because they lack cognitive processes that integrate knowledge from all levels when reasoning and solving more complex problems.

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REFERENCES


I. Introduction

As adults we seamlessly and effortlessly carve nature at its joints. We group objects, entities, and events together into veridical and meaningful collections; we make inferences about the likely properties of those objects, entities, and events; we attach labels to them; and we appropriately generalize our knowledge to newly encountered instances. We can put together exemplars on the basis of their surface properties (e.g., things that are red) or their deeper,
nonobvious properties (e.g., things that have engines). We can infer what properties something may have based on our knowledge of similar things or those from the same category. We can quickly learn the label for objects or entities or for their actions, and we can apply information, either that acquired recently or further in the past, to novel objects and entities in the world. These processes, which often occur without any explicit awareness, reflect how our mental machinery has made sense of the world by representing the regularities and structure that exist in it.

But how do we, as adults, reach the point where we possess such knowledge and are able to apply it in a multitude of contexts? That is, what are the developmental means to this adult end-state? Perhaps nowhere in the developmental literature are such questions so fiercely debated, and so accessible to study, than in the ever growing database on infant perception and cognition. The study of infant cognition, and of concept formation for animate entities and inanimate objects in particular, provides a window into the very foundation of our adult mental processes and the mechanisms that underlie the way that we represent the world around us. Our aim in this chapter is to examine a number of these core issues by focusing on contemporary research on early object category and concept formation, and in particular on research on infants’ developing understanding of the properties of animates (e.g., people, animals) and inanimates (e.g., tools, furniture). Although this field has always been central in the study of infant cognition, at the start of the 21st century it enjoyed an upsurge in attention. For example, a number of peer review journals devoted entire special sections to discussions of early category and concept development (e.g., *Infancy, Journal of Cognition and Development*), and meetings of scientific societies (e.g., SRCD, ICIS) were marked by a number of symposia focused on new findings and theories. In this chapter we outline a number of the most prominent and thorny questions and issues in the field and show how the answers to these questions and issues have wide reaching significance to development and cognition in general.

### II. Definitions and Implications: What is Categorization? What are Concepts? What Broader Issues Apply?

The ability to group things together, or categorize, is among the most primary cognitive processes that underlies, among other things, language, problem solving, induction, and memory. Categorization is the process whereby discriminable properties, objects, or events are grouped into classes by means of some principle or rule. Concepts are the mentally stored depictions that represent the commonalities and structure that exist among items within categories. In one sense, then, categories can be defined as collections of things
in the world whereas concepts can be defined as the internal mental representation of those collections (Margolis, 1994; Smith, 1995). Note that the ability to categorize is not the same as the ability to discriminate or differentiate. The former refers to the case in which a number of exemplars are involved (e.g., treating a number of animals as equivalent and as different from a number of vehicles) whereas the latter refers to the case in which only two exemplars are involved (e.g., treating a car as different from a truck).

Beginning in the 1990s, the study of infant category and concept formation for animate entities and inanimate objects became one of the primary battlegrounds for a number of fundamental issues for developmental and cognitive psychologists, and more generally for the multidisciplinary approach taken by cognitive science. Most notably, the long-debated question of the relative influence of nature (i.e., innate structure and content) and that of nurture (i.e., experience) has received a good deal of attention in the literature, with researchers presenting radically different theoretical views. Various theorists have suggested that infants are endowed with innate modules (Leslie, 1995), inherent skeletal principles (Gelman, 1990), or specialized abstraction processes (Mandler, 1992) that, in one way or another, are essential for the acquisition of concepts and categories for animates and inanimates. In contrast, a number of theorists have argued that (a) infants’ ability to learn about the objects and entities in the world is grounded in domain-general processes such as associative learning, and (b) constraints on learning in this or any particular domain emerge as a result of experience with a naturally structured input (e.g., Jones & Smith, 1993; Oakes & Madole, 2003; Quinn & Eimas, 1997, 2000).

A second major theme that is central to the field relates to the nature of the developmental trajectory of category and concept development, or more specifically, whether developmental change in infants’ categories and concepts is intrinsically discontinuous or continuous. Again there are two radically divergent views on this issue, which perhaps have been most clearly and fiercely disputed in the context of what is known as the “perceptual to conceptual shift.” This term refers to the phenomenon whereby younger infants and toddlers tend to use surface properties to categorize (e.g., object parts, color, shape) whereas older infants and preschoolers tend to rely on nonobvious properties to categorize (e.g., has a heart, is self-propelled). According to one theoretical view this developmental change is indeed a shift—in the Piagetian stage-like sense—with infants and preschoolers forming concepts in fundamentally different ways and relying on fundamentally different processes before and after its occurrence (e.g., Gelman & Markman, 1987; Keil, 1989). In contrast, others have proposed that the same cognitive mechanism or mechanisms are sufficient to account for category and concept formation before and after the apparent “shift” from one kind of information to another. According to this view, category and concept development is best thought of as a process of continuous enrichment rather than
of discontinuous change (e.g., Eimas, 1994; Mareschal, 2003; Quinn & Eimas, 1997; Rakison, 2003a,b,c; Smith, Yoshida, & Colunga, 2003).

Another theme that is fundamental to the field and that is applicable to development in general relates to the mechanism(s) underlying category and concept formation. The term mechanism is used here to refer to the mental processes that allow or cause developmental change (see Siegler, 1996). Although this theme overlaps somewhat with the two presented previously, a specific focus on the mechanism underlying change is commonly absent from discussions of conceptual development. For example, the “perceptual to conceptual shift” is often debated in terms of whether it involves continuous or discontinuous change but the mechanism(s) that cause or bring about this change are often vague or, worse still, ignored. Perhaps in light of this issue, a number of researchers have begun to adopt a more mechanistic approach to conceptual development (e.g., Leslie, 1995; Mandler, 1992; Oakes & Madole, 2003; Rakison, 2003a); however we will show in the following sections that these researchers diverge considerably in their view of the mechanistic underpinnings of conceptual change.

One of the aims of this chapter is to address these themes in the context of research on early category and concept formation and on inductive inference for animate entities and inanimate objects. As such, one of the main goals is to provide insight into some of the most enduring and knotty issues in development and cognition. A second and very much related goal is to review the empirical evidence to address the issue highlighted by the title of the chapter; that is, what mechanism(s) underlie infants’ concept acquisition for things in the world and what are the bases for categorization and induction in the first years of life? As the title of the chapter suggests, there is more than one plausible answer to these questions, and these answers stem in many ways from the diverse theoretical views held by those in the field. These views are presented in Section III.

III. Theoretical Approaches to Category and Concept Development in Infancy

The proliferation of research on early category and concept development emerged hand-in-hand with a number of plausible and well-presented theoretical approaches. These theories, which tend to focus on the early development of categories and concepts that relate to the animate–inanimate distinction, can be organized roughly into two groups.

Theorists who fall into the first of these groups—which we shall label “The Smart Infant view”—support the position that infants possess some kind of innate structure that is specific to category and concept formation for objects
and facilitates learning in that domain. According to the theorists in this group, these innate processes or structures allow relatively young infants to learn about the surface properties of objects and entities as well as some of their less obvious properties, such as those relating to motion. As a consequence of this rapid conceptual development, it is posited that the basis for categorization is often such less obvious properties (e.g., these things go together because they are self-propelled) rather than surface features (e.g., these things go together because they have the same shape). This reliance on nonobvious properties is regarded as a preferable end-state because, it is argued, perceptual features are unreliable and even misleading as the basis for category membership decisions (Medin & Ortony, 1989). Perceptual similarity is thought to be misleading because it is unstable in the sense that the aspect of similarity to which adults and children attend depends on context (Barsalou, 1989; Jones & Smith, 1993); for instance, kittens might be considered more like lions in one context and more like puppies in another. Thus, although perceptual similarity may be an indicator of category membership, it is suggested that objects are judged to be members of a larger category by virtue of qualities that are invariably not perceptual but rather because of some common essence that defines them as “the same kind of thing” (Medin & Ortony, 1989; see also Brown, 1989; Rips, 1989).

Theorists who fall into the second group—which we shall label “The Dumb Infant view”—contend that specialized innate processes are unnecessary for category and concept formation for objects and entities. Broadly construed, they suggest that domain-general processes coupled with a sensitive perceptual system are sufficient for infants to learn about both surface and nonobvious properties. According to this view, infants are able to form categories and use induction in ways that give the appearance of a swiftly developing conceptual system but in many cases the actual bases for these behaviors are relatively simple surface properties.

As is perhaps clear, these theoretical distinctions are at the very heart of the debate on the nature of early concepts and the basis of early categorization, and, therefore, we outline them in greater detail in the next few pages.

A. THE SMART INFANT VIEW

A number of theorists have proposed that innate processes or structures allow infants to form concepts of objects that include information about nonobvious properties such as movement capabilities (e.g., agency, self-propulsion), psychological properties (e.g., goal-directed action), or sources of energy (e.g., Leslie, 1995; Mandler, 1992; Gelman, 1990; Premack, 1990). Although the specifics of these theories differ considerably, they have in common an emphasis on the precociousness of infants as category and concept formers; that is, they
share the view that infants rapidly acquire and use knowledge about the surface and nonobvious properties of objects and entities.

Among the most nativist of these views is perhaps that forwarded by Leslie (1984, 1988, 1995). Leslie proposed that infants are born with three modules that, in conjunction, allow infants rapidly to develop an understanding of the properties of animates and inanimates. In particular, Leslie argued that one module processes the physical or mechanical properties of objects and entities, another processes their psychological or intentional properties, and a third processes their cognitive properties. Infants, according to Leslie, consequently develop knowledge of a three-part theory of Agency—by which is meant an enduring property of things rather than simply the cause of an action—such that different brain mechanisms process, attend to, and interpret, certain events in certain ways. For example, the mechanical module interprets action through a theory of body, whereby a physical feature (e.g., a hand reaching for a ball) will be viewed as having an internal and renewable source of energy or force. The intentionality module interprets action through a theory of mind mechanism, which interprets motion toward an object as involving a goal or intentions on the part of the agent.

Although Leslie’s theory is elegant and detailed, there are both empirical and theoretical concerns with it as it stands. First, there is little direct evidence that infants possess innate modules to deal with distinct kinds of information, and a number of studies could be interpreted as evidence against a nativist view of causal perception (e.g., Oakes & Cohen, 1990; Woodward, 1998). For example, research by Oakes and Cohen (1990, 1995) suggests that 7-month-olds do not perceive causality and that 10-month-olds’ successful perception of causal events is contingent on the stimuli involved, which could be interpreted to mean that causal perception is context dependent and emerges as a result of experience. Second, it remains an open question how an appropriate module is “triggered” by the same type of input. Lastly, the need to posit specific mental structures that divide up and deal with physical, psychological, and cognitive aspects of the world seems unparsimonious (Rakison & Poulin-Dubois, 2001).

A related, though less modular, view of concept development for animates and inanimates has been forwarded by Rochel Gelman (Gelman, 1990; Gelman, Durgin, & Kaufman, 1995). Gelman proposed that infants are born with innate skeletal causal principles that facilitate discrimination of animate entities from inanimate objects. These skeletal principles allow infants to develop conceptual schemes for objects and entities by guiding attention to aspects of their motion and composition. Importantly, however, Gelman reasoned that motion cues are often vague and sometimes even deceptive (e.g., a rolling ball that makes another ball move could be interpreted as an animate agent). She therefore proposed that infants also develop conceptual schemes for the energy sources and materials of objects that relate to motion and composition. Again, however, there is little
experimental evidence that infants possess innate principles that allow them to process the different properties of animates and inanimates.

Perhaps the most influential and comprehensive theory of category and concept development that has at its core the notion of an innate specialized process is that forwarded by Mandler (1992, 1998, 2000, 2003). According to Mandler, the earliest categories are formed on the basis of the surface appearance of things and are represented in terms of a perceptual prototype. However, Mandler suggests that by around 12 months of age, infants categorize objects together because of a shared meaning. For example, at 3 months of age infants will categorize as equivalent various cats because of their surface features (Eimas & Quinn, 1994) but by the end of the first year of life infants will group together the same cats because of an understanding that they are self-propelled entities that can act as agents. Conceptual categories, according to Mandler, are based on image-schemas, or conceptual primitives, that summarize crucial characteristics of objects’ spatial structure and movement. These image-schemas are constructed through an innate specialized process called perceptual analysis that recodes the perceptual display into an abstract and accessible construct (Mandler, 1992): Image schemas that encapsulate animate entities include self-motion, nonlinear motion, and the ability to cause action at a distance, whereas those that encapsulate inanimate objects involve caused-motion, linear motion, and caused motion through contact. Thus, it is argued that “what holds a class such as animals together so that membership can be assigned to it is neither overall perceptual similarity nor common perceptual features, but instead a notion of common kind” (Mandler & McDonough, 1996, p. 314). This is not to say, however, that infants use only deeper, nonobvious properties in category membership decisions. Instead, Mandler suggests two separate but connected processes in categorization. During perceptual categorization an object or entity is recognized by its surface appearance and during conceptual categorization the same object or entity is classified because of its nonobservable properties (e.g., motion characteristics, category relatedness).

Although Mandler’s view of concept and category development has been prominent in the field, at this juncture some important theoretical challenges are worth noting. First, a number of theorists have suggested that Mandler does not specify in sufficient detail how perceptual analysis might operate (Quinn & Eimas, 2000; Rakison, 2003a). Although these theorists agree that infants’ ability to represent the movement patterns of objects and entities is fundamental in early concept formation, it is unclear how perceptual analysis abstracts this information into a simpler, more available form or how it might differ from perceptual categorization of movement patterns (Quinn & Eimas, 2000; Rakison, 2003a). Second, it has been argued that it is unparsimonious to posit distinct representational mechanisms that deal separately with perceptual and conceptual categorization as well as processes or mechanisms that connect...
the two of them (Quinn, et al., 2000; Quinn & Eimas, 2000; Rakison & Poulin-Dubois, 2001). Although it is clearly not always the case that “simpler is better,” such a proposal does seem to put an unduly heavy encumbrance on the representational system. And, as the next section will illustrate, a number of researchers have suggested that a somewhat more straightforward solution will do the representational job.

B. THE DUMB INFANT VIEW

In considerable contrast to the theoretical positions presented by Leslie, Gelman, Mandler, and others, a number of researchers have proposed that domain-general learning processes are sufficiently powerful to support infants’ category and concept acquisition (e.g., Jones & Smith, 1993; Oakes & Madole, 2003; Quinn & Eimas, 1996a, 1997; Rakison & Poulin-Dubois, 2001). According to this view, early concept acquisition is a process of continuous representational enrichment that relies on a sensitive perceptual system and an associative learning mechanism. Again the specifics of the different theories that fit this description vary to some extent; yet they all have in common a focus on the perceptual properties of objects and the idea that infants’ concepts for animates and inanimates are formed considerably more slowly than it may appear from the available empirical evidence.

One of the first advocates of this more perceptually oriented view was Linda Smith (Jones & Smith, 1993; Smith, 2000; Smith, Colunga, & Yoshida, 2003; Smith & Heise, 1992). Smith and Heise (1992), for example, suggested that experience with correlations in the world leads infants to attend to the features that are a part of those correlations. As a consequence, infants do not need innate mechanisms to direct them to the relevant physical, psychological, or cognitive aspects of animates and inanimates but instead they develop a structured similarity space that is biased toward particular features and correlations of features (see also Nosofsky, 1986). The basic idea of a similarity space is that as changes occur in the perceived similarity of features of things so those features are representationally drawn together or stretched apart: Attention to shape over texture causes the representational space for shape to become closer while at the same time creating distance in the representational space for texture.

Although the attention processes involved—called dumb attention mechanisms (Smith, Jones, & Landau, 1996)—are nonstrategic they become selective through experience and lead infants to use ever more sophisticated and detailed levels of perceptual information to form categories. Smith’s extensive work on label extension suggests that shape, texture, and even features such as eyes are used by toddlers to generalize a novel label to a novel object (e.g., Smith et al., 1996; Landau, Smith, & Jones, 1988, 1998). Thus, “the dynamics of the similarity
space both change and increase [italics in original] as the child learns to represent the regularities that exist between how words are used, the co-occurrences of properties in objects, and the act of attending to particular properties“ (p. 132). The specific mechanism by which these correlations are represented is associative learning, with categories emerging from correlational bundles of features in the world (Smith & Heise, 1992; Smith et al., 2003). Jones and Smith (1993) extended this view by arguing that the fact that surface features are used differently in different contexts should not be thought of as a weakness—as is the general view taken by those in the Smart Infant camp—but rather should be considered as a strength. In other words, perceptual information (as well as other kinds of information) is dynamic and flexible and can be applied appropriately in distinct situations (Jones & Smith, 1993; see also Smith (2000) and Thelen & Smith (1994)).

Oakes and Madole (1999, 2003) have also proposed that the similarity space becomes more structured over time and that context is an important aspect of early category and concept formation, though they stress that the processes underlying category formation change little if at all during development. More specifically, Oakes and Madole (2003) proposed a principled, three-part developmental trajectory in infants’ categorization abilities. First, infants’ general development in cognitive, motor, and linguistic skills allows them access to an increasingly wide range of features on which to base their category membership decisions. Second, with development infants have access to information in a broader set of contexts and with their improving cognitive skills they are better able to take advantage of this information. Third, over time infants increase their background knowledge about the likely and plausible relations that exist among features, and they use this knowledge to determine which features predict category membership.

A related perceptual account for category and concept development, but one that focuses more specifically on the earliest concepts for objects and entities, has been presented forcefully by Quinn and Eimas (Eimas, 1994; Quinn & Eimas, 1996a, 1997, 2000). They too suggest that concept acquisition is a process of continuous representational enrichment that relies on a sensitive perceptual system that is robust enough to allow infants to form categories that cohere because of similarity relations. Thus, young infants categorize on the basis of object attributes such as, for example, shape and texture (e.g., Jones, Smith, & Landau, 1991; Jones & Smith, 1993), functional parts (e.g., Rakison & Cohen, 1999), or facial features (e.g., Quinn & Eimas, 1996b).

According to this view, the development of language allows the acquisition of knowledge about the nonobservable characteristics of objects—in particular, biological functions such as reproduction and other internal properties—through formal and informal tuition. In other words, language functions “as an input system that can serve as a rich source of information about objects that may not
often, or even ever, be immediately apparent through looking, hearing, touching, and tasting” (Quinn & Eimas, 2000, p. 57). This leads, ultimately, to a representation for animals that includes shape, texture, facial features, and less obvious, nonobservable properties. In other words, infants continuously add associative links between their earliest perceptual schemas and newly encountered information. Infants may associate “chases mice” and “meows” with the perceptual category of cats, and ultimately this process will lead to the ability to form conceptually coherent categories that are based not on what something looks like but rather on what it is. Quinn and Eimas also propose that infants acquire knowledge about the motion characteristics of objects—which are thought by many to be important in developing an animate—inanimate distinction (e.g., Gelman, 1990; Mandler, 1992; Rakison & Poulin-Dubois, 2001)—through the same processes; yet this inclusion of dynamic cues into representations that involve predominantly static ones has yet to be described in any detail other than as “abstraction” (Eimas, 1994, p. 87).

C. SUMMARY OF THE TWO VIEWS

In our view, both of the theoretical camps outlined in this section have considerable strengths and weakness; but at the present time neither camp fully describes or explains how infants develop concepts and categories for animates and inanimates that include the static, surface features of objects (e.g., facial features) as well as their more dynamic, often less observable features (e.g., the ability for self-generated motion). Those who fall in the camp described under the Smart Infant view, although endeavoring to explain how infants learn about less observable features of objects and things, lack explicit evidence to support the view that specialized processes for category and concept formation are necessary or even viable. Those who fall in the camp described under the Dumb Infant view account well for how infants learn about the static features of things in the world but have thus far failed to address, both theoretically and empirically, how less perceptually available information is acquired. In our view, what is therefore needed is an account that provides a parsimonious and plausible approach for infants’ early category and concept development that includes a detailed explanation for the acquisition of static as well as dynamic cues. To this end, our theoretical position is very much in line with that forwarded by Smith, Eimas, Quinn, and others, yet we explicitly focus on the acquisition of properties that are available only intermittently in the perceptual array. In Section IV we briefly outline this theoretical view, after which we provide evidence to support our position from studies on categorization and induction with infants and preschoolers.
IV. Bridging the Gap: A Domain-General Approach of the Representation of Perceptual and Nonobvious Information in Infancy

In previous work, the first author (Rakison, 2003a; Rakison & Poulin-Dubois, 2001; 2002) has presented a framework of early concept development that is in the spirit of those who are described in the Dumb Infant view but that has as its focus the motion and psychological characteristics of animate entities and inanimate objects. As with Oakes and Madole (2003), Rakison suggested that infants learn about the static and dynamic aspects of animates and inanimates due to a developing perceptual sensitivity to different kinds of information and developing cognitive ability to encode such information. As with Quinn and Eimas (1997), it was suggested that concept acquisition is a process of continuous representational enrichment. And as with Smith and colleagues (Jones & Smith, 1993; Smith et al., 2003; see also Quinn & Eimas, 1997), it was suggested that the primary mechanism underlying this process is associative learning whereby correlations from a structured input are represented.

More generally, Rakison (2003a) proposed that associative learning together with a finely tuned perceptual system allows infants to detect and encode static and dynamic features and relations among features. Initially these relations will involve only surface properties of objects such as, for example, the perceptual appearance of arms and hands. Later, however, as more complex information (e.g., dynamic cues) becomes available to the perceptual system and the representational system becomes able to encode such information, these relations will include intermittently available information such as those relating to motion. This latter represented associative link may be thought of as the preliminary development of a meaning about an object or its attributes; objects that were categorized as equivalent because of shared surface properties (e.g., things with wings belong together) come to be categorized as equivalent because of less obvious properties (e.g., things that fly belong together). With the addition of other perhaps less causally relevant features to this initial relation, and later with the emergence of labeling, the associative link expands to include a whole host of features as well as whole objects and categories of objects. Nonetheless, this broad range of represented information need not be thought of as “nonobvious” versus “perceptual”; instead, obvious and nonobvious aspects of objects and entities are associated by the same mechanism and are represented in the same way.

This framework has clear similarities, as already stated, to those who support the Dumb Infant view. However, we believe that this view also differs from previous formulations in a number of important ways. First, we adopt the view that early representations are able to support inferences about information that is not directly available in the input. According to Quinn and Eimas (1997),
early perceptual categorization involves detailed information but, “does not include inferential information unavailable to the perceptual system” (p. 273) whereas later so-called conceptual representations are informative about object kinds and therefore “support numerous inferences about the nature and behavior of the thing represented” (p. 273). Thus, although it is agreed that the basic processes underlying early category and concept formation remain constant, there is debate about the nature and function of initial and later representations.

Our stance is that even very early representations are capable of supporting some kind of inferences about the properties of objects that are not necessarily available in the input (Rakison, in press; Rakison & Poulin-Dubois, 2002). Thus it is suggested that infants’ ability to detect and encode dynamic as well as static feature correlations leads to a representation of an associative link that allows expectations about one component of the link based on the perception of the other component (Rakison, 2003a, in press). If infants learn that things with wings have feathers and they observe an object with wings, they will expect it also to have feathers. Likewise, if infants learn that things with wings fly they will expect flying things to have wings and things that have wings to fly. In some cases these expectations will be incorrect—after all some things that fly that do not have wings (e.g., helicopters)—but in general they will allow for accurate inferences about the properties of things. A corollary of this view is that early knowledge of “nonobvious” properties—those not constantly available in the input when an object is experienced—is similar or even identical in structure to early knowledge of objects’ surface properties. Thus, according to this view, infants’ early knowledge about the motion properties of, for example, animals is not in the form of an abstract concept of animacy (Gelman, 1990; Mandler, 1992) but instead a specific motion property is representationally associated with a specific perceptual feature.

The view presented here also extends previous views that fall within the Dumb Infant view because it is proposed that infants possess a number of general attention biases, though they could just as easily be called constraints or learning enablers, which help to guide attention to important or relevant information (see also Quinn & Eimas, 1997). Elsewhere, Rakison (2003a) suggested that these attention biases are sensitive to motion, relative size (with larger objects and features attracting attention more than smaller objects and features), and object features. In all likelihood, infants possess a number of other such attention biases—such as a preference for high contrast over low contrast and complex stimuli over simple ones—that, at least early on in development, means that not all information in the array is equally salient. We suggest that these preferences are psychological adaptations that evolved to allow infants to extract quickly and efficiently the significant aspects of the world available among the myriad of information that is presented to them. For example, infants who are not sensitive
to dynamic cues, object features, and high contrast would be unlikely to be attracted and interested in human faces, and they would not reap the early social and cognitive benefits of early interaction with a caregiver. One could argue that such a view is consistent with the Smart Infant view because, after all, we are suggesting that infants have a number of innate predispositions that play an important role in developing a veridical representation of the world. However, we suggest that these biases have not evolved specifically to support infants’ category and concept development but rather they are general biases that are co-opted by the representational system (e.g., a bias to attend to motion is a common component of predator and prey detection mechanisms).

In relation to concept and category development of animates and inanimates, we suggest that attention biases play a primary role by focusing infants to the causally relevant information that differentiates animates from inanimates. In general, an animate entity’s dynamic features (e.g., legs) tend to move when that entity engages in a motion typical of, and specific to, animates; in contrast inanimate objects, even those with dynamic features (e.g., a clock’s hands), do not tend to exhibit such relations. To be more specific, things with dynamic features such as legs, arms, and faces tend to act as agents, are self-propelled, are goal-directed, and so on, and the movement of specific features co-occurs with these more global motions. In contrast, things without such dynamic features (e.g., soda cans, books) tend to be recipients of an action, are caused to move, and are not goal-directed, and the movement of any specific feature is not generally related to this global motion. For example, typical agents in a causal event that infants may encounter include mammals and people, both of whose legs will generally be in motion as the exemplar acts as an agent. The same cannot be said of plants, furniture, or tools.

Thus, we suggest that a heightened sensitivity to dynamic features, along with an associative learning mechanism, could in principle account for how infants learn about the motion properties (and perhaps the psychological properties) of things in the world. Importantly, the same mechanism can also account for learning in nonanimacy contexts, such as when preschoolers learn that placing a block on a machine makes that machine function (Gopnik & Sobel, 2000). Associative learning is hence constrained in the sense that infants initially attend to some features and their correlations and ignore others. The presence of these attention biases means that not all information available in the perceptual array is equally salient to infants, and consequently the theory presented here is not undermined by the argument of Original Sim (Keil, 1981), which is often levied at so-called similarity-based views. This argument, generally, is that because so many features are available in the environment it is impossible to know a-priori which ones are significant for category membership and which are not. For instance, why is it that features such as wheels or engines are more important to our notion of “car” than the features “shiny” or “has lights”? We believe that the
framework presented here overcomes this argument and offers a plausible account for how infants learn about surfaces properties as well as less obvious ones such as those involved in motion.

Finally, the view presented here differs from previous Dumb Infant formulations because it leads to specific claims about categorization and induction later in childhood. Recall that, according to the Smart Infant view, the use of deeper nonobvious properties in category membership decisions is a preferable end-state because perceptual similarity is thought to be misleading; that is, it is unstable and context dependent, among other things. According to some researchers, preschoolers and adults have an essentialist bias such that they believe that objects of a category share some sort of common essence that makes them the “the same kind of thing” (Medin & Ortony, 1989; Gelman, 2003). Evidence taken to support this view comes from a number of sources. In a classic study, Keil (1989; see also Rips, 1989) presented children with stories in which various objects underwent a transformation such that their appearance changed but their nonobvious properties remained intact. For example, in one story children were told that scientists shaved and painted a raccoon so that it looked like a skunk but still possessed the internal properties of a raccoon (e.g., blood, bones, reproductive properties). By around 4 years of age, children labeled transformed objects in accordance with their nonobvious properties rather than their perceptual appearance. Similarly, Susan Gelman and her colleagues (e.g., Davidson & Gelman, 1990; Gelman & Coley, 1990; Gelman, Collman, & Maccoby, 1986; Gelman & Markman, 1986, 1987) demonstrated that conceptual properties override perceptual appearance in children’s category inductions. For example, when shown a picture of a bird, preschool-age children are more likely to infer that it shares a given nonobvious property (e.g., eats bugs) with a perceptually distinct object that is also called a bird than an object that is similar in appearance but that is called a bat.

The view presented here offers a somewhat different interpretation of the representations underlying children’s behavior. As outlined previously, concepts for objects are posited to be based on associative links between object features, functions, actions, and so on. The strength of these links will be a direct consequence of the exemplars experienced. Young infants rely on surface properties because they have experience with those properties and have learned that they are good—though not perfect—predictors of category membership; for example, most dogs, but not all dogs, have tails. These infants have little option, however, when they have to use their knowledge about objects; all they have represented are the static surface properties of things. In contrast, older infants and preschoolers, who have learned about objects’ motion capabilities (see Section V) and later about biological or internal properties, will have access to other information in category membership decisions. Unlike surface features, those properties related to motion, biology, and psychology tend to
be perfectly correlated with category membership; all animates are self-propelled, are alive, and are goal-directed. Thus, if children in category induction tasks are asked to choose between surface properties on the one hand and motion-related, biological, or psychological properties on the other hand, they will choose the one that they know is more highly correlated with category membership. This is not to say that surface features are poor predictors of what kind of thing an object is or that they are not used in everyday decisions about category inductions. In our view, surface properties continue to play a primary role in such inductions. However, when surface cues are pitted against nonobvious properties—as they often are in the studies by Keil, Gelman, and others—children will rely on the cues or properties for which the associative link is stronger.

We believe that this explanation of the processes underlying preschooler’s behavior is very much in line with Siegler’s (1996) influential theory of overlapping waves in conceptual change. Such change is not characterized in terms of one representational content or structure replacing another; instead, it is that new strategies (or in this case associative links) develop and contend with those that are already established.

Thus far, we have discussed the theoretical framework with little reference to empirical evidence. In the sections that follow we outline research with infants and preschoolers that employed a variety of methods and that speaks directly to the issues discussed in this section: What is the basis for categorization in infants and preschoolers? Can early representations support inferences about object properties? What evidence is there for attention biases in infancy? And can associative learning, in conjunction with these biases, explain how infants learn about the motion properties of objects?

V. Empirical Evidence

The first issue to be addressed here concerns the basis for categorization and induction in infancy and beyond. Recall that according to the Smart Infant view, early categorization is thought to be grounded not in the surface properties of objects but instead in the meaning of an object (Mandler, 1992, 1998, 2003); that is, what “kind of thing” it is. A corollary of this view is that older children rely on nonobvious properties, such as those relating to internal biological properties, rather than perceptual surface features (Gelman, 2003). Here we outline research with infants and preschoolers that suggests that not only are surface features important in early categorization but that they may continue to play an important role throughout the lifespan.
A. THE BASIS OF CATEGORIZATION IN INFANCY

According to the seminal work of Eleanor Rosch and Carolyn Mervis, categories are structurally organized in a hierarchy with three levels called basic, superordinate, and subordinate (Rosch, et al., 1976; Rosch, 1978; Mervis & Rosch, 1981). Rosch (1978) referred to these domains as taxonomic categories by which she meant that they are “related to one another by means of class inclusion” (p. 27). The basic level, which Rosch claimed were the first conceptual—that is, mentally represented—categories to develop, maximizes within-category similarity and between-category dissimilarity (e.g., car, boat, bed, table, dog). Thus, instances from a single basic-level category are alike in many ways (e.g., form, function, structure) and are very different from other basic-level category types. At the superordinate level objects within a category are relatively diverse and therefore perceptually dissimilar (e.g., cars, planes, and boats within the superordinate category of vehicles), and are quite different from members of other superordinate categories. Hence, the superordinate level is thought to be minimally dependent on perceptual similarity and maximizes between-category differences.

Among these levels of categories, the basic level is proposed to be psychologically privileged. Children’s first object words are often at the basic level and when asked to name pictures of objects 3-year-olds tend to use those at the basic level rather than any other (Anglin, 1977; Clark, 1973; Rosch et al., 1976). Adult labeling is also consistent with this pattern such that naming occurs more frequently at the basic level (e.g., frog) than the superordinate-level (e.g., amphibian) or the subordinate level (e.g., tree frog). The ubiquity of basic level labels was initially supported by research on early categorization: In sorting and match-to-sample studies in which children were asked to put objects that are alike together, 3-, 5-, and 6-year-olds sorted poorly at the superordinate level but performed almost perfectly at the basic level (Rosch et al., 1976), whereas infants as young as 22 months made basic level matches more easily than superordinate matches (Daehler, Leonardo, & Butkatko, 1979). These findings led researchers to believe that children form categories at the basic level (e.g., lions versus pigs) before they form categories based on superordinate groups (e.g., animals versus vehicles) (e.g., Daehler et al., 1979; Mervis & Rosch, 1981; Rosch et al., 1976). Basic level categorization was thought to be particularly easy for children because exemplars belonging to the same basic level category are highly similar to one another (e.g., dogs share many perceptual features with one another) and at the same time differ substantially from members of neighboring categories (e.g., dogs and horses look different).

An alternative view of categorization, one that gained favor in subsequent years, was posited by Mandler and her colleagues (Mandler, Bauer, & McDonough, 1991; Mandler & McDonough, 1993). According to this approach,
superordinate, or *global* categories, are formed before basic level categories. In one study, Mandler and Bauer (1988) presented 16- and 20-month-old infants with basic level contrasts from either a single superordinate domain (e.g., dogs and horses) or from distinct superordinate categories (e.g., dogs and cars). Categorization was assessed through sequential touching, a measure that reveals category formation through the systematicity of children’s successive touches (Mandler, Fivush, & Reznick, 1987). Infants at both ages were successful in forming categories based on different superordinate domains, that is, they categorized dogs as different from cars. In contrast, only the 20-month-olds formed basic level categories within the same superordinate domain, that is, by categorizing dogs as different from horses. The results, then, reveal a global-to-specific trend in categorization—one that opposes the view that children initially categorize at the basic level before the superordinate level.

Although the primacy of the superordinate level has become less of a controversial issue, the factors responsible for early global categorization are still a matter of contention. As discussed earlier, the position held by those supporting the Smart Infant view is that global categories are based on conceptual knowledge of nonobvious properties (e.g., animacy, support). The argument made is that members of a superordinate category share few perceptual properties but they do share a number of deeper nonobvious properties. Consequently, if infants group together a diverse set of superordinate members this cannot be done on the basis of perceptual features and must instead be based on their nonobvious properties. For example, rabbits, giraffes, parrots, and whales do not share many perceptual features but they are all self-propelled agents that are goal-directed. In this sense, categorization is thought to be driven by knowledge of the “kinds of things” objects are (Mandler & McDonough, 1993).

An alternative framework—one suggested here—is that perceptual features may be sufficient to explain early global-level categorization. Rakison and Butterworth (1998), for example, argued that infants’ superordinate categorization could be explained by attention to one or more object features. Although members of superordinate categories typically possess different features they also often share a few important features, and exemplars of two basic level categories from within the same superordinate category generally share the same features. That is, infants might successfully categorize animals as different from vehicles or cars and different from dogs *not* because they have knowledge of category relations that exist among animals or among vehicles or of the deeper properties of the objects within these categories but rather because all the dogs have legs and all the cars have wheels. Along the same lines, children’s failure to categorize at the basic level may be attributable to the fact that both dogs and horses have legs.

Support for this interpretation was garnered from a series of studies employing the sequential touching technique (Rakison & Butterworth, 1998). In an initial study, 14-, 18-, and 22-month-old infants were presented with two kinds of
superordinate contrasts (Rakison & Butterworth, 1998, Experiment 1). In one kind, infants were presented with two categories of objects that shared a single large feature, for example, they were presented with varied animal exemplars and varied furniture exemplars, which all possessed legs. In the other kind of contrast, infants were presented with two categories of objects that were characterized by different parts, for example, they were presented with varied animal exemplars that possessed legs and varied vehicle exemplars that possessed wheels. The results revealed that infants at each age successfully categorized the different-part contrasts, but only at 22 months were infants able categorize the same-part contrasts.

To examine further the importance of object features in categorization, in a second study the features of objects were manipulated so that they no longer confounded category membership (Rakison & Butterworth, 1998, Experiment 2). Infants at 14, 18, and 22 months of age were presented with objects in four conditions, each with animals and vehicles. In one trial, the objects possessed ordinary parts (e.g., cow with legs and bus with wheels); in a second trial, the object parts were eliminated (e.g., cow with no legs and bus with no wheels); in a third trial, the objects were endowed with both kinds of parts (e.g., cow with legs and wheels); and in a fourth trial, the objects were manipulated so that objects of the same category did not share the same parts (e.g., two animals with legs and no wheels and two with wheels and no legs). This final trial pitted category membership against part relations so that infants were presented with a choice to group together, for example, all of the animals or to group together objects from different superordinate categories that shared the same parts (e.g., vehicle with wheels and animal with wheels).

The results revealed that when object parts were left unmodified, infants at all three ages categorized the animals as distinct from the vehicles. However, when object parts were no longer indicative of category membership—the trial in which exemplars possessed no parts and the trial in which exemplars possessed both parts—infants failed to categorize the animals as different from the vehicles, which suggests that object parts have a critical effect on categorization. Stronger evidence for this claim was found in the trial in which object parts were pitted against category membership. At 14 and 18 months, infants categorized on the basis of parts, grouping together “things with legs” and “things with wheels” rather than categorizing animals as different from vehicles. At 22 months, infants failed to categorize systematically based on either parts or category membership. Together, these results suggest that until at least 22 months of age, perceptual features may be sufficient to explain infants’ ability to form categories at the superordinate level without positing the existence of conceptual knowledge.

Another possibility is that object parts play a singularly important role in categorization at the superordinate level because members of a single superordinate domain share few perceptual properties besides certain crucial features.
When within-category similarity is high, as in the case of basic level contrasts (e.g., cows and cars), object parts may no longer play a substantial role in categorization because exemplars of the same basic level category are generally similar perceptually (e.g., cows look like other cows). To address this issue, Rakison and Cohen (1999) investigated the role of object parts in infants’ categorization at the basic level using a procedure similar to that used by Rakison and Butterworth (1998, Experiment 2). Specifically, infants at 14, 18, and 22 months were presented with the same four conditions as those in Rakison and Butterworth (1998) except that basic level contrasts of cows and cars were used rather than the superordinate-level contrast of animals and vehicles.

The results indicated that infants at each age categorized the cows and cars as different when their parts were unmodified (e.g., cows with legs and cars with wheels). Yet when the parts were eliminated (e.g., cows without legs and cars without wheels), 14-month-olds failed to categorize the stimuli as different. Furthermore, when additional parts were added to the objects (e.g., cars and cows with both legs and wheels) only 22-month-old infants categorized successfully the stimuli as different. In the final task—when parts were pitted against category membership—infants at all three ages grouped objects based on category membership rather than parts, a finding that contrasts with infants’ reliance on object parts in superordinate categorization (Rakison & Butterworth, 1998). Together, the results suggest that within-category similarity impacts the extent to which children rely on a single object feature and that categorization of superordinate contrasts appears to be more heavily influenced by such single features than categorization at the basic level. Furthermore, infants’ tendency to categorize on the basis of object parts appears to diminish with age, such that by 18 months category membership may be characterized by a myriad of perceptual features rather than attention to a single cue alone.

In summary, the evidence suggests that information in the perceptual array plays a significant role in infants’ categorization. Object parts in particular seem to have a substantial impact on infants’ decisions about category membership. At the superordinate level, and to a lesser degree at the basic level, infants younger than 22 months sort objects on the basis of parts (e.g., things with legs versus things with wheels) rather than on the basis of category membership (e.g., things that are animals versus things that are vehicles). These findings suggest that perceptual information may be sufficient to account for early category formation; thus, the categories that infants form, at least in terms of the objects included in them, seem to imply a precocious knowledge of category relations or the deeper properties of objects but they may in fact be grounded in attention to relatively simple perceptual features. We propose that this evidence is at least suggestive that the roots of early categorization may lie in domain-general rather than domain-specific processes that are central to the Smart Infant view.
B. THE BASIS OF INDUCTION IN INFANCY

One of the fundamental purposes of concepts is to provide a basis for generalization. People can experience only a fraction of the entities, objects, features, and events in the world; we must therefore rely on inductive inference to determine how far to generalize a specific observation. The data presented in the previous section cast doubt over the role of abstracted knowledge in infants’ categorization at the superordinate and basic level. However, a significant database suggests that infants make inductive inferences on the basis of such knowledge.

1. Evidence for Conceptually Driven Induction

In a series of seminal papers Mandler and McDonough (1996, 1998b) used the inductive generalization technique to show that infants as young as 9–12 months of age understand that animals engage in certain actions (e.g., drinking from a cup) whereas vehicles engage in a set of distinct actions (e.g., starting with a key). The basic procedure in these studies is as follows. During a baseline phase infants are presented with two exemplars from different categories—for instance, a dog and car—and a prop that is relevant to one (or sometimes both) of the exemplars; for example, a bed. Infants are allowed to play spontaneously with the toys and prop and the toys are then withdrawn. An experimenter then introduces a novel model exemplar—for the bed it would be an animal such as a cat—and performs an appropriate action such as putting the exemplar in the bed while simultaneously making a congruent vocalization (e.g., “Night, night”). The model exemplar is then withdrawn and infants are presented with the prop and the two category exemplars from the baseline condition and are encouraged to repeat the observed action.

Mandler and McDonough (1996, 1998b) predicted that infants will generalize an action to the appropriate novel category exemplar if they understand that animate entities engage in certain actions and inanimate entities engage in different actions. In line with this prediction, Mandler and McDonough (1996) found that infants between 9 and 14 months of age generalized animate and inanimate properties to appropriate category exemplars, and they did so for prototypical (e.g., a car, a cow) and nonprototypical category members (e.g., an eagle, a plane). A later set of studies extended and supported these findings. Mandler and McDonough (1998b) modeled the same events as those used in the earlier studies but presented infants with two members of the same superordinate category (e.g., after seeing a dog go to bed, they were given a dog and a cat or a dog and a rabbit). It was predicted that if infants understand that animates go to bed they would imitate with both of the available exemplars. And indeed, infants were just as likely to repeat the action with the cat or the rabbit as the dog.
According to Mandler and McDonough (1998), Mandler (2003), even more compelling evidence for the idea that infants possess a conceptual understanding of the behaviors of animates and inanimates was produced in a comparison of domain-general and domain-specific actions. In one set of studies, Mandler and McDonough (1998b) tested infants with domain-general actions—those that are appropriate for both animals and vehicles (e.g., being washed or going into a building) and domain-specific actions (e.g., going to bed). The results showed that 14-month-olds generalized domain-general actions to both available exemplars (though infants tended first to imitate with the same category member as that used during the modeling phase) whereas they generalized the domain-specific actions only to the appropriate category members.

These findings were interpreted as support for the Smart Infant view. Specifically, Mandler and McDonough (1998b) claimed that:

Infants appear to have formed global concepts of animals and vehicles, and it is noteworthy that it is these broad concepts that control associations...Thus, conceptual control of inductive generalization begins early in life. There does not seem to be a period in which infants respond only on the basis of physical appearance or are restricted in their generalizations to objects that look alike. (pp. 230–231)

Thus they claimed that infants’ concepts of animals and vehicles guide the acquisition of further knowledge about the attributes and actions of objects. Infants, according to this view, form concepts for global categories very early in life and these concepts act as a representational core of sorts to which later knowledge is attached. These concepts are able to support inductive inference within the first year of life and allow infants to respond without reference to surface appearance.

2. Challenges to the Conceptual Induction Position

As stated earlier in the chapter, we agree with the basic idea that early concepts can support inductive inference. However, we have reason to question the empirical findings presented by Mandler and McDonough (1996, 1998b) as well as the theoretical implications that they draw from them. At an empirical level, it is unclear to what extent infants’ behavior was generated on-line and to what extent it was based on knowledge of the specific actions tested. If infants selectively produced the actions with the appropriate rather than inappropriate exemplar in the absence of any external cues this could be taken as compelling evidence that infants’ conceptual knowledge is driving their behavior in the task. However, infants tend to imitate actions only in the generalization phase following the experimenter’s demonstration and rarely perform those actions spontaneously in the baseline phase. We predict that adults or preschoolers, if placed in a similar situation, would on their own volition put the cup to the animal
or the key to the car in a form of symbolic play and would not have to rely on the experimenter’s demonstration.

Perhaps more troublesome, the appropriate object or objects in the generalization phase tend to share significant surface characteristics with the model exemplar (Rakison, 2003a). Infants’ choice might well have been guided, at least to some degree, by similarity between the model and one or more of the test exemplars. In other words, we suggest that when infants see an experimenter model an action with a specific category exemplar, particularly in cases in which they have no knowledge of that action, they imitate with the object or objects that they perceive as most similar to that exemplar. This would explain why infants use animals—including cats, rabbits, anteaters, fish, and birds—rather than vehicles when a dog is used to model drinking or going to bed and why they use vehicles—including trucks, buses, forklifts, motorcycles, and airplanes—when a car is used to model starting with a key or giving a child a ride. The animals and vehicles involved are certainly quite varied, but the animals are more similar to each other than they are to vehicles; fish and dogs do not share a great deal of similarity; but they are probably more similar than a dog and a truck.

There are two obvious objections to this claim. First, it is possible to interpret this argument to mean that infants should only choose the most similar exemplar to the model exemplar. According to Mandler (2003), the fact that infants in the study by Mandler and McDonough (1998b) imitate drinking from a cup with a cat or rabbit as often as a dog when the dog is a model means that “we must discard the perceptual matching explanation for these data” (Mandler, 2003, p. 111). However, the claim here is that infants will model with the exemplars that are seen to be similar to the model exemplar: cats and rabbits are considerably similar to dogs and therefore infants imitate actions with both when given the opportunity. A second objection relates to the findings of Mandler and McDonough (1998b): If infants rely on the perceptual appearance of the objects to generalize it could be argued that they should imitate with only the test animal or the test vehicle—depending on which was the model—in the domain-general tasks rather than both stimuli (as was found in the task). However, careful analysis of Mandler and McDonough’s (1998b) results reveal that infants’ first imitation was generally with the exemplar that was similar to the model, for example, if infants observed a car go into a building they would first make the other vehicle go into the building. That infants’ second action tended to be with the other test exemplar—an animal in the building example—suggests that they may have some knowledge about the action in question; however, their first action is potentially revealing about the role of similarity on their behavior in the task.

Importantly, we are not claiming that infants’ behavior is entirely driven by on-line perceptual matching and imitation. The point we want to make is that one must be cautious in making strong claims about the basis of infants’ inductive
inferences. They may be generated during the task without access to prior knowledge or they may be driven in part by perceptual matching and in part by such knowledge. And in cases in which infants rely on prior knowledge of the exemplars or actions in question, it remains to be seen whether the basis for induction is a more conceptually abstract notion that “animals drink” or “vehicles start with a key” or a specific represented relation such as “things with mouths drink” or “things with wheels start with a key.”

3. Evidence Against Conceptually Driven Induction

A number of studies with the generalized imitation paradigm subsequently addressed these issues (Rakison, 2003a,b; Rakison & Poulin-Dubois, 2000). That is, the studies were designed to assess the relative role of on-line performance and prior knowledge on infants’ inductive generalizations. The studies were also designed to examine infants’ developing knowledge of the motion properties of objects. Recall that according to the Smart Infant view, this knowledge develops early in life and is generally abstracted from the appearance of the objects; that is, infants are thought to develop a concept of animacy that encapsulates how things start to move, their path of motion, whether they act as agents and so on. However, few, if any studies have thus far examined directly how and when infants learn about such motion properties.

In the first set of studies to address this issue (Rakison, 2003a; Rakison & Poulin-Dubois, 2000), 14- and 18-month-old infants were tested with four motion events, two characteristic of animates (jumping over a block or going upstairs) and two characteristic of inanimates (jumping from one ramp to another or moving back and forth on a u-shaped ramp). In the experiment, infants were first presented with two exemplars from different superordinate categories (e.g., a cat and a truck) and the prop for one of these events (e.g., stairs), and they were allowed to interact with these objects in any way. Following this phase, the two exemplars were withdrawn and an experimenter modeled the action (e.g., going upstairs) with a prototypical exemplar (e.g., a dog). The initial data from these tasks suggested that 14- to 18-month-old infants have indeed started to develop knowledge about the motion capabilities of animals and vehicles. Infants in both age groups increased in their modeling of the events with the target exemplar (i.e., the appropriate category member) from baseline to generalization, suggesting that they had inferred that, for example, only animals move up stairs and only vehicles can jump over ramps. To address the issue of prior knowledge versus on-line behavior, in a second experiment the same events were presented to infants except that the exemplar from the incorrect category was used as the model; for example, the experimenter modeled the stairs event with a car rather than a dog. The rationale for this procedure was that if infants have concepts that embody the motion characteristics of animals and vehicles, they should take the action as the cue to repeat the event with the appropriate exemplar (e.g., a cat
goes upstairs). In contrast, if infants rely on perceptual similarity to generalize observed actions, they should repeat the event with the inappropriate exemplar (e.g., a truck moves upstairs). Somewhat surprisingly, a quite different pattern of results was found in this experiment than the first one. Infants in both age groups chose to model the events with an inappropriate exemplar—using the truck to go upstairs, for example—with the same regularity that they had used the appropriate exemplar in the first experiment.

It could be argued that infants have had relatively little experience with events such as “going upstairs” (although they are perhaps no more specific than “starts with a key”), and that in the absence of such knowledge infants applied a matching and imitation procedure to complete the tasks. To address this issue, the same procedure was used to test 14-month-old infants with more general motion characteristics (Rakison, 2003a; Rakison & Poulin-Dubois, 2000). Specifically, the studies examined infants’ knowledge of the path of motion of an object (i.e., linear versus nonlinear) and the causal role of an object in a simple causal event (i.e., agent versus recipient). Infants in one set of trials observed an object “rolling” or “hopping” and were encouraged to imitate with an animal or vehicle. In another set of trials the same infants observed one object making contact with another object which then moved away; in these trials infants were encouraged to replace the agent with a novel animal or novel vehicle, or they were encouraged to replace the recipient with a novel animal or novel vehicle. There were two independent groups of 14-month-olds in the experiment: One group of infants saw an experimenter model the events with an appropriate exemplar (e.g., a dog moving nonlinearly, a car acting as the recipient of an action) whereas infants in the second group saw an experimenter model the events with an inappropriate exemplar (e.g., a dog moving linearly, a car acting as the agent in a causal scene). In line with findings of the experiments with specific motion events, 14-month-old infants tended to imitate the general events with the exemplar that was similar to the model. If a dog was observed moving nonlinearly infants would imitate the motion with a rabbit rather than a truck but if a car was observed moving nonlinearly infants would imitate the motion with a truck rather than a rabbit (Rakison, 2003a).

These data suggest that the object with which infants chose to imitate was affected somewhat by the model exemplar. However, two related aspects of these findings need to be teased out. First, infants may have possessed some knowledge about the general and specific motion properties of different object kinds, but they could not disregard what they saw during the modeling phase. Thus, infants may have known, for example, that certain objects walk and certain objects roll but they could not inhibit responding with the test exemplar that was similar to the one seen during the modeling phase. Second, even if some component of infants’ behavior was driven by prior knowledge, what the content of this knowledge might be remains unclear.
A subsequent series of studies with a novel version of the inductive generalization task was performed to examine precisely these issues, as well as to explore further infants’ knowledge of motion properties and the basis for their inductions (Rakison, 2003b). Infants were tested with two simple motions that are characteristic of animates (walking and flying) and two simple motions that are characteristics of inanimates (rolling and flying). The animate motions were typified by nonlinear motion such that, whether on the ground or in the air, the motion of the model exemplar was in an up-and-down motion. Similarly, the inanimate motions were characterized by linear motion such that, again irrespective of the specific movement domain, the motion of the model exemplar was along a straight line.

The design of the studies was novel in that infants were given a choice of four objects rather than two with which to demonstrate the actions. The advantage of increasing the number of stimuli that are available is that it allows the experimenter to choose objects that are systematically related to the action or motion in question or to the model exemplar. For example, in the studies described here one of the available objects was from an appropriate superordinate domain and possessed the appropriate overall similarity and functional parts (i.e., same parts, same category). Thus, if the cat was the model the exemplar with the same parts and from the same category was a dog. A second test object was from an appropriate superordinate domain but it did not possess typical functional parts for the motion (i.e., different parts, same category). Thus, if the cat was the model the exemplar with different parts but from the same category was a dolphin. A third object was from an inappropriate superordinate domain for the action but it had the same appropriate parts for that action (i.e., same parts, different category). Thus, if the cat was the model the exemplar with the same parts but from a different category was a bed with four legs. A final object was neither from the appropriate superordinate domain nor did it possess appropriate functional parts for the motion (i.e., different parts, different category). Thus, if the cat was the model the exemplar with different parts and from a different category was a car.

Because this design allows researchers to examine more closely the basis for infants’ inductive generalization, we can make detailed predictions about infants’ behavior. According to the general theoretical model advocated by the Smart Infant view, infants’ inductive generalizations are supported by a concept of animacy and should not be connected to any specific feature or features. More specifically, Mandler and McDonough (1996, 1998b) argued that infants’ inductions in their tasks are guided not by physical appearance but instead by global concepts of animals and vehicles. This view leads to the prediction that infants in the studies described here should demonstrate motions with members of the appropriate category, that is, the same parts-same category and different parts-same category exemplars—regardless of their surface shape.
or features. In contrast, we have suggested that infants initially associate the motion of an object with the feature or features that conjointly are in motion and only later extend this association to objects that share with it other, less causally relevant features (e.g., eyes). This leads to the prediction that younger infants should demonstrate motions with the exemplars that possess the appropriate parts for a motion (e.g., legs in the case of nonlinear land motion: the same parts-same category and same parts-different category exemplars) and older infants should demonstrate motions with the exemplars from the appropriate category.

For ease of discussion, we focus on the results of the conditions in which land-based motions were modeled (i.e., nonlinear and linear movement in contact with a flat surface). Because no difference was found in infants’ behavior on the linear and nonlinear land-based motions, we describe the collapsed data for those two conditions. Consistent with the prediction that infants initially connect specific functional features with motion properties, infants at 18 months repeated the land-based movements they observed with the same parts-same category and same parts-different category exemplars significantly more than any other exemplar. For example, infants who observed a cat moving nonlinearly imitated that motion with a dog and a bed. However, in contrast to the predictions of both the Smart and Dumb Infant view infants at 22 months tended to demonstrate the land motions only with the exemplar that is perceptually and conceptually similar exemplar to the model, namely, the same parts-same category exemplar (Rakison, 2003b). To complete the developmental story, it is worth noting that a separate study with the same design that examined 14-month-olds’ behavior found that although their overall number of responses was relatively high, they did not show a significant preference to demonstrate the motions with any one specific exemplar (Rakison, 2002). That is, infants at 14 months of age tended to imitate more with the same parts-same category exemplar than any of the other exemplars, but this effect was marginal.

In a second experiment, infants at 18 and 22 months of age were tested with the same motions and the same test exemplars. However, in contrast to the first experiment an ambiguous block was used to model the various movements. The rationale for using the block, which is shown in Figure 1, was to test more exactly infants’ knowledge of objects’ paths of motion by eliminating any information about the identity of the exemplars that typically follow those paths. Recall that we suggested that infants in the generalized imitation task may rely on the model exemplar as a guide for which objects they should choose to demonstrate the actions. And the data from the studies with specific motion events, in which infants imitated motions with an inappropriate exemplar if the model was similarly inappropriate-supported this view. By using an ambiguous block as the model exemplar, infants could not generalize to one of the test objects on the
basis of physical appearance. Instead, the basis for any generalizing behavior must be attributable to knowledge brought to the task.

The results of the experiment were indeed informative about infants’ concepts for animals and vehicles, and they supported and extended those of the first experiment. Infants at 18 months of age performed similarly on the land-related tasks as those in the first experiment; in other words, they demonstrated linear and nonlinear land motion with the exemplars that possessed the appropriate parts (i.e., the same parts-same category and same parts-different category exemplars). In contrast, infants at 22 months demonstrated the motions with exemplars from the appropriate category; that is, they repeated the observed motions with the same parts-same category and different parts-same category exemplars. That the older infants in this experiment outperformed, in some sense, the same age group in the experiment with an appropriate model suggests that behavior in the task is affected to a certain degree by the model exemplar. Presumably, 22-month-olds in the first experiment were influenced by the model such that they generalized only to the exemplar that looked similar in appearance to that model.

The pattern of results across these studies suggests a developmental trend more in line with the theoretical view outlined here than that presented by those who support the Smart Infant view. Infants at 14 months imitated the observed actions when given a choice between two exemplars but were highly influenced by the identity of the model exemplar. Moreover, when given a choice of four exemplars infants at 14 months showed little or no basis for generalization. Taken together these results imply that infants at this age possess little knowledge about
the identity of objects that move along different motion paths or that engage in specific motions such as going upstairs. Infants at 18 months were also affected by the model exemplar; however, they demonstrated actions with objects with the appropriate features even when the model was ambiguous. This suggests that at 18 months infants have started to represent the motion paths of different objects and entities, and these representations are grounded in the relation between a specific causal feature and a trajectory of motion (e.g., things with legs move nonlinearly). Finally, infants at 22 months, who were perhaps constrained in their behavior when the model exemplar was a specific object, demonstrated motions with objects that belong to the appropriate category for those motions even if they were not prototypical exemplars of the category. This indicates that at 22 months infants have started to generalize the initial associations between specific features and a motion path to a wider range of exemplars that do not necessarily possess the appropriate parts. Note that it is not clear what the exact nature of 22-month-olds’ basis for induction for motion paths might be. Perhaps infants at this age generalized to the different parts-same category exemplar on the basis of shared category membership (e.g., animals move nonlinearly). But they may have generalized to that exemplar because it possessed specific features that infants have learned are highly correlated with linear or nonlinear land motion (e.g., things with eyes move nonlinearly).

In sum, although much of the literature on infants’ inductive inferences putatively presents a clear picture of early representational development, we suggest a quite different view. According to Mandler and McDonough (1996, 1998a), infants as young as 9–11 months of age have developed what they call conceptual categories whereby inductive inferences are grounded in knowledge about the deeper properties of objects and without reference to the perceptual appearance of things. In contrast, we have presented data that suggest that infants’ initial generalizations, in the inductive imitation procedure at least, are driven by similarity between the model exemplar and the available test objects. The findings of the studies reported here also support the theoretical view that infants do not form abstract concepts for animates and inanimates but instead develop representations that have at their core the associations between specific features and the actions to which those features are causally related. The studies reported here are among the first to focus on when and how infants learn about the identity of objects that exhibit distinct motion characteristics—thought by many to be the cornerstone of more advanced concepts (e.g., Gelman, 1990; Mandler, 1992; Premack, 1990)—and as such they speak directly to the debate between the Smart and Dumb Infant view. We see no reason why the same process of association cannot operate for actions not related to motion properties (e.g., things with a mouth drink), and it is an empirical question whether such associations underlie infants’ behavior in other tasks that have used the same procedure.
C. THE BASIS OF CATEGORIZATION AND INDUCTION IN THE PRESCHOOL YEARS AND BEYOND

The data presented in Section V. A cast doubt over the role of conceptual knowledge in infants’ categorization at the superordinate and basic level, however, it is generally accepted that children and adults weigh nonobvious properties more heavily than perceptual ones in category membership and induction decisions. Recall that from around 4 years of age, but not earlier, children judge that an object that has been superficially transformed maintains its original identity (Keil, 1989). And from 2.5 to 3 years of age, children make inductive generalizations to perceptually different objects that belong to the same category as a target (e.g., a cobra after being shown a brown snake) and not to perceptually alike objects that belong to a different category (e.g., a worm) (Gelman & Markman, 1986, 1987; Davidson & Gelman, 1990).

Preschoolers’ reliance on nonobvious properties has been interpreted most commonly as evidence that such properties hold a privileged status in children’s categorization. According to this view, children rely on nonobvious properties to determine category membership because they understand that such properties are causally related to an object’s identity. For instance, the reason that all lizards belong to the same category is not because they merely look alike, but instead because, among other things, they have the same kind of blood, reproduce in the same way, and share similar internal structures.

An alternative view, outlined earlier, is that categorization is based on nonobvious properties not because of an underlying theory of category membership but because they are more predictive of an object’s identity than surface features. Nonobvious properties tend to be highly—if not perfectly—correlated with category membership, whereas perceptual features are strongly but not perfectly indicative of an object’s identity. Consider for example, if you were told that a certain animal has donkey DNA; most likely, you would not hesitate to infer that the animal is in fact a donkey. Now consider if you were told that a certain animal has four legs and a tail. In this case, the identity of the animal is much less certain; it could be any one of a number of creatures, for example, a donkey, a mouse, or even a giraffe. As this example illustrates, nonobvious properties often allow for more accurate predictions about category membership.

We suggest that by the time children are in preschool they begin to recognize this discrepancy; they learn that nonobvious features are more highly correlated with category membership than are perceptual features. This bias to attend to nonobvious properties might emerge from a single instance and gain strength as children encounter other instances that follow the same pattern. For example, a child might recognize that members of the category *bird* look very different from one another (e.g., a hummingbird and an ostrich). Despite these surface differences, children learn that members of the category *bird* share a number of
less obvious properties: they fly, lay eggs, and share similar internal structures. Later in development, children encounter other species of animals and the pattern is again confirmed: members of a category may look different, but they share many other kinds of properties. With each confirmation, the associative link gains strength such that with time it may form the basis for a general expectation that nonobvious properties are more highly correlated with an object’s identity than perceptual properties. When children are given a choice between nonobvious properties and perceptual properties, they will base category membership on the property that, in the past, has been most predictive.

To assess the possibility that children rely on nonobvious properties because of their predictive power, we conducted a series of studies manipulating the degree to which perceptual and nonobvious properties are related to category membership (Hahn & Rakison, 2003). The goal was to investigate the basis of children’s categorization; that is, the properties that children use to determine which things belong to the same category. Specifically, we were interested in whether we could shift the basis of children’s classification decisions by manipulating the degree to which certain properties were predictive of category membership. If children are not sensitive to the predictive power of features and have a general essentialist bias to focus on nonobvious properties, they should rely uniformly on those properties even when they are not highly predictive. If instead children are receptive to the predictive nature of features, the basis of their category decisions should vary as a function of this predictiveness irrespective of the type of features involved.

In one study, 5-year-old children participated in three categorization trials (Hahn & Rakison, 2003). In each trial, children were taught the properties of two categories of unfamiliar animals (e.g., Wombats and Sugar Gliders), each represented by color pictures of four nonidentical exemplars. For each trial, we varied the degree to which category membership was related to certain perceptual and nonobvious properties and then presented children with test items that possessed some combination of these features (see Figure 2). The perceptual and nonobvious properties for each set are listed in Table I.

In one trial, the control trial, all four members of one category possessed a certain perceptual feature and did not possess a certain nonobvious feature, and all the exemplars in the other category possessed the nonobvious feature but not the perceptual feature. For example, all the Wombats had beaks and were said to “not like people” and all the Sugar Gliders were described as “liking people” and did not have beaks. In this case, as in the remaining trials, the perceptual and nonobvious properties were mutually exclusive, so that an animal that possessed the perceptual property did not possess the nonobvious property and vice versa.

In another trial, called Perceptual-Most, perceptual properties occurred more frequently than nonobvious properties. In this trial, three of the four exemplars of one category possessed the same perceptual feature; in the other category, half of
Fig. 2. Distribution of perceptual and nonobvious properties in three experimental trials presented to preschoolers and adults (Hahn & Rakison, 2003).

**TABLE I**
Perceptual and Conceptual Features Used in Three Studies with Adults and Preschoolers

<table>
<thead>
<tr>
<th></th>
<th>Insects</th>
<th>Mammals</th>
<th>Birds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Studies 1 and 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceptual Property</td>
<td>Tail</td>
<td>Beak</td>
<td>Ear</td>
</tr>
<tr>
<td>Nonobvious Property</td>
<td>Sleeps in a tree</td>
<td>Likes people</td>
<td>Has a round heart</td>
</tr>
<tr>
<td><strong>Study 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceptual Property</td>
<td>Tail</td>
<td>Beak</td>
<td>Ear</td>
</tr>
<tr>
<td>Nonobvious, Biological Property</td>
<td>Has a brain with two parts</td>
<td>Lays eggs</td>
<td>Has curly DNA</td>
</tr>
</tbody>
</table>

Hahn and Rakison (2003).
the exemplars possessed the same nonobvious feature and half possessed the same perceptual feature. For example, three of the Shield Bugs were said to sleep in a tree and one had a sharp tail, and two of the Leaf Hoppers had a sharp tail and two were said to sleep in trees. In a third trial, called Nonobvious-Most, nonobvious properties occurred most frequently. Three of the four exemplars in one category possessed the same nonobvious feature and one possessed a distinctive perceptual feature; in the other category, half of the exemplars possessed the same nonobvious feature and half possessed the distinctive perceptual feature. For example, three of the Kingfishers had a big ear and one was said to have a round heart, and two of the Bustards had a big ear and two were said to have a round heart.

After children were told about the properties of objects within each group they were presented with three test cases and asked to decide to which of the groups it belonged. All of the test cases were from a novel category such that if, for example, Sugar Gliders and Wombats were the two categories children were initially taught, the test items were a Prairie Dog, a Tasmanian Devil, and a Coatomundi. One of the test cases possessed the perceptual feature but not the nonobvious feature; one possessed the nonobvious feature and not the perceptual feature; and one possessed both the perceptual and nonobvious features. The test cases that possessed only one feature were included as a control: It was predicted that children would categorize them as belonging to the category that mostly possessed the feature in question.

The test cases that possessed both the perceptual property and the nonobvious allowed us to differentiate between responses that likely were based on the statistics of the category and those that might have emerged from an essentialist bias to attend to nonobvious properties. If, for example, children’s responses were guided by an essentialist bias, they should categorize test exemplars in accordance with their nonobvious properties; the critical test item would be assigned to the category containing the most instances of the nonobvious property. If, in contrast, children were sensitive to the statistics of the category, they would be just as likely to group the test item with either of the two available categories because the statistical predictiveness of both features was equivalent.

In fact, rather than exhibiting a consistent essentialist bias to attend to nonobvious features, children’s category membership decisions were affected considerably by the statistical distribution of features among category members. In the control trial, all children categorized the perceptual test item as belonging to the perceptual-based category and the nonobvious test item as belonging to the category defined by the nonobvious feature. This finding was taken to mean that children understood the nature of the task. When given the test item possessing both perceptual and nonobvious properties, children were equally likely to categorize it as a member of the perceptual-based category as they were to categorize it as a member of the nonobvious-based category. This implies that
children are sensitive to the distribution of perceptual and nonobvious properties among category members and use this information to guide their decisions about category membership. When perceptual and nonobvious properties were pitted against one another and the statistics of the category were held constant, children did not appear to weigh one kind of feature more heavily than the other.

In the Nonobvious-Most trial, in which 75% of the exemplars in one category possessed the nonobvious property, children’s performance was consistent with the statistical distribution of features among category members. When presented with the perceptual test item, children categorized it as belonging to the perceptual-based category (e.g., the category that contained the most frequent occurrence of that feature); likewise, when presented with the nonobvious test item, children categorized it as a member of the nonobvious-based category (e.g., the category that contained the most frequent occurrence of that feature). When presented with the test item that possessed both the perceptual property and the nonobvious property, children’s performance did not differ from chance, a finding consistent with the statistical distribution of the categories. Specifically, items that possessed the perceptual property were more likely to belong to one category and items with the nonobvious property were more likely to belong in the other category; therefore, an item that possesses both properties could just as likely belong to either of the categories.

Somewhat surprisingly, in the Perceptual-Most trial, the trial in which 75% of the exemplars in one category possessed the perceptual property, children performed at chance for each of the three test items. That is, each test item was equally likely to be categorized as a member of the perceptual-based category as it was to be categorized as a member of the nonobvious-based category. This pattern of behavior was especially surprising for the test items that possessed either the perceptual feature alone or the nonobvious feature alone. In each of these cases, category membership should have been clear; the particular property in question was a more frequent occurrence in one of the categories. For example, three of the four exemplars in one category possessed the perceptual feature, whereas, only two exemplars in the other category possessed that feature. For the test item that possessed both the perceptual feature and the nonobvious feature, children’s performance, as in the Nonobvious-Most trial, did not differ from chance.

It is not immediately evident why children performed successfully in the Nonobvious-Most trial but not the Perceptual-Most trial. One possibility is that the Nonobvious-Most trial was most consistent with what children knew about the predictive property of nonobvious features and when presented with a conflicting scenario—the Perceptual-Most trial—children randomly assigned the test items to categories. Another unexpected finding emerged in the control trial in which children failed to show evidence of an essentialist bias. Rather than weighing nonobvious properties more heavily than perceptual ones, 5-year-old
children appeared to weigh both kinds of features equally. This is especially
surprising considering that the essentialist bias to selectively attend to
nonobvious properties is thought to come online by the age of four (Gelman,
2003).

To examine how adult category decisions would be impacted by distributional
information about perceptual and nonobvious features, the same study was
conducted with adult participants. Undergraduate students were presented with
the same stimuli as used in the previous study and were asked to determine
the category membership of the three test items. In the control trial, participants
categorized the perceptual test item as belonging to the perceptual-based
category and the nonobvious test item as a member of the nonobvious category.
When presented with the test item that possessed both the perceptual property and
the nonobvious property, participants exhibited a perceptual bias: they were
significantly more likely to say that test item belonged to the perceptual-based
category than the category defined by the nonobvious property. Performance in
the Perceptual-Most trial and Nonobvious-Most trial followed suit. The
perceptual test item was categorized as a member of the perceptual-based
category, the nonobvious test item was categorized as a member of the
nonobvious-based category, and the test item possessing both the perceptual and
nonobvious features was more likely to be identified as a member of the
perceptual-based category.

Adults’ bias to attend to the perceptual property in their decisions on category
membership was not predicted. An essentialist framework would predict that
nonobvious properties would drive categorization, but instead, adults apparently
weighed the perceptual feature more heavily than the nonobvious one. One
possible explanation for this discrepancy is that the nonobvious properties used in
the study—a psychological property (i.e., likes people), a behavioral property
(i.e., sleeps in trees), and a biological property (i.e., has a round heart)—were not
powerful enough to create an essentialist bias. Perhaps when nonobvious
properties are biological they become more central to category membership and
are more likely to result in an essentialist bias that favors nonobvious properties
over perceptual ones.

To assess this possibility, we altered the nonobvious properties so that they
were exclusively biological in nature (e.g., has curly DNA, has babies by laying
eggs) and conducted an additional study with undergraduate participants (see
Table I). In the control trial, participants categorized the perceptual test item as a
member of the perceptual-based group and the nonobvious test item as a member
of the nonobvious-based group. When presented with the test item that possessed
both features, participants’ performance did not differ from chance; they were as
likely to say that it as a member of the perceptual-based category as they were to
group it as a member of the nonobvious-based category. In the remaining two
trials, Perceptual-Most and Nonobvious-Most, the change of nonobvious
properties had no impact on performance. The perceptual test item and the nonobvious test item were categorized appropriately, and the test item that possessed both the perceptual feature and nonobvious feature was categorized most often as a member of the perceptual-based category suggesting that even when nonobvious properties are biologically based, adults still exhibit a perceptual bias.

Overall, these results suggest that 5-year-olds and adults are sensitive to the statistical distribution of perceptual and nonobvious properties across categories and use this information to inform their decisions about category membership. Rather than attending to nonobvious properties in all circumstances, children and adults seem to consider how accurately certain properties predict category membership and adjust the basis of their category decisions accordingly. For example, when given information suggesting that a perceptual property is the best predictor of category membership, children and adults will attend to perceptual properties when deciding to which category something belongs; likewise, if a nonobvious property is the best predictor of category membership, children and adults will adjust their expectations so that the nonobvious property forms the basis of their category decisions. The data also suggest that if adults possess any bias to use one property over another it is toward surface rather than nonobvious ones.

VI. Summary and Conclusions

The evidence outlined in the previous sections goes some way in addressing the debate between the Smart and Dumb Infant views. The research on early categorization suggests that 14- and 18-month-old infants are able to form categories that appear, at least in terms of the objects included in them, to be at the superordinate and basic level. We have argued that the basis for these categories is not, however, knowledge of class membership or “the kind of thing” that something is. Instead, we suggest that infants use one or more surface features to group together perceptually diverse objects such as animals and as vehicles and relatively similar objects such as cats and as cars. Likewise, the research on infants’ inductive inferences reveals that early generalization of motion properties is not grounded in an understanding of category membership or abstract concepts for animates and inanimates. The data show that around 14 months of age infants’ inductive generalizations are generated on-line and in the absence of specific knowledge of objects’ motion properties. In contrast, by 18 months or so infants rely on prior knowledge about the motion properties of objects to make inductive inferences, but this knowledge is only just developing; that is, it is underpinned by associations between surface features (e.g., legs) and specific motions or actions. By 22 months, however, infants’ knowledge has
developed such that they are more constrained in their inductive inferences and generalize to appropriate category members even if they are perceptually diverse.

In light of the evidence presented here and elsewhere in the early perception and cognition literature (e.g., Quinn & Eimas, 1996a,b; Younger & Cohen, 1986), we believe that the burden of proof vis-à-vis the mechanisms underlying early category and concept development rests with those who support the Smart Infant view. In our view there is no direct empirical evidence that infants possess innate specialized mechanisms that facilitate early concept formation. Indeed we believe that it is virtually an impossibility to either provide empirical confirmation for or against this view. What findings would reveal that infants are born with a process of perceptual analysis? Or skeletal principles? Or three modules that facilitate learning about Agency? Because such theoretical constructs are so hard to establish or disconfirm empirically, the goal of this chapter was to show that domain-general associative processes coupled with a predilection to attend to, among other things, dynamic cues is sufficient to account for representational development in infancy. The data are consistent with this view. Attention to specific surface features and their relations (especially those pertaining to motion) is more than adequate for infants to develop representations that encapsulate not only how something looks but also the actions of which it is capable. We also suggest, albeit tentatively, that the evidence presented here are consistent with the notion that category and concept development is gradual and continuous rather than stage-like and discontinuous; infants’ basis for induction, for example, suggests that they associate single features with a motion property and then expand this association more broadly to other within-category members.

Finally, the research with preschoolers suggests that surface properties of objects may continue to play an important role in categorization and induction. As predicted, preschoolers (and adults) are highly influenced in their category membership decisions by the predictability of perceptual and nonobvious features. When perceptual features are the best predictor of category membership, preschoolers rely on them to decide which things belong together; when nonobvious features are the best predictor of category membership, preschoolers rely on them instead. When both are equally good predictors, preschoolers rely on each kind to categorize. We propose that this pattern of behavior suggests that the well-known essentialist bias results from experiments that pit one type of property against another, which causes children to choose the type of property they have learned is a better predictor of category membership. We speculate, however, that in everyday categorization and induction children use a more “rough and ready” process; that is, they rely on surface properties because they are highly predictive of other properties and category membership, and are easily accessible.
We believe that the developmental trend observed here highlights how different properties are acquired and employed in categorization and induction at different points in development. In line with Oakes and Madole (2003) and Smith and colleagues (Jones & Smith, 1993; Smith & Heise, 1992), we posit that this trend results from increasing cognitive, linguistic, and social skills. These skills provide infants and preschoolers with access to, and the ability to encode, ever more complex and ever more inaccessible information. Initially, infants’ attentional, perceptual, and cognitive abilities limit them to learn about the surface properties of things, later they learn about properties related to motion and psychological causality (e.g., intentionality), and still later they start to learn about internal properties of things. As is shown in Figure 3, this trend directly relates to the accessibility of the properties involved: Surface properties of objects and entities are almost constantly available in the array; motion properties are more intermittently available, and psychological properties (particularly intentionality) are rarely directly observable. Finally, internal properties, especially those related to biological aspects of animates, are seldom, if ever, presented in the array. Thus, the various properties of animates and inanimates are acquired roughly in the order in which they are available to the sensory systems. To be sure, some properties (e.g., those related to motion) are

![Figure 3: Timeline of acquisition of different properties of animates and inanimates. Note that the black line denotes approximate age at which infants begin to discriminate animate- from inanimate-related properties. The grey line denotes approximate age at which infants begin to associate animate-related properties with animates and inanimate-related properties with inanimates.](image-url)
accessible to infants earlier than we have suggested they are learned; in our view, this is because infants do not yet possess to capacity to encode or represent such properties. In other cases, as denoted in the figure, infants will discriminate two properties (e.g., agency from recipiency) before they can associate one of those properties with the appropriate category (e.g., cats are agents) (see Rakison & Poulin-Dubois, 2001).

To finish, it is worth pointing out that the evidence presented here merely touches the surface of infants’ developing concepts and categories for animates and inanimates. The studies we report, particularly those with infants, are among the first to examine when infants start to develop knowledge about the identity of objects that move in different ways. This work needs to be extended by examining infants’ developing understanding of, among other things, agency and self-propulsion and the path taken toward a goal. However, we are aware that a considerably larger database of research on this issue is required before the debate between the Smart and Dumb Infant view is resolved. The difficult task that faces researchers who focus on this issue is not only to provide theories that are testable, but also to provide evidence that speaks directly to the debate. Researchers have made a first step in this direction, but many more such steps are required before the field has a clear view of the structure, content, and mechanisms involved in early infant category and concept development.

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