A PIAGETIAN APPROACH TO INFANT REFERENTIAL BEHAVIORS

by

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(Under the Direction of Lynda Henley Walters)

ABSTRACT

The term joint attention refers to the ability to share attention to an object with another person. Near the end of the first year of life, infants begin producing behaviors that in adults indicate joint attention, and these behaviors have been interpreted in the cognitive developmental literature as an indication that infants have a rudimentary theory of mind. In this paper I address current theory on infant behaviors described as joint attention and offer an alternative explanation for the presence of these behaviors in infancy that does not require a theory of mind. Specifically, I argue that infants' referential behaviors are motor signifiers of thought and that infants recognize humans as a particularly relevant object for their goal-directed behaviors. I support this argument by presenting a case study of 4 infants producing referential behaviors toward a novel toy in the presence of an adult, using a paradigm typical in joint attention studies in infancy. Finally, I discuss the implications of applying this theory for the field of cognitive

development and suggest directions for future research on referential behaviors in infancy.

INDEX WORDS: Infant, Toddler, Early Childhood, Social Cognition, Joint Attention, Piaget

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TABLE OF CONTENTS

Page

CHAPTER 1

INTRODUCTION

The term joint attention refers to the ability to coordinate sharing attention with another person (Bates, Camaioni, & Volterra, 1975; Scaife & Bruner, 1975). Behaviors people use to coordinate visual attention include alternating gaze between a person and an object, pointing to an object in the presence of a person, and following the gaze of a person who has indicated her direction of attention. Near the end of the first year of life, infants begin producing such behaviors (Bates, O'Connell, & Shore, 1987; Butterworth, 1995; Carpenter, Nagell, & Tomasello, 1998; Desrochers, Morissette, & Ricard, 1995; Lempers, 1979; Leung & Rheingold, 1981; Zinober & Martlew, 1985) and increasingly incorporate them into their repertoire of behavioral interactions with the environment in subsequent years.

Cognitive psychologists call these behaviors “joint attention” and attribute the presence of these behaviors in infancy to the infant having the complex social cognitive ability of either intent to share information or understanding of the intent of others to share information (Carpenter et al., 1998; D'Entremont & Seamans, 2007; Tomasello, Carpenter, & Liszkowski, 2007). For example, Tomasello and colleagues (Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004; Liszkowski, Carpenter, Striano, & Tomasello, 2006; Tomasello, 1999; Tomasello et al., 2007) have examined infant

pointing throughout the first two years of life as a form of prelinguistic communication, arguing for a deeply social view in which infant pointing is best understood as a form of cooperation and shared intentionality. Moore and colleagues (Barresi & Moore, 1996; Corkum & Moore, 1998; Moore & D'Entremont, 2001; Moore, 1999) have examined infants initiating and responding to pointing, arguing for a leaner social view in which infants either point to elicit adult attention to the infant or as a reflection of infants' emergent understanding of intentionality.

Explaining infant behaviors as social-cognitive assumes that infants are aware of others having a different psychological state than they themselves have. Such an idea seemed to be a revolutionary when Scaife and Bruner (1975) reported that in the first year infants follow the gaze of others with age-related increasing accuracy and Bates, Camaioni, and Volterra (1975) reported that infants point to objects in the presence of others. These first observations seemed to refute Piagetian theory that infants are egocentric and primarily focused on constructing knowledge about the world through sensorimotor exploration (Piaget, 1954; Piaget, 1960). Since these original studies, the phenomenon of joint attention in infancy has enjoyed a great deal of attention in cognitive and developmental literature, most of which is based on a social-cognitive explanation of joint attention behaviors in infancy.

The use of the term "joint attention" implies that an infant *can* be aware of another person's subjective attention or experience. In other words, it implies that infants have a theory of mind. However, there is substantial evidence that refutes this theory. For

instance, infants point to objects even when others are already attending to the target referent (Moore & D'Entremont, 2001). More importantly, a large body of research describes the emergence of theory of mind at approximately age 5 (see Flavell, 2000 for a review). Theory of mind is the awareness that other people can have a different psychological perspective than oneself, including emotional, perceptual, and conceptual perspectives (Flavell, 2000).

Piaget referred to thought void of theory of mind as egocentric (Piaget, 1954). The term “egocentric” refers to a child’s inability to experience the world from any perspective other than her own. If referential behaviors in infancy are not indicative of a theory of mind, what do they indicate and how do they function for the infant?

In this paper, I address the question “does infant behavior reflect joint attention (thus, theory of mind) or can infant behavior be described from a Piagetian perspective and be considered support for and evidence of Piagetian theory without attributing a mature social cognitive ability to infants?” Using case studies of infants involved in object exploration in the presence of an adult, I will argue that the study of “joint attention” uses a top-down approach to a phenomenon that is more useful to describe from the bottom up.

CHAPTER 2

LITERATURE REVIEW

Researchers of joint attention have operationalized this variable either as a state or a set of behaviors. A state description of joint attention refers to an infant and adult attending to the same target. Studies addressing state joint attention are, for example, Morales, Mundy, Crowson, Neal, and Delgado (2005), who measured the variable "collaborative joint attention," which they defined as an instance in which a parent and her 22-month-old infant are visually focused on the same toy for at least 2 seconds and the infant indicates awareness of joint focus by looking toward the parent's face. In another classic joint attention study by Bakeman and Adamson (1984), they measured "coordinated joint attention," which they defined as the infant being actively involved with another person and object and producing behaviors that coordinate her own and the other person's attention. As can be seen in both definitions, an infant and an adult were intentionally attending to the same target and to each other. Operationalizing joint attention behaviors as a state makes the assumption that infants can share attention to an object with another person and precludes alternative explanations for infant referential behaviors.

It is more useful for the purposes of comparing study findings and understanding the function of behaviors in so-called joint attention situations to refer to the set of

behaviors that researchers describe as indicating joint attention. Such behaviors include infant pointing (Butterworth, Franco, McKenzie, Graupner, & Todd, 2002; Murphy, 1978), infant visual checking with an adult and infant following of the gaze, head direction, or point of an adult (Baldwin & Moses, 1994; Carpenter et al., 1998). Infant pointing involves the infant extending her arm and index finger in a direction. Infant visual checking refers to an infant looking at an adult for information. For the purposes of this paper, I will refer to behaviors, not a state, and call the set of behaviors "referential" because pointing, following the gaze, point, or head turn of another person, and visual checking with another person indicate a visio-spatial line in reference to an object in the immediate environment.

In the following section I will apply Piaget's theory to the empirical findings of "joint attention" studies and show how the referential behaviors in these studies can add to an understanding of infant object and event perception without assuming that infants understand people as mental agents.

Piaget and Referential Behaviors

Using Piaget's constructivist theory of cognitive development to interpret referential behaviors involves examining behaviors in the context of egocentric thought and constructivist learning (Piaget, 1954; Piaget, 1960). Describing thought as "egocentric" refers to a child's inability to experience the world from any perspective other than her own. Constructivist learning involves the child acquiring knowledge of the world by acting on it. According to Piaget, through her actions, a child explores the

properties unique to the world's elements and their relationship to one another. Piaget referred to these properties and relationships as schemas. The infant develops different object schemas depending on her age including what an object feels like in her mouth in early infancy to what it looks like, what it does, what she can do with the object, what actions can be associated with objects, and what objects go together in later infancy.

Piaget described the mechanism through which people develop schemas at different ages in his description of stages. In the first two years of life this mechanism is sensorimotor, which refers to development of schemas through one's own motor activity and perceptual abilities (Piaget, 1954; Piaget, 1960). He further described the period of sensorimotor thought as including six age-related stages. In the first two stages, infants act reflexively and repeat actions they discover by chance on their own body. In the second half of the first year, which he called the stage of secondary circular reactions, they begin to focus on their environment. In this stage, they discover by chance that they can have an effect on their environment such as kicking the side of the crib to make a mobile move. It is through secondary circular reactions that infants subsequently develop an understanding of cause and effect.

Secondary Circular Reactions: Referential Gestures

The age range in which infants evidence referential gesturing and gaze following is generally considered to be around 11 months (Bates et al., 1987; Butterworth, 1995; Carpenter et al., 1998; Desrochers et al., 1995; Lempers, 1979; Leung & Rheingold, 1981; Zinober & Martlew, 1985), which coincides with the transition to the stage of

coordination of secondary circular reactions. Coordination of secondary circular reactions involves coordinating more than one movement in reference to an object at a time. Behaviors typical of this stage include holding an object with one hand while manipulating it with the other or using one object to act on another. During the coordination of secondary circular reactions stage, the infant evidences the first sign of goal-directed behavior. Goal-directed behavior in infants involves the recognition of actions one can produce on an object or effects an action can produce and acting in pursuit of those actions and effects. That infants evidence goal-directed behavior is a demonstration that they are developing schemas about objects that include actions associated with those objects.

Assuming that infant thought is egocentric and that infant learning is constructivist, the presence of infant referential gestures can be considered an indication of emerging goal-directed behavior. For example, when a 1-year-old infant sees an interesting object, she acts to explore that object through multiple senses. In infancy, this is typically haptic, (ie., touch) and visual. If an object is out of reach and the infant intends to explore it, the infant will look in the direction of the object and work toward exploring it. If more information is needed or tactile manipulation is not possible due to the object being out of her reach, she may extend her arm in the direction of the object or move her body toward the object to continue exploration. From this perspective, visually guided pointing and reaching are evidence that infants are in the stage of coordinating secondary circular reactions, that they recognize the direction and course needed to

explore an object haptically, and that they are actively involved in trying to follow that course to explore the object through touch. A study of the gestures of 12-month-olds by Blake, O'Rourke, and Brozellino (1994) highlighted this interpretation of infant pointing. They found that infants point to an object that is out of reach and poke at an object that is within reach. This explanation of goal-directed object exploration shows how extension of the index finger in a pointing gesture occurs as part of infants' interaction with objects, but whether the behavior is defined as a point or a poke depends on the distance of the object from the infant.

A similar way to interpret referential gestures from a Piagetian perspective is that they are a motor signifier of thought and function to focus perceptual resources. In support of this theory, the emergence of referential behaviors coincides with the emergence of an executive attention system. The executive attention system is thought to emerge around the end of the first year of life and is evidenced by infants' increasing ability to inhibit their actions, regulate their emotions, and pay attention to environmental stimuli for longer periods of time (Ruff & Rothbart, 1996). Executive attention, the ability to deploy or manage attention, includes the focusing of perceptual resources for the purposes of orienting, such as looking at and manipulating an object in one's hands and the ability to focus on relevant information and inhibit focusing on irrelevant information (McCall, 1994). If the object of an infant's attention is out of reach and the infant cannot move her body to obtain the object for tactile exploration, she may make

referential behaviors such as extending her arm in the direction of the object to maintain her line of visual regard and limit perceptual distractions.

Research on referential gesturing supports this interpretation. Experimental studies of pointing in which the adult's direction of attention is manipulated show that infants point more when adults look at and vocalize about something other than the target of the infant's reference (Moore & D'Entremont, 2001; Vaish & Striano, 2004). In these studies, the adult's actions to show attention toward the infant or to a target in the environment that the infant is not attending to serve to distract the infant from the focus of her goal-directed exploration. When the adult is adding information to what an infant is already attending to there is less of a need for the infant to point to focus perceptual resources. It could then be argued that instead of thinking of the emergence of an executive attention system as coinciding with the emergence of referential behaviors, it may be more appropriate to say that the emergence of referential behaviors is indicative of the beginning of an executive attention system.

Returning to the goal-directed theory of infant pointing, a similar argument can be applied to the phenomenon of social referencing. The presence of social referencing at about the same age can be considered an indication of infants' understanding of others as causal agents who make things happen or as a tool to make things happen (Bates et al., 1975), or as a source of additional information about the infant's object of attention. Studies of social referencing have shown that around the end of the first year of life, infants look at adult faces when they experience a novel situation that evokes uncertainty

of behavior (Walden & Ogan, 1988; Klinnert, 1984). Oddly, social referencing is not typically included in discussions of joint attention, and investigations of social referencing typically involve either a fear- or anxiety-provoking situation (see for example Klinnert, 1984; Walden & Ogan, 1988). Joint attention studies do refer to visual checking with an adult or alternating gaze between an object and an adult (see for example (Bakeman & Adamson, 1984; Slaughter & McConnell, 2003), but these behaviors are not related to social referencing in the literature and are typically described in research on joint attention as a state. Using the same argument previously applied to pointing, looking at a person in any situation in which an infant is first fixated on exploring an object or event and then looks at people in the environment can be an indication that infants recognize people as relevant objects and use them in pursuit of their goal-directed behavior. In addition, the presence of social referencing indicates that infants recognize the face, eyes, and hands of a person as a source of useful information for associating an action with a situation. More research is needed to understand infants' looking at people in the context of their object exploration.

Tertiary Circular Reactions: Problem Solving

Infants increasingly incorporate multiple referential behaviors in a single situation in the beginning of their second year (Mundy & Gomes, 1998), a change that can be considered an indication of the stage that Piaget referred to as tertiary circular reactions. In this stage, infants explore multiple ways of achieving their goals. Tertiary circular reactions are infants' use of familiar coordinations of secondary circular reactions to

make interesting things happen, such as turning over a full toy box versus turning over a cup of liquid or trying out multiple paths to a goal. Tertiary circular reactions have been described as the very earliest way that we see infants beginning to solve problems because they will try out alternative actions to produce a desired effect or as in the previous example, the same action on different objects to produce different effects (Fogel, 2001).

It may be more useful to think about the stage of coordination of secondary circular reactions as the first evidence of problem solving. Rodríguez & Palacios, (2007), describe infant referential behaviors and gestures while problem solving as private behaviors, serving a similar function as private speech. As such, they are an outward manifestation of thought or problem solving that guides the infant's own behaviors. Piaget described infant behaviors at this age as motor signifiers of the presence of thought in infants (Piaget, 1954). In other words, by watching the motor behaviors of infants, we can infer progress in their thinking.

Infants' use of visual checking with people in their environment can also be considered evidence that infants are transitioning to the stage of tertiary circular reactions and that they recognize people as particularly relevant objects to aid them in carrying out their intended actions. As in the previous example, if an infant's actions do not result in the infant being able to explore an object or produce a desired effect, she may use relevant objects in the environment including faces to glean more information about the actions she can produce on the object or how she can obtain the object to explore it. A

developmental change in the use of social referencing would support this explanation but so far no studies have undertaken this investigation.

Both pointing and social referencing in the context of object exploration involve the infant attending to an object and then producing a behavior that indicates her attention and problem solving. These behaviors coincide with and have been discussed in relation to the infant's ability to follow the gaze of another person who has produced behaviors to indicate his line of regard in the presence of an infant.

The ability to follow the gaze of another person can be considered an indication of the emergence of infants' recognition of vectors of face direction as a relevant property of faces. Infants recognize that the relevant part of a face is the eyes and recognize that eyes indicate direction to a useful sight. For example, Legerstee and Barillas (2003) provided evidence that infants are aware of and can distinguish the direction of an adult's eye gaze. Brooks and Meltzoff (2005) found that infants followed the gaze direction of adults differentially depending on whether the person's eyes were closed or not. Butterworth and Jarrett (1991) discussed a "geometric" mechanism emerging at about 12 months, in which the infant will not look at the first stimulus encountered but instead continue to look into their visual periphery for a target to which another person is looking. Such studies indicate infants' understanding of people as unique and particularly relevant objects in their environment.

Despite the fact that joint attention researchers often discuss referential behaviors as indicating an underlying singular mechanism for intent to share and understanding of

the intent of others to share, recent studies of referential behaviors provide evidence that different types of referential behaviors are not correlated. For example, Slaughter and McConnell (2003) found that gaze following and social referencing in infants between the ages of 8 and 14 months were not significantly correlated, and Mundy and colleagues found few significant cross-domain correlations between responding to the pointing and head turn of an adult and infant production of referential gestures such as pointing and visual checking (Mundy & Gomes, 1998; Mundy, Card, & Fox, 2000; Vaughan Vaughan, Mundy, Block, Burnette, Delgado, & Gomez, 2003). The results of these studies suggest a need to examine initiating and responding behaviors separately in terms of their function in infant object exploration.

The Current Study

Although many studies provide interpretations of infant referential behaviors at the end of the first year of life, few describe their prevalence or sequence within an interaction and only one describes gesturing as evidence of thought processes (Rodriguez & Palacio, 2007). As a result, it is difficult to determine under what conditions infants produce referential behaviors and what they might indicate about infant thought processes. Most studies of joint attention examine only one referential behavior at a time. For instance, joint attention studies of pointing tend to focus only on the infants' production of the pointing gesture and not on visual checking or pointing in the context of other behaviors (see for example Butterworth et al., 2002; Liszkowski et al., 2004; Moore & D'Entremont, 2001). However, most studies report that little pointing actually

occurred in their samples, with reports of between 34% and 64% of 12-month-olds pointing (Cheek, Dice, & Hsu, 2004; Legerstee & Barillas, 2003; Moore & D'Entremont, 2001). In these studies, only the data from the children who pointed were analyzed. If these reports were supplemented with detailed descriptions of all of the behaviors of infants we might be able to develop a better understanding of the nature and function of referential behaviors. Recently, one group of researchers has begun to follow this line of thinking by describing a low-cognitive set of behaviors such as pointing or visual checking and a high-cognitive set of behaviors that involve incorporating multiple behaviors within seconds of each other such as pointing, visual checking, vocalizing, and smiling (Mundy et al., 2003; Seibert, Hogan, & Mundy, 1982). However, these researchers have concluded that the presence of a higher order cognitive joint attention state includes the presence of these behaviors in any temporal order. A description of the sequence of these behaviors and their relationship to one another in the context of object exploration are needed to provide further evidence to affirm or disconfirm the social cognitive theory of joint attention. It could assist researchers who examine referential behaviors in understanding their nature in relation to object exploration.

In this study, I explore the referential behaviors of infants who are in the stage of coordination of secondary circular reactions and infants who are in the stage of tertiary circular reactions. I have used a paradigm that is typically used to measure referential behaviors. A case study approach, which involves examining the dynamics of a single situation, is a useful strategy for exploring infants' referential behaviors within a situation

where joint attention is typically studied. Specifically, I describe four sequences of infants producing referential behaviors and show how interpretation of these behaviors need not imply a theory of mind. By applying Piagetian theory and describing the behaviors in detail, I show how it is possible to interpret these behaviors in the context of object exploration and infants' growing understanding of the relevance of faces in their work of exploring the world and constructing schemas.

CHAPTER 3

METHODS

Participants were four female infants ages 12, 12, 17, and 19 months who participated in a larger study on the development of infant referential behaviors. The infants were from middle to upper-middle class families and were full-term gestation. All participated in the infant classroom at a university child development laboratory. Parents and teachers were sent a letter describing the study, and parents were given a photo album of their infants as an incentive to participate. Observations were conducted in the infant's classroom with only the infant, the assessor, and the teacher present. The other infants were on the playground. The names of the infants have been changed to protect their identity.

Procedures

Infants participated in a 20-minute play assessment designed to elicit referential behaviors in children from 6 to 30 months. The play assessment was based on the tasks in the Early Social Communication Scales (ESCS: Mundy, Delgado, Block, Venezia, Hogan, & Seibert, 2003; Seibert, Hogan, & Mundy, 1982). For the ESCS, the assessor and the child sit facing each other across a table, and the assessor offers the child several opportunities to interact with her and with a toy. Each of the toy interactions involves situations that have been shown to elicit infant referential behaviors such as pointing,

visual checking, or following another's line of regard. In one toy interaction situation, the assessor activates a wind-up or mechanical toy to the side, waits a second or two after the toy has stopped moving, and places the toy on the table in front of the child so that the child can explore it with her hands. After activating each toy, the researcher looks silently at the child with an expression of excitement. This sequence is repeated for a total of three activations of each toy. The results for these case studies include only the referential behaviors that occurred during the presentation of the wind-up or mechanical toy, including a hopping bunny, walking crocodile, or one of two mechanical wind-up tops. This situation was selected for multiple reasons. First, it offered a unique opportunity to separate visual coordination and bodily gestures. The assessor presents the activated toy to the side so eye movements toward the assessor are easily distinguished from eye movements toward the toy. Second, it was also the situation indicated by previous studies as the most likely to produce referential behaviors because the toy is activated out of reach of the infant (Mundy et al., 2003; Seibert et al., 1982). And third, there was little variability in responses to the gaze, point, and head-turn of the assessor during other parts of the assessment in which the assessor indicated her line of regard for the infant to follow. Prior to the presentation of the wind-up or mechanical toy, all infants were first presented with a ball that was rolled back and forth between the infant and assessor to familiarize the infant with the situation and the assessor.

Three different assessors, one graduate student and two undergraduate students, administered the ESCS with the infants. All were trained using the ESCS manual. Infants

sat across a low table from the assessor in either a child-sized chair or on the lap of their teacher. Seating the infant on the lap of a familiar person is recommended by the authors of the ESCS to make the infant comfortable emotionally. Infants who were older did not sit on their teacher's lap because it was decided that they would be too distracted by the presence of their teacher. In such cases, the teacher sat behind the child, a few feet away, focused on reading or writing or around a corner out of the infant's sight but still in the room. The teachers were instructed not to talk to or look at the infant.

The Case Study Approach

Data are presented using the case study approach. The case study approach was selected because previous studies of joint attention make the assumption of social cognitive abilities in infants and therefore only measure the prevalence of referential behaviors. In order to explore the meaning of referential behaviors, it was important to examine their context, prevalence, and sequence in relation to all of their behaviors, both referential and non-referential. The case study approach involves examining dynamics present within a single setting (Eisenhardt, 2002) so it was the most useful method. This study involved four cases in a similar context to highlight the strategies infants use during this interaction and to show that these behaviors can be interpreted without assuming infants have theory of mind or intend to be social during the interaction.

As suggested by Glaser and Strauss (1967), the four cases presented here were selected for theoretical reasons. Specifically, they were selected from a sample of 20 children ranging in age from 10 to 34 months. Criteria for selection included being in the

age ranges where coordination of secondary circular reactions and tertiary circular reactions are expected, (approximately 8 to 12 months and 12 to 18 months respectively). This reduced the pool to 9 infants. Five infants were excluded because of specific behaviors during the assessment. Two were excluded because of the short duration of their assessments. One of the two became frustrated with the assessor taking the toy from him. The other climbed across the table to try to obtain the toy and gave the toy to the assessor quickly after holding it. Three were excluded because they demonstrated anxiety. One of these two stared at the toy and the assessor with a smile but sucked her thumb and did not touch the toy. One infant looked up at the assessor compulsively. Another looked at the assessor several times while the toy was activated. He held on to the sides of his chair for a large part of the assessment, indicating his mild anxiety. For these three infants, it was difficult to distinguish referential behaviors from anxious visual checking. In summary, the infants who were selected did not exhibit shyness, anxiety, or impulsivity and showed a clear sequence of behaviors.

Reliability and Validity

Reliability for the ESCS has been well established in previous studies (e.g., Mundy & Gomes, 1998; Mundy, Kasari, Sigman, & Ruskin, 1995; Mundy, Sigman, & Kasari, 1994), with infant initiated referential behaviors ranging from .77 to .95 at 9 months (Mundy, Block, Delgado, Pomares, Van Hecke, & Parlade, 2007) and .82 to .87 at 14 to 18 months (Mundy et al., 2000). Although the current study used only the tasks

from the ESCS and not the coding or scoring schemes, the reliability of this measure for eliciting referential behaviors has been established in prior studies.

All assessments were videotaped using a tripod and a digital camera. Four researchers, including the principle investigator and three undergraduate students, transcribed the videos with emphasis on describing referential behaviors including pointing, reaching, gaze direction, vocalizing, affect, and talking during the play session. To ensure reliable descriptions of behaviors, the principle investigator checked the accuracy of the transcripts by watching all of the videos and comparing the behaviors described in the transcripts with the behaviors observed on the video. Any omissions of behavior were subsequently added to the transcripts.

Several measures were taken to address threats to validity. An apprehension threat to internal validity would involve something in the study making the infants fearful of participating and therefore biasing the results. To address this threat, all assessors visited the infants' classrooms and played with or talked to the infants a minimum of once per week for 3 months prior to assessment. In addition, the infants in the child development laboratory are accustomed to having college-age females who typically wear pony tails participate in their classrooms as part of an internship and practicum program at the laboratory. Therefore, to reduce the likelihood that the assessment measured stranger anxiety instead of infant object exploration behaviors, the assessors were all college-age females and wore a pony tail. In addition, the infant's teacher was present in the room and visible to the infant. To further reduce the likelihood of measuring anxiety instead of

referential behaviors, only infants who did not exhibit moderate to extreme anxiety were selected for this study.

CHAPTER 4

RESULTS

The results of the case studies are presented below. They are the cases of 12-month-old Ella, 12-month-old Hannah, 17-month-old Emily, and 19-month-old Nichole. Each case will be presented separately with a summary followed by a cross-case comparison.

Twelve-month-old Ella

In the following interaction, 12-month-old Ella looks at the assessor after she has produced other referential gestures toward the toy and they do not result in activating the inactive toy. Her actions show the sequence of strategies she employs to get the toy to move again.

> The assessor winds up the toy crocodile, and Ella watches it as it crawls across the table with her mouth open. Her hands are lying flat on the table. She lifts one finger on one hand and then a finger on the other hand but keeps looking at the toy. When it stops moving she looks at it for a few seconds then puts her finger in her mouth. The assessor places the toy on the table in front of Ella. Ella looks at it for a couple seconds then takes her finger out of her mouth and picks it up, waving it side to side slightly. She touches the crank with her other hand, makes an “eh” vocalization, then glances up for a split second at the assessor and smiles.

Ella looks back down at the toy and holds it out to hand it to the assessor. Her eyes remain fixed on the toy while the assessor takes the toy, winds it, and places it on the table. Ella's hands are again lying flat on the table. She watches the toy move with her mouth open and then puts her thumb in her mouth as she keeps watching it. When the toy stops moving, Ella is still looking only at the toy, and the assessor places it on the table in front of Ella. Ella stares at it for a few seconds, then pushes the toy onto its side, then glances up at the assessor briefly while making an "eh" noise. Then Ella leans to one side to look at the underside of the toy while making three different toned vocalizations. The assessor takes the toy, and Ella watches the assessor's hands.

Ella's behaviors indicate her interest in getting the toy to move again. She uses several behaviors to reach this goal. First she picks it up, then she moves it through the air, then when that is not successful, she turns it over and touches the crank. These are behaviors she has seen the assessor produce toward the toy. Although her production of them does not result in the outcome she intends, they are an indication that she associates picking up the toy in one's hands and touching the crank with activation of the toy. After these strategies are not successful, she briefly glances at the assessor with a vocalization.

According to the ESCS coding scheme, Ella's glance at the assessor would be indicative of joint attention. However, the context of the glance and the fact that the glance is brief suggests otherwise. During this interaction, Ella keeps her eyes focused on the toy, suggesting that her actions are all related to object exploration. She only looks up

at the assessor two times, both of which are less than a second. In both cases she has just tried several strategies for reaching her object-related goal of reactivating the toy. Her glance at the assessor seems to indicate that she associates the assessor with the toy being activated. Her other behaviors toward the toy indicate that she observed and can imitate some but not all of the behaviors that activate the toy.

Twelve-month-old Hannah

In the following description, 12-month-old Hannah's actions and visual interest are also focused on the toy and activating it.

> The assessor pulls the string to wind the mechanical top. Hannah watches it spin. Then the assessor stops it from spinning and puts it on the table in front of Hannah. Hannah does not take her eyes off the top or move her body. The assessor says "whoop" as she stops the top from rolling off the table. Hannah keeps looking at the top and does not avert her gaze. Hannah picks up the top and turns it around in her hands. She fumbles with it in her hands…. The assessor says, "Hannah, give it to me" so she can activate the toy again for trial 2. Hannah looks up when the assessor says her name and then looks back down at the toy and keeps fumbling with it while the assessor requests it again. The assessor reaches out her hand and points to her hand requesting the object be put there and calls Hannah's name again. Hannah looks up at her for a split second and then looks back at the toy and keeps fumbling with it in her hands. The assessor gently takes the toy from Hannah while Hannah is still looking at it. The assessor says,

"Okay, let's try it again." Hannah looks at her when she says this, but watches the assessor's hands while she winds the toy. She places the spinning top on the table and Hannah points with a smile and leans her body toward the toy. The assessor puts it on the table in front of Hannah, who picks it up then fumbles with it and drops it on the table and picks it up again. The assessor says, "Hannah, give it to me" several times and Hannah looks up at her at the sound of her name and stares at the assessor for a second. Then Hannah looks back down at the toy and continues moving it around in her hands, exploring it with her fingers. The assessor holds out her hand and points to her palm. Hannah glances at the assessor's hands and pulls on the string. The assessor gets up on her knees as if she going to get up to reach for the toy. Hannah glances up for a split second and hands it to the assessor after several requests and the assessor says "Thank you. One more time." Hannah glances at the assessor very briefly while the assessor talks. The assessor spins the top and Hannah points to it and leans toward it, then looks up at the assessor, then watches the toy spin some more and points again. The assessor puts the toy in front of Hannah and Hannah looks at it. She picks it up, fumbles with it, and looks up at the assessor.

Hannah's refusal to give the toy to the assessor when the assessor requests it shows her intense focus on exploring the toy. She looks up at the assessor when her name is called, acknowledging that she heard the request, but does not comply and continues manually exploring the toy in repeated attempts to reactivate it. This action as well as her

continued visual focus on the toy and lack of looking at the assessor indicate her goal-directed behavior of exploring the toy manually in an attempt to produce the correct actions on the toy to reactivate it. Hannah is first focused on watching and touching the novel toy, then she makes referential gestures toward the toy and leans her body toward the toy as an external signifier of her intent to obtain the object in her hands and activate it. When the object is spinning and not in her hands, she leans toward it and points, indicating the line she must take to get the object into her hands to try actions on it. She is visually captivated by the toy when it is activated and only looks at the assessor when her name is called and one other time. This other time occurs after she has manually fumbled with and explored the toy without successfully reactivating it. This glance at the assessor indicates her recognition of an association between the assessor and the toy being activated. She employs looking at the assessor's face only after her initial strategies, such as picking it up, touching the parts with her fingers, and dropping it on the table, do not result in her goal.

Seventeen-month-old Emily

A similar use of glancing at the assessor is evident in the case of Emily, with slight variation. In the following general description of 17-month-old Emily, she also looks mostly at the toy and produces several gestures toward the toy that show she also recognizes certain behaviors as associated with the toy being activated. She is older and tries more behaviors than Ella and Hannah to attempt to reach her goal of exploring the object and getting it to move.

Emily sucks her fingers while she watches the bunny hop across the table. She leans toward it and points to it when it stops; she keeps her eyes fixed on it. Her pointed finger turns to an open hand that looks like a reach. The assessor puts the toy on the table in front of Emily. Emily picks it up, turns it over, pushes on the feet, bangs the bunny's feet on the table as if it is hopping, touches the feet again, then hands it to the assessor with her eyes still focused on the bunny. The assessor says thank you as she takes the toy, and Emily looks at her for less than a second. Emily puts her middle two fingers back into her mouth and watches the toy. The assessor winds the toy again, and Emily watches it bounce across the table. The assessor bounces slightly up and down. When it stops moving, Emily bounces up and down looking toward the toy and glances up to the assessor briefly while bouncing. Then she vocalizes "eh" while reaching and looking at the toy. The assessor hands her the toy, and Emily pulls at the feet with her fingers, turns it over, then bangs it on the table harder than before. She picks it up, turns it over, and touches the feet with her fingers.

Emily, like Ella and Hannah, seems focused on activating the toy and uses several referential behaviors to reactivate it. During this entire interaction she only looks at the assessor twice, once when the assessor talks and another time when Emily is bouncing but the toy is not. Her body movement of bouncing is something the assessor did, but while the assessor displayed this behavior, Emily was not looking at her. Emily seems to produce the movement as a motor signifier of the action she wants the toy to make. Her

other behaviors during the toy presentation, such as making the toy bounce manually, touching the feet, and handing the toy to the assessor are all strategies she uses to reactivate the toy. When she reaches for and points to the toy, this action is not accompanied by eye contact with the assessor. There is no indication that she is aware that the assessor is not attending to the toy or to her because she does not look away from the toy. Her arm extension gesture could be an attempt to touch the toy and activate it herself or could be a gesture that she has learned is useful when adults are present to get an object moved closer to her. She only produces it when the toy is not activated and not in her hands. Her behaviors evidence an understanding of some of the behaviors associated with activating the toy. She recognizes the association between the assessor and the toy being activated and she hands the toy to the assessor after her own attempts fail.

Nineteen-month-old Nichole

In the following description, 19-month-old Nichole is also focused on activating the toy but tries few strategies herself before using the assessor as a strategy.

> Nichole watches the assessor's hands and the object in them while the assessor clicks the blue top into place on the yellow spring-activated plunger and pushes a button on top of the plunger. The blue top detaches and starts spinning on the table. She places the yellow plunger on the table next to the blue top. Nichole watches the top spin. Once it stops spinning, the assessor waits a second and then moves both pieces to the table in front of Nichole. Nichole picks up the pieces and

turns them around in her hands. She tries to put them together several times but cannot get them to stay together. The assessor says, “mmm. Can I have it?” Nichole pauses then hands over the yellow part while looking the assessor in the eyes. The assessor also takes the blue piece from Nichole’s hand and spins the top again. While it is spinning, Nichole briefly looks up at the assessor and does not change her flat facial expression. Then she looks back at the toy and the assessor places the toy pieces in front of Nichole, who pokes around the blue top to make it wiggle. Then Nichole hands both pieces to the assessor while looking up at her face. The assessor says, “Thank you. One more time?” She reactivates the top, and the top spins for a while. Nichole watches it and does not look away. When it stops, the assessor puts the toy in front of Nichole and Nichole fumbles with the pieces in her hands. Then the assessor coughs several times and Nichole watches her cough while still fumbling with the toy. Then she looks back down at the toys and turns both pieces over on the table. Then she hands them to the assessor while looking at her face.

Nichole’s strategies for activating the toy when it is out of her reach do not include pointing or reaching but instead involve looking at the assessor for additional information. Her looking behaviors seem to indicate that she expects the assessor to have useful information about activating the object; she also understands that the assessor’s face is a relevant place to look for such information. Two different interpretations of this case are possible but both indicate Nichole’s developing concepts about the actions one

produces toward this novel toy. One interpretation is that she is trying to understand the relationship of the two pieces. When first given the two pieces, she moves both of them around. Then, when asked to hand over the toy, she only hands one part of it. This seems to indicate that she is not sure of the relationship between the two objects for getting the blue top to spin. Another interpretation is that she understands the end action of the blue top spinning but hands over only the yellow piece because its function or the action performed on it is still unclear. Her subsequent actions are focused on working to make the blue top move, but she begins to understand that the yellow plunger and blue top are related in some way because she hands both to the assessor eventually.

Nichole pokes the toy when it is in front of her, indicating her goal-directed interest in reactivating the toy. She looks at the assessor when handing the toy over after being asked to hand it over, then again while the toy is activated on the table, and finally while handing it over after she has tried poking and wiggling parts of the toy.

Cross-case Comparison

The cases of Ella, Hannah, Emily, and Nichole demonstrate infants' associative learning in reference to the toy, which can also be interpreted as schema development for activation of the toy. However, the behaviors of these infants do not indicate that their referential behaviors function to interact with the assessor except in the context of their interest in reactivating the toy. Infants' looking at the assessor does not appear to function as sharing affect, interest, or intersubjectivity, but instead are an indication that infants associate looking at the assessor's face with activation of the toy. All four of the infants

were object-focused and did not appear to socially share with the assessor, indicating their interest in their goal of toy activation and obtaining the toy for exploration. Their referential and non-referential behaviors show their intent to obtain and explore the toy with the end goal of activating it.

CHAPTER 5

DISCUSSION

Using case studies, I was able to describe the prevalence and sequence of referential behaviors that infants use in object exploration. The prevalence of referential behaviors was low, with most infants only looking at the assessor two or three times. This referential behavior and pointing behaviors occurred in the context of several other non-referential behaviors. Contrary to studies such as those by Tomasello and colleagues (see for example Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004; Liszkowski, Carpenter, Striano, & Tomasello, 2006; Tomasello, 1999; Tomasello et al., 2007) as well as Moore and colleagues (see for example Barresi & Moore, 1996; Corkum & Moore, 1998; Moore & D'Entremont, 2001; Moore, 1999), in this study, infants displayed behaviors that can be interpreted as indicating goal-directed behavior, schema development, focus on object exploration, and the development of schema about people. Goal-directed behavior and schema development were inferred because all of the infants' behaviors seemed to be focused on activating the toy. Some behaviors suggested that they either wanted to hold the object or produce another gesture to reactivate the object. Included in the strategies infants used were imitating the movements of the toy with their bodies, tapping the toy on the head, touching the crank, pushing the toy on the table, turning it in their hands, picking it up, and looking at or handing the toy to the assessor.

Their use of multiple behaviors indicates their developing schemas about behaviors one can produce to activate the toy. The sequence of behaviors included the infants first attempting to activate the toy themselves and after several attempts, using the assessor as a strategy. Their use of the assessor as a strategy *after* other strategies suggests their behaviors are directed toward exploring the toy. It also suggests their intent to recreate the activation of the toy or in other words, acting on the toy in the way they have seen is possible to make it active.

The inference that infants were focused on the objects was made because during the majority of their exposure to the toy, infants remained fixated visually on the toy and only looked at the assessor briefly. In studies conducted by Mundy and colleagues (see for example Mundy & Gomes, 1998; Mundy, Card, & Fox, 2000; Vaughan Vaughan, Mundy, Block, Burnette, Delgado, & Gomez, 2003) and Tomasello and colleagues (see for example Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004; Liszkowski, Carpenter, Striano, & Tomasello, 2006; Tomasello, 1999; Tomasello et al., 2007), looking at the assessor was interpreted as the infant's joint attention, however, in this study, infant goal-directed, object-focused behaviors were considered evidence of their use of self-initiated actions on the toy prior to looking at or handing the toy to the assessor as a strategy. Infants in this study showed little interest in interacting with the assessor; the assessor was a means to an end: she could make the toy move. Finally, rather than theory of mind, as suggested by Tomasello et al. (2007) and Mundy et al. (2007), in this study, infants' referential behaviors are considered indicative of their

developing people schemas because they looked at the assessor as one of their strategies, a behavior indicative of their recognition of the adult's relationship to the activation of the toy. Infants did not appear to look at the assessor with any shared understanding; rather, their glances at the assessor were a part of a goal-directed behavior in which the assessor was incidental. By describing these behaviors in sequence and in the context of goal-directed, object focused intentions we can infer that infants are problem solving using multiple referential and non-referential gestures.

The cases presented here are good examples of Piaget's stages of sensorimotor thought. Ella and Hannah, in the stage of coordination of secondary circular reactions, recognized actions they could produce on the toy while holding it in their hand, showing that they had developed schemas about the toy based on actions they saw produced on it as well as actions they had seen it make. They produced far fewer behaviors than Emily to reactivate the toy. Emily and Nichole, in the stage of tertiary secondary reactions, try more and varied strategies for reaching their goal, including more active use of the person as a strategy, thus indicating their exploration of alternatives to reaching their end goal.

Implications for Research and Theory

This study differs from other studies of joint attention in that it was not assumed that infants have a complex social cognitive ability and therefore tend to include others in their interactions with objects for the purpose of sharing attention with others. The goal of this study was to show how one can explore referential behaviors in infancy in terms of infant goal-directed behavior and problem solving. In particular, this study supports

the need for researchers to record behaviors instead of states because states are difficult to operationalize and may be based on inappropriate assumptions. In other words, an empirical approach requires the researcher to describe the set of behaviors, the situations in which they occur, and the sequence of their occurrence separate from conclusions about the underlying cognitive processes such behaviors reflect. Making prior assumptions about states of sharing attention confuses theory with empirical evidence. The evidence in this study does not support the theory that infants are sharing attention to an object with another person.

This study adds to existing discussion on joint attention because it highlights the need to reconsider terms and ideas such as "joint" attention in infancy. In previous studies of joint attention, as long as the adult is attending to what the infant is attending to and the infant points, reaches, or looks at the adult, the infant is said to be participating in joint attention. These studies failed to take into account research on theory of mind in preschool-age children and object property research in infancy. The current study highlights the need for researchers of joint attention specifically and cognitive researchers in general to examine emergence of behaviors from a developmental perspective. Specifically, if there is evidence that children older than infants cannot exhibit theory of mind, then it is unlikely that infants can have theory of mind and an alternative explanation for referential behaviors in infancy is needed.

This study also supports the need for researchers to examine studies outside their own typical bodies of literature. Researchers of joint attention do not tend to who

awareness of studies of infant object property learning and could benefit from considering research on this topic for discriminant validity purposes. By thinking in terms of "referential behavior" instead of "joint attention," I was inclined to describe observable behaviors. By referring to the state of "joint attention" when considering referential behaviors, researchers apply a top-down theory to behaviors that need to be described from the bottom-up. As suggested by Sirois and Jackson (2007), claims of complex social cognition in infancy are premature and serve to distract from more appropriate interpretations.

Implications for Theories of Joint Attention

Cognitive psychologists who study joint attention have contributed a great deal of knowledge to our understanding of the phenomenon of referential gesturing in infancy. Their terminology can still be useful, but needs to be reconsidered. For example, we *can* think of referential behaviors as a form of prelinguistic communication as Tomasello and colleagues do (see for example Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004; Liszkowski, Carpenter, Striano, & Tomasello, 2006; Tomasello, 1999; Tomasello et al., 2007), but not *intentional* communication. That is, an adult who watches an infant point can infer that the infant's point shows her interest but should not infer that the infant points for the purpose of sharing this interest or informing others of this interest. The infant points only because she has a goal-directed interest in her target, end of story. Adults can use this information to assist the infant in her goal-directed behavior or to build on it, but not as an indicator that the infant is including the adult in her goal-

directed behavior for social purposes of sharing. Similarly, we can refer to infant pointing as indicating the infant's need for assistance or adult attention or direction of intent as Moore and colleagues suggested (see for example Barresi & Moore, 1996; Corkum & Moore, 1998; Moore & D'Entremont, 2001; Moore, 1999), but not that the infant points for the purpose of requesting the adult to join with her or to "perform" for the adult. As stated previously, adults who observe this behavior can use it as information to assist the infant but not as an indicator that the infant is including the adult's mental state in her exploration. The infant's point shows the adult that the infant could benefit from adult attention but not that the infant recognizes this fact.

Mundy and colleagues used a multiple process model to describe "joint attention" behaviors (Mundy et al., 2007). According to this model, referential behaviors occur because of the interaction of multiple factors including individual differences in and developmental timing of information processing and attention regulation. Although, they attribute a social cognitive awareness to infants, their model was helpful to me as I thought of the variables that should be considered if a comprehensive understanding of referential behaviors in infancy is desired. This theory combined with Piaget's theory point to a need to explore referential behaviors in terms of their cognitive functions. Particularly, a simple process approach to referential behaviors without assumptions about social meanings was used for the present study. As a result, motives about "joining" with another person were not made. Working without this assumption appears

to be a valuable way to examine referential behaviors in infancy along with their meaning, development, and implications for later development.

Implications for Piagetian Theory

This study adds to existing discussion of the substages of sensorimotor thought by interpreting infants' referential behaviors in the presence of an adult as an indication of object-focused sensorimotor construction of knowledge and not a dimension of social interaction or sharing attention. It also suggests that referential behaviors in infancy are actually an indication of the beginning of goal-directed behavior, object schema development, and as external signifiers of infant thought processes. In addition, this study suggests a refining of Piagetian theory about the stage of tertiary circular reactions, the stage typically described as the beginning of infant problem solving. The presence of referential behaviors during the stage prior to tertiary circular reactions, the stage of coordination of secondary circular reactions, suggests that infants begin to problem solve earlier than previously thought. By describing referential behaviors as external signifiers of thought, we can infer a sequence in infant thinking and observe a part of infant problem solving.

Piaget offered what is perhaps the most comprehensive of all descriptions of infant cognition and development. Infant development textbooks primarily teach Piagetian theory to explain infant behavior at all stages of infancy (Fogel, 2007; Snow & McGaha, 2003), but researchers are quick to try to refute it. Perhaps Piaget's method of using only case studies of his own children to demonstrate his concepts of sensorimotor

thought are a factor that blinds infant development researchers to its usefulness. Instead of disagreeing with his theory because of his methods, providing evidence to support, refine, discriminate, and refute parts of his theory would be a more useful empirical endeavor.

Limitations and Future Directions

There were several limitations to this study including sample size and composition as well as method. All of the infants selected were female and did not act anxious, shy, or impulsive. This limits the results to infants with specific temperaments. However, the behaviors exhibited by some of the infants who were not selected also seemed to support the theories proposed about referential behaviors in this paper. The infant who became frustrated with the assessor taking the toy from him seems to show evidence of goal-directed behavior because he intended to continue manually exploring the toy and his efforts were thwarted. The infant who climbed across the table to try to obtain the toy and gave the toy to the assessor quickly after holding it also evidenced his goal-directed behavior of intent to obtain the toy and activate it. Although three of the infants who were excluded demonstrated visual checking and referential behaviors, their behaviors could not be differentiated from anxiety. It may be that attention management skills interact with emotion and problem solving resulting in a different set of behaviors for infants with a different temperamental tendency. Future studies need to examine temperament in conjunction with object-exploration behaviors in order to distinguish which behaviors are referential and which are temperamental. Similarly, an examination

of referential behaviors in infancy should consider the development of executive attention. Moore and D'Entremont (2001) and Vaish and Striano (2004) reported that infants use more referential behaviors in the presence of distractions from the target of their goal, implying executive function.

Future research is needed to provide clarification of the specific role, or roles, of referential behaviors during infant goal-directed behaviors or problem solving. Such research can be accomplished by (a) examining infants' goals in object-related tasks, (b) not assuming that because infants produce referential gestures toward an object in the presence of adults they intend to share attention with an adult, and (c) examining infants' development of schemas of people as unique and relevant objects. The assumption that infants are sharing attention seems to be an artifact of adults projecting their own attempts to share an experience with an infant (Povinelli, Prince, & Preuss, 2005). Without a theory of mind, infants cannot recognize and analyze the thoughts of others; thus for infants, egocentric thought organizes the way she interacts with her environment. In her mind, sharing is not relevant and she assumes that her thoughts represent all the thoughts there are. Her looks toward an adult while engaged in goal-directed behavior are functional in the context of the intended goal. This study was limited in that it only provided qualitative reports of time. By providing a quantitative measure of time with a larger sample, the hypothesis that infants are focused on object-exploration only could be further supported.

Practical Applications

According to Piagetian theory, infants should not be able to participate in episodes of joint attention. Instead, infants act in the world. Adults are vulnerable to attributing mature social meaning to infant actions. Certainly infants can think about situations and objects, but they cannot think about other people's mental states. This study provides valuable information about infant thought processes. For teachers, parents, and caregivers of infants, explaining infant thought processes would be a useful endeavor, reducing their frustrations, the infant's frustrations, and supporting the adult in determining the most appropriate response to infant behaviors. Attributing mature social cognitive abilities to infants perpetuates myths that pervade popular understanding about infants having intentions that they do not have such as "knowing better" than to act a certain way and it distorts our understanding of the abilities they do have.

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