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ABSTRACT

Examined are developmental changes in infants' strategies for using adults instrumentally to achieve goals. Data were derived from longitudinal observations of 1 girl and 1 boy twin individually interacting with 21 somewhat or totally unfamiliar adults at 2- or 3-week intervals from the age of 4 to 15 months, inclusive. Videotapes of interactions were viewed by four observers paired randomly and working independently. Findings indicated an increase in agreement between observers as infants grew older. The manner in which babies attempted to influence adults suggested that babies as young as 4 to 6 months of age may engage multiple means to use adults to implement goals. While babies at the earliest age use adults as tools without obvious acknowledgement of the existence of the other as a person, babies as young as 6 months may use more sophisticated strategies that are less direct and more communicative, such as self-initiated eye contact and symbolic gestures. It is not until the end of the first year that the infants used sustained and complex conventional symbols such as symbolically demonstrating the action to be performed or using words or nods. All the infants, even the youngest, were persistent. (RH)

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INFANTS' INSTRUMENTAL SOCIAL INTERACTION WITH ADULTS

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The role of social interaction in guiding children's development is receiving increasing attention as an explanation for children's rapid learning (Rogoff, 1986; Vygotsky, 1978; Wertsch, 1979). It is important to place child development in context, rather than focusing on individual children as if they develop in a vacuum, uninfluenced by the people around them and by the social and technological inventions they learn to employ.

However, a balance is needed in which the child's own efforts to learn and to employ social tools is recognized, along with the socialization attempts of those around the child (Rogoff, in press). It is the aim of this paper to examine how children direct the actions of those around them, deliberately attempting to use others to accomplish actions of which they are not independently capable or which require mutual involvement. We focus on the development of instrumental use of adults during infancy.

Researchers interested in social referencing have pointed out that infants attend to the intents and emotions of adults as a means of guiding their understanding of new situations (Feinman, 1982; Gunnar & Stone, 1984; Sorce, Emde, & Klinnert, 1981), as adults provide cues regarding the nature of situations, models of how to behave, and interpretations of behavior and events (Rogoff, in press).

In this paper we stress that social referencing is a mutual activity. In addition to the communication received from adults that influences infants' actions, infants actively attempt to influence adults' understanding of situations to promote infants' goals. This paper examines developmental changes in infants' strategies for using adults instrumentally to achieve goals which infants are unable to reach alone.

Our perspective is built on Bruner's work on intentional communication in infancy and Vygotsky's theory stressing the role of children's social interactions in their developing abilities to use the material and conceptual tools of society. Among the most important tools for infants are their caregivers, who provide the means for infants to satisfy their needs, as well as guiding the meaning of infants' encounters with the social and physical world. While caregivers interpret infants' actions and focus the meaning in them (for example, interpreting an arched back as an attempt to communicate), infants develop skills in using the available means to communicate and to use adults as tools to achieve goals.

We examine the development of infants' instrumental use of adults using longitudinal observations of one or the other of two infants interacting with 21 adults at two or three week intervals from the age of 4 to 15 months. We explore developmental changes in the extent to which the babies initiated an episode that appeared designed to use an adult instrumentally, the extent of agreement of independent observers that this has occurred, and developmental changes in the nature of the babies' goals and the means they used to reach them.

DETECTING INFANTS' ATTEMPTS TO USE ADULTS INSTRUMENTALLY

In order to study infants' attempts to use adults instrumentally, it is necessary to apply some criteria to their ongoing behavior that are precise enough to apply only to episodes that would qualify as attempts to use adults instrumentally, yet adaptable enough to apply to infants of quite different ages. The analysis requires attention to the structure of action, that is, how the episode unfolds and each person's actions build on those of the other. It also requires inference regarding the participants'

purposes, based on the interactive evidence provided by them in the interaction (see McDermott, Gospodinoff, & Aron, 1978). They are, we assume, actively trying to tailor their behavior to fit with each other's intentions and thus frequently test hypotheses regarding the direction the other means to take the interaction.

Our definition of an instrumental episode required observers to be certain that the baby had a definite goal, that the baby used multiple actions (simultaneously or in succession) to indicate to the adult what they wanted done, and that the baby evidenced satisfaction upon achieving the goal or dissatisfaction if thwarted. Our definition did not require the participants to be "conscious" of their purposes or actions, in the sense of being able to introspect or to describe them (see Lunzer's, 1979, definitions of consciousness, and Piaget's, 1952, discussion of intentionality). Our definition resembles Miller, Galanter, and Pribram's (1960) Test-Operate-Test-Exit cycle of planning, and is elaborated directly from Bruner's (1981) definition of intentional actions:

> An intention is present when an individual operates persistently toward achieving an end state, chooses among alternative means and/or routes to achieve that end state, persists in deploying means and corrects the deployment of means to get closer to the end state, and finally ceases the line of activity when specifiable features of the state are achieved. The elements of the cycle, then, comprise aim, option of means, persistence and correction, and a terminal stop order. (p. 41)

Specifically, the following criteria were applied to the videotaped play interactions of adults and babies to define an episode as instrumental:

1. The baby had to signal clearly that he/she wanted something, and must have either indicated clearly what was wanted or persistently attempted to clarify what was wanted over the course of the episode. The observer did not need to be certain exactly what the goal was, but just that there was one. The observer must have stated a goal (specific or diffuse) or two alternative goals that would fit the event.

2. The child's signalling must have been more than fleeting. It must either have been quite clear initially what the child wanted, or else the child must have shown clear or persistent attempts to get the adult to do something on his or her behalf. If the baby's expression of intent was brief and effective, it must nevertheless have involved several kinds of evidence indicating goal-directed behavior (e.g., simultaneous gazing and vocalizing toward an object). For clear requests to which adults responded rapidly, it was not necessary that the baby show persistence or adjustment of strategies. For less clear, more extended episodes, the baby must have been persistent or have adjusted strategies to get closer to achieving the goal or to clarify what the goal was.

3. The child must have ceased efforts when the goal was reached or became unreachable. The baby may either have shown satisfaction or acknowledgement when the goal was achieved, or have shown distress or avoidance if the adult did not understand or responded in a manner inconsistent with the baby's goal. If the goal was not met because of an interruption or if the outcome was ambiguous, the episode may still have been considered instrumental if there was other good evidence that the baby was attempting to use the adult to reach a goal.

4. In order to exclude reflexive activities by the child, or cyclical variations in the baby's state, or indications simply of interest in an object (rather than attempts to use the adult to get access to an object), the evidence for instrumental intent must have been stronger than any of these other explanations. If the baby's behavior was as easily explained in terms of intent to do something with an object as intent to use the adult to do something with an object, the event was not considered instrumental use of an adult.

5. If the adult commented on the baby's intentions (e.g., "You want the jack-in-a-box, don't you?"), this was not taken as evidence of an instrumental episode. Adults frequently make such comments (Harding, 1982; Kruper & Uzgiris, 1985). Often the adults in this study appeared to be talking aloud as they tried to figure out what to do next with the baby. Sometimes their comments appeared to be a way of communicating their own intentions to the experimenter (e.g., "You're ready to quit now, aren't you, baby?").

However, if the observers felt that the baby's actions provided evidence of an attempt to use the adult instrumentally, the adult's interpretation was sometimes useful in untangling the interaction, especially as the consequences of the adult's interpretation could be observed as the adult tested a hypothesis regarding the baby's intent.

Scoville (1984) argued that intentionality is in the eye of the beholder. In the present study, the beholders of interest are the trained observers, who used the evidence provided by the infants and the attempts of the adults to understand the infants' actions.

The observers only proposed episodes that they felt personally willing to argue for, rather than including episodes that another observer might

consider instrumental. They had to feel strongly that the event fit the criteria. They attempted to apply the criteria similarly across all ages. For example, they tried not to leave out episodes in which older babies used rudimentary strategies even though older children are capable of more sophisticated strategies.

There are undoubtedly instances in which the babies used an adult instrumentally but the evidence for inferring this was not clear enough for the observers. For example, if the communication between infant and adult is very smooth, the adult may anticipate the infant's desires before the infant needs to make them clear, and the observer does not have the chance to see if the infant can use alternative means to make the intention clear. Evidence shows that babies aged 9 to 18 months are more likely to attempt to regulate games with adults during an interruption than when the game is proceeding smoothly (Ross & Lollis, 1984). Since much of infant-adult interaction does function smoothly, with adults supporting infants' actions in what appears to a fine-tuned fashion (Bruner, 1983; Rogoff, Malkin, & Gilbride, 1984), this definition of infants' instrumental use of adults is rather conservative, and would miss many incidents that transpire smoothly between babies and those who are familiar with them.

The data that we analyze in this paper involve adults who are somewhat or entirely unfamiliar with these babies, and some of the adults are not familiar with babies at all. This may increase the likelihood that the babies will need to clarify their wishes in order to make themselves understood. (Our assumption here contrasts with Harding, Kromelow, & Touris' 1984 finding that infants produced more instrumental and intentional communication attempts toward their mothers than toward their daycare providers. However, in that study, the adults were instructed to

ignore the infants in a frustration situation. The infants' greater instrumental and intentional communications may be a function of their greater expectation that their mothers would respond.)

Another way in which use of these criteria may underestimate infants' attempts to use adults instrumentally is that they require infants to be somewhat persistent and not distracted from their goals -- and young infants are not known for their persistence. Older infants are able to withstand longer delays in carrying out their intentions (Diamond, 1985). Such differences in resistance to distraction could limit the appearance of instrumental episodes at the early ages.

Thus it may be appropriate to regard these criteria as an operational definition that specifies a certain kind of instrumental use of adults, one that involves great responsibility on the part of the child to make the goal clear and to persist in trying to reach it. Others may argue that younger babies than those we studied also use adults instrumentally (see Dunn's, 1982, thoughtful discussion of alternate definitions of intentionality). Rheingold (1969) argued persuasively that infants socialize their caregivers, teaching them what the infants need to have them do though the power of the cry and the rewards of smiles and vocalization. "From his behavior they learn what he wants and what he will accept, what produces in him a state of well-being and good nature, and what will keep him from whining (p. 786)." While we are open to the possibility that very early parent-child interaction may involve intentionality of some sort on the part of the infant, our criteria are designed to detect more deliberate efforts of infants to use adults instrumentally.

It is worth noting also that our criteria differ from those used by some other researchers interested in infants' intentional communication (e.g., Bretherton, McNew, & Beeghly-Smith, 1981; Sugarman-Bell, 1978). While we and they are both interested in infants' expression of intent, we do not require evidence of an intent to communicate, but rather an intent to get the adult to do something. Intent to communicate requires evidence that the baby recognizes that the adult is another person, and that a message is transmitted. This may be shown through eye contact as a baby requests an object, for example. Intent to use an adult as a tool is simpler, in that it could involve moves that treat the adult, or part of the adult (e.g., the hand) as an instrument, without signs of recognition that there is person "running" the hand (see Harding & Golinkoff, 1979; Piaget, 1952). The baby could attempt to get the hand to assist in reaching an object without making eye contact with the adult (Bates, 1979; Harding, 1982). Instrumental use of an adult could, of course, also include communicative moves. However, our criteria make it more likely to find instrumental episodes from younger children than in studies focusing on intentional communication.

THE NATURE OF THE DATA

We observed two infants as they interacted one at a time with 21 different adults, from the time the infants were 4 to 15 1/2 months old. The infants were a girl and a boy twin who were each observed with one adult every two or three weeks over the 11 1/2 months of the study. Each adult interacted only once with each baby. The data analyzed in this study consist of each adult's interaction with one of the two babies. (An earlier study reported by Rogoff, Malkin, and Gilbride, 1984, used the data

from these same adults with the other baby, in a parallel but different data set.) Twelve of the interactions are with the boy and nine are with the girl; the two babies appear in equal proportions in the early and later months of the study.

The adults were recruited through personal contacts, and were an assortment of relatives, acquaintances, and strangers to the babies. None of them were very familiar with the babies at the time of the observation, and 14 were complete strangers. They were either college students or had already completed college, and ranged in age from about 20 to 75. Thirteen of the adults were female and eight were male. Only nine of them were parents themselves.

The interactions occurred in a playroom in the babies' home, with the baby usually placed in a high chair facing the adult, who was asked to "get the baby to talk and smile and play with toys." A box of 11 toys was available beside the adult. The camera was placed at a right angle to the dyad, so that expressions and movements of both participants were available. The interactions continued until the adult or baby seemed to lose interest, and either the adult or sometimes the experimenter suggested that it was enough -- usually after about 5 to 7 minutes.

The videotapes of the interactions were each viewed from beginning to end by two of four observers (the authors), paired at random but working independently. They used the criteria discussed above to extract instrumental episodes from the flow of the interaction. Each episode that an observer identified as providing convincing evidence of instrumental use of an adult was described in detailed narrative identifying the evidence for the decision. These narrative episodes were examined for agreement between the two observers, as well as for the nature of the goal, the means the baby used to influence the adult, and the outcome.

AGREEMENT REGARDING THE EXISTENCE AND NATURE OF EPISODES

Agreements and disagreements between observers are informative regarding developmental changes in the clarity of the infants' attempts, as well as for purposes of determining the similarity in application of the criteria across episodes. We were interested in early hints of instrumental episodes, despite lack of agreement, to get a picture of what might be the precursors of infants' instrumental use of adults. To try to catch all possible episodes in a situation in which it was easy to miss one lasting only a few seconds in a 5 to 7 minute session, two independent coders evaluated each session. The ambiguity of the evidence at the youngest ages made for lack of agreement on whether or not an episode was convincing.

When the total footage of the sessions is considered, the agreement between observers is high, in that only 9% of the total footage consisted of actual disagreements (one observer identifies an episode that the other observer does not identify). However, this figure is inflated by the footage consisting of agreements that no episode occurred. While this is not irrelevant, it is important to consider the relation between footage that both observers identified as the same episode, and footage on which there was disagreement. (Please refer to Table 1.)

Insert Table 1 about here

From 4 to 6 months, there was no footage containing episodes on which both observers agreed. (In 2 cases, observers agreed that no episode had occurred, and in the others, observers identified up to 3 episodes per

session, but no episodes were chosen in common by both observers.) From 6.5 to 8 months, there was roughly an equal amount of footage involving agreement and disagreement. From 9 to 10.5 months, there was almost twice as much agreement as disagreement footage. And from 11 to 15.5 months, there was almost 3 times as much agreement as disagreement footage.

When agreement is considered in terms of number of episodes rather than footage, it increases similarly with infant age. At 4 to 6 months, there is no agreement; at 6.5 to 8 months, 36% of the episodes are identified by both observers; and after that, approximately 50% of the episodes are identified by both observers (and the remainder were identified by only one observer).

To correct for varying session length at the different ages, we also examined the number of episodes per hundred feet of videotape (which was about the average length of a session for the ages with the shortest sessions). There was an increase with age in the average number of episodes per hundred feet of videotape that were identified by both observers.

This increase in agreement with increasing age of infants suggests that evidence of instrumental interaction is very unclear in the first half of the first year, and becomes more explicit with each two-month advance. Consistent with this developmental pattern, Bruner, Roy, and Ratner (1982) found 8 months to be the age at which they could first consistently code their two subjects' requesting behavior. However, the frequency of instrumental episodes found here was approximately double that reported for requests at the same ages by Bruner, Roy, and Ratner (1982). The difference may be due to the fact that their subjects interacted with mothers and ours interacted with strangers, or to differences in focus for requests versus instrumental interaction.

When both observers agreed that an episode existed, their description of the evidence of instrumental interaction, the baby's goal, and the outcome were highly congruent. Almost all of the episodes coded by two observers were the same except for slight differences in the degree of detail recorded by one or the other observer.

For subsequent analysis, disagreements between observers were resolved by having a third observer decide whether the episode in question was or was not a convincing case of instrumental interaction. There were 22 episodes that observers agreed upon initially, and 31 episodes that only one of the observers noted. When a third observer voted on the disputed episodes, 16 of them were considered to have strong enough evidence of instrumental interaction, and 15 of them were discarded as having insufficient evidence. This results in a corpus of 38 episodes that were initially or finally agreed upon by two observers.

DEVELOPMENTAL CHANGES IN THE EXTENT AND NATURE OF INSTRUMENTAL INTERACTION

Frequency of instrumental episodes

The frequency of instrumental episodes (agreed upon initially or eventually by two observers) increased with age, as shown in Table 2. The youngest children had the most dyads with no episodes at all, and had the fewest episodes on the average. With greater age, there was an increase in the number of episodes and number of episodes corrected for length of session. At 4 to 6 months, there was an average of a half an episode, while at 6.5 to 8 months, there was an average of one and a half episodes, increasing to an average of over 2 episodes by age 11 to 15.5 months. The greatest change appeared to occur between the first two age groups (4 to 6 months and 6.5 to 8 months).

Insert Table 2 about here

Consistent with these findings, Bruner (1983) reports that Pratt, in an Oxford thesis, found a transition at about 6 months in mothers' interpretation of the intent of infants' cries. Before 6 months, mothers regarded cries as indicating physical needs, and infants were more likely to stop crying when the mother responded physically by feeding, resettling, or comforting the child. After 6 months, however, mothers added more "psychological" interpretations, and infants were more likely to respond to the "psychological" interventions of being offered an object or being engaged in interaction.

Using the observers' narratives of each episode, we examined the goal of the infants' interaction, the means applied, their persistence, and their success.

Purpose of the instrumental interaction

The babies' goals were classified according to whether they involved access to an object, an activity with an adult, or an activity with an object, and whether the baby wanted the object access or activity to begin (or continue) or to cease. An example of each type of purpose appears in Table 3, along with the frequencies.

Insert Table 3 about here

The most common purpose was to get the adult to assist with an activity with an object. The purposes involving access or activity with objects

predominantly demonstrated interest; the babies never tried to get the adult to take an object away and seldom tried to get the adult to stop an activity with an object. On the other hand, the purposes involving activities not involving an objects were generally avoidant; the baby often tried to get the adult to stop doing something social but seldom requested a purely social activity with the adult.

For the most part, the different purposes were distributed across the ages in proportion to the number of episodes at each age. An exception was that there were no activities involving objects at 4 to 6 months, activities involving objects increased to equal the other purposes at 6.5 to 10.5 months, and at 11 to 15.5 months the babies began to engage in activities involving objects to a much greater extent than the other purposes. At 11 to 15.5 months, there were 9 episodes involving activities with objects, 2 episodes involving access to an object, and 2 episodes involving activities with the adult.

Related to this shift is a change at the oldest ages to purposes that predominantly involved approach (11 episodes) rather than avoidance (2 episodes). At the earlier ages, the babies had a roughly equal distribution of purposes involving continuation versus cessation. It may be that at older ages the babies' greater communication skills procluded the need for persistent avoidance efforts, and the adults may have been more certain what the babies' cues meant so they would discontinue unwanted activities before the baby needed to insist.

The manner in which the babies attempted to influence adults

The means which the babies used to attempt to influence the adults were classified into the following categories:

changing posture toward or away from the adult or ongoing activity (such as turning the body away),

moving body in interest or distress (such as wiggling feet eagerly),

smiling at adult or indicating distress through facial expression,

non-word vocalizing of interest or distress,

gesturing with nondirect motions to indicate interest or rejection,

gazing fixedly at object,

making self-initiated versus responsive eye contact or avoiding eye contact,

slapping palm of hand against high chair tray in frustration,

pointing,

touching object to draw attention to it,

offering object,

demonstrating activity with object,

using words or symbolic moves such as affirmative or negative nods.

The total number of means used in each episode was greater for episodes involving cessation than those involving continuing an activity or access (10.9 actions versus 8.4 actions). The different ages used roughly comparable numbers of actions, except that the oldest age used more actions than the other three groups (11.9 versus 7.5 to 9.3), and the oldest age used far more actions for purposes involving approach than did the younger ages (11.5 versus 5.6 to 6.5). So in addition to greater involvement in positive activities with objects, at the older ages the babies engaged in much more extensive directions to the adults regarding what to do with the object.

The number of different means used per episode was only slightly greater for avoidance than approach purposes (5.7 versus 4.9 different actions). Here too the babies at the oldest ages used more different means per episode when pursuing a positive purpose than did the babies at the other three ages (5.8 versus 4.0 to 4.5 different actions).

Table 4 presents developmental changes in the use of a means that may be considered sophisticated: self-initiated eye contact. This may be compared with the use of avoidance of eye contact. It is important to distinguish episodes involving a purpose of beginning or continuing an activity (approach) from those involving an attempt to stop an activity (avoidance).

Insert Table 4 about here

In our data, it appears that the use of self-initiated eye contact as a means of influencing an adult begins as early as 6 months of age. At least half of the episodes after that age used self-initiated eye contact. It appears that the use of eye contact increased with age for episodes in which babies tried to influence an adult to begin or continue an activity (going from 50% to 100% of the interactions), while it decreased with age after 6 months for attempts to get an adult to stop an activity (going from 100% of the episodes at 6.5 to 8 months, down to 50% of the episodes at 11 to 15.5 months).

This onset of instrumental self-initiated eye contact may be somewhat earlier than the ages reported for coordinating eye contact and object manipulation in the literature on the development of intentional

communication (Sugarman-Bell, 1978). Bruner (1983) found that only at 9 months did his two subjects glance at their mothers concurrently with extending a hand towards an object in a request. Harding and Golinkoff (1979) found that most of their subjects aged 8 to 11 months intentionally used eye contact and gazing at an object when their mothers stopped working an object for them in a frustration episode. The discrepancy may be partially explained by the fact that our self-initiated eye contact episodes before the age of 9 months did not necessarily involve coordination of attention to an object and a person, since some of the episodes involved attempts to get the adult to continue or cease an activity that did not involve an object. However, of the 8 episodes in which the baby initiated eye contact between 6 and 8 months, 3 did involve objects.

An episode involving a 6-month-old demonstrated the use of self-initiated eye contact as the baby attempted to attract the adult's attention and resume interaction:

> The adult had been whistling, to the baby's delight, but quit when the baby bumped her chin on the high chair tray. The adult looked over into the box of toys. The baby immediately looked at the adult, straightening from her bent position and turning to watch him. The adult looked back at the baby questioningly, glancing back and forth between baby and toy box uncertainly, as if trying to decide whether to return to her or to go on to get a toy. The baby sat silently gazing at the adult, almost in expectation, with her mouth open in an expectant almost-smile. As the adult turned back to the toy box, the baby called out to him, loudly, "Hey!" as she looked intently at him, eyes widened and body making emphatic movements. As the adult

continued to look in the toy box, the baby called again loudly and with emphasis "Hey-ey-ey!" making excited motions with her upper body. The adult put a toy onto the high chair tray and the baby commented "Ah!", looking at the toy, then at the adult, then at the toy with less excitement but apparently satisfied, ceasing vocalization.

The early appearance of social acknowledgement of the adult's role is also apparent in the babies' responses when they accomplished their goals. On some occasions when the babies were successful, they acknowledged the adults' involvement when the goal was accomplished by making eye contact with the adult and smiling as they, for example, began to play with a toy they had requested. Acknowledgement of satisfaction using eye contact occurred as young as 6 months of age, and occurred in 3 of 9 episodes at 6.5 to 8 months, and in 5 of 26 episodes from 9 to 15.5 months. On occasion, of course, the baby simply engaged immediately with the object, or the attempt failed, so such social acknowledgement did not occur. An example of acknowledgment occured when a baby aged 9 months attempted to get an adult to take a stuffed plush frog out of the toy box:

It was the beginning of the session, and the adult and baby were sitting on the floor, facing the box of toys. The baby reached into the toy box and touched several toys. She looked up at the adult with her hand on the frog, which was wedged between other toys in the box. As soon as the baby looked at her, the adult reached for the frog, whispering "What's that?" The adult began to pull the frog out of the box, with the baby gazing at the frog.

At this point, the adult was interrupted by the experimenter, who was considering how to start the session. The baby straightened up suddenly, looking in the toy box, and exclaimed "A ha ha <u>ha</u>!" as if

saying "What's going on!" At the baby's exclamation, the adult looked back at her quickly, but the experimenter continued talking and the adult turned back to the experimenter. The baby then looked up at the adult, still holding onto the frog, waiting until the interruption ended.

When the adult turned her attention back to the baby, the baby proceeded to bang her hand on the frog, looking down at the frog now. The adult moved other toys out of the way to get the frog out of the box, as the baby watched. The baby looked appreciatively, shyly, toward the adult, and after knocking the frog over a few times, the baby got hold of the frog and proceeded to laugh wildly, clutching and chewing on the frog.

The use of avoidance of eye contact as a means of influencing the adult was limited (for obvious reasons) to episodes involving attempts to get an adult to stop an activity, and decreased with increasing baby age. It may be that avoidance of eye contact is a means of communication that is easy enough to implement at the earlier ages but drops out as more sophisticated strategies for influencing others become possible.

An interchange involving extensive use of eye contact (avoidance as well as self-initiated eye contact) is provided by a baby at 6.5 months, attempting to get an adult to stop blowing in his hair:

The baby seemed pleased the first time the adult blew in his hair, but the second time, the baby looked from side to side and not at the adult. His face was serious. When the adult blew again, the baby effortfully pushed his body to turn entirely away from the adult, sitting slumped over the arm of the chair facing 90 degrees away, looking down with a serious expression.

At this, the adult stopped the cadence of blowing and looked at the baby, gently touching his hand, saying "Huh?" The baby immediately turned back to face the adult, pulling both arms back onto the tray. He still did not look at the adult however. When the adult blew on the baby's hair again, the baby sighed deeply and looked up at the adult for a long intense gaze, putting his head back against the chair with his eyes squinted. The adult looked at him for a while, then asked sympathetically, "Want me to stop doing that now? Don't want me to blow on your hair anymore?" At this the baby smiled and sat upright again, as if indicating readiness to interact.

Some of the more sophisticated strategies include gestures with some symbolic (rather than direct) function, pointing, and touching an object to draw attention to it. Such gestures, combined, were used by all four age groups, increasing somewhat with age (from 33% to 78% to 46% to 77% of the episodes at each age, in order). They were used in roughly equal proportions of the episodes with approach versus avoidance goals.

Bruner (1983) notes that his 2 subjects began at 8 months to use a stylized symbolic reach -- open-handed, noneffortful, and with distinctive vocalization. We found a rudimentary form of such a symbolic gesture at 5.5 months, as a baby seemed to attempt to get an adult to hand him a Bugs Bunny jack-in-a-box:

> The baby took the ring (which he had been gumming) out of his mouth and looked intently at something to the side, saying "Uhhnn" as if to attract the adult's attention toward the object. The adult was busy trying to put the baby in a comfortable position on her knees, and the baby continued to look fixedly at the object, with his hand moving sort of in the direction of the object. Finally the adult was satisfied with the baby's position and called the baby's name. The baby still looked intently at the object, then reached out toward it with his index finger raised slightly above the rest of his spread out fingers so that it looked like an approximation of a point (and definately not an attempt to grasp), as he vocalized "uhhnn" apparently toward the adult. The adult responded, "Do you want Bugs?" and brought the box closer. The baby grasped and held it.

The most sophisticated symbolic gestures that we coded were when a baby held a toy out to an adult as an invitation to work the toy, or when the baby actually demonstrated the action that he or she wanted the adult to perform with the toy. These symbolic gestures occurred almost exclusively in the episodes involving an activity with an object. There were no such gestures (nor activities with objects) at 4 to 6 months. At 6.5 to 8 months, there was 1 episode in which the baby offered an object (out of 4 episodes at that age involving an activity-with an object, 25%). At 9 to 10.5 months there were 2 episodes with offers (out of 4 involving an activity with an object, 50%). At 11 to 15.5 months, there were 9 episodes involving an activity with an object, and in 7 of them there was an offer (77%), and in 3 the baby demonstrated the activity to be performed (33%). In addition, at this upper age, there was 1 episode of demonstration in an activity involving the adult but not involving an object.

The earliest episode involving an offer of a toy to get the adult to carry out an activity was when a baby at 6.5 months attempted to get an adult to work the jack-in-a-box:

> The adult had just put the jack-in-a-box on the high chair tray. The baby put her hands on both sides of the jack-in-a-box, pushing the box slightly toward the adult, looking up fixedly at the adult with a little smile, and vocalizing softly in a request tone, "Nnnh!" The baby continued to look at the adult, stretching to hold the box out to the adult. The adult reached for the handle, asking "What happens when we do this?" and the baby looked down at the front of the box as the adult began to wind the handle.

An episode involving an 11-month-old trying to get an adult to help him get the bunny out of the jack-in-a-box demonstrates how the baby both offered the toy as an invitation to act, and attempted to indicate what he wanted the adult to do. The interchange was awkward, in the sense that the adult felt uncomfortable in the situation as well as uncertain about the direction the handle should be turned, and the baby seemed to be overcome by eagerness to get the box open and occasionally gave conflicting messages:

> The baby touched the top of the closed jack-in-a-box with one hand and the handle with the other, vocalizing softly "Hnh!" The adult assisted the baby in turning the handle, then moved the baby's hand off the top of the box, probably to allow lid to open freely. The baby was surprised at this 'instruction' to keep his hand off the lid, and looked around for another place to put his hand, first putting it back on the lid but immediately removing it.

(Later he seemed uncertain about where to put his hand, and instead of trying to open the box at the lid (as he usually did), he 'scrabbled' his fingers at the front surface of the box apparently as a way of indicating that he wanted it opened.)

The baby reached for the handle and looked up at the adult, very directly. She let go of the handle and said, "OK, you can turn." But as soon as she let go, the baby took his hand off the handle also. The adult wound a few tentative notes, uncertain of the direction to wind. Then the baby reached for the handle again, and the adult withdrew her hand. The baby made a soft friendly growl sound (ggg) and reached for the top of the box as if to pull at it. He then looked up at the adult and moved this hand down to the front of the box, vocalizing softly with a questioning intonation as if remembering her moving his hand off the top of the box previously, and proceeded to scratch softly at the front of the box, looking at it. When the adult began to wind the handle again, the baby ceased fiddling his fingers on the box, and watched her wind for a moment.

Suddenly he sat up straight and enthusiastically grasped the box with both hands, fingers again moving as if trying to get into the box, exclaiming in a deep voice "Ga ga ga ga ga ga ga!" The adult took her hands off the box uncertainly. The baby broke into a smile and looked up at her, holding his hands on the box and smiling. She asked "What are you saying?" and he immediately pushed the box toward her, looked down at it, and moved his hand to scrabble at the front of the box with his fingers.

The adult tried to change activities with a mouse puppet, but the baby put his hands back on the top of the box and exclaimed again loudly "Ga ga ga ga ga ga ga!" in a friendly growl, then moved his hand and almost fiercely scrabbled at the front of the box with his fingers. The adult managed to distract the baby using the puppet, and then the episode was momentarily interrupted as the adult requested a kleenex for the baby's nose.

After the nose wipe, the baby returned his attention to the box, scrabbling at the front. When the adult tried to distract him again with the mouse puppet, the baby turned his head from side to side about 8 times, looking at the box, in what appeared to be a very effortful and deliberate negative comment. Then the baby picked up the box a began to chew on the bottom corner! (Perhaps indicating another way to get the box open? By this age he had ceased putting things in his mouth automatically for exploration.)

This successfully attracted the adult's attention, and the baby grinned, looked up at the adult, and pushed the box energetically toward her. He grinned, took his hand off the box, then looked down at the handle, which he held with the other hand. Eventually the adult turned the handle again, and the baby smiled and watched, contentedly looking at the box, then at the adult.

The adult continued trying to wind, but was uncertain which direction to turn the handle, and quit, encouraging the baby to try. The baby tried, but as soon as the adult turned her attention away, the baby picked up the box and again chewed on the bottom edge of it, vocalizing loudly "Ga ga ga ga ga!" He then looked up at the adult

with a very mischievous grin. But it was for nought, as the adult was now talking with the experimenter. The baby pushed the box away from him on the tray, and eventually let go and turned away, leaning over the side of the high chair. He continued to look away from the adult for some time.

It was only at the upper age range that the babies used the sophisticated strategies of conventionalized communication: uttering words or nodding affirmatively or negatively. These communications occurred in 36% of the episodes with an approach purpose at age 11 to 15.5 months (see rudimentary example in previous episode), but never occurred in the episodes with an avoidance purpose at that age, nor in any episodes at previous ages.

An example of conventionalized vocal communication (along with offers of an object) occurred with a baby aged 15.5 months trying to get an adult to wind the handle of the jack-in-a-box and make the bunny come out:

> The baby had been turning the handle of the jack-in-a-box, extensively and somewhat successfully. He glanced at the adult and took his hands off the handle and box momentarily. But the adult began to put the box away. The baby looked surprised and reached for the box with his hands and his glance. The adult asked, "You wanta still play with this?" holding it up. The baby seemed to say "Mm hm," and the adult asked "Yeah?" The baby extended his arm, looked at the adult, and grasped the box. The adult still didn't put the box on the tray, so the baby grasped the box with both hands and put it on the tray with conviction.
>
> The adult said "MmK " and leaned over to pick something up from the floor. The baby held the box, banged it on the tray, then held it

out toward the adult, saying "Mo?" [More?] as he turned his face and eyes to the adult (who had been off task for a moment). The adult said "What?" and the baby pushed the box further toward the adult, smiled, and looked down at it. The adult said, "You want me to do that?" The baby responded by looking intently at the handle, putting his fingers on it, cocking his head and saying "Mo?" The adult said "No?" and nodded her head negatively. The baby instantly looked up as if misunderstood. The adult asked "Do you wanta do it?" nodding yes and smiling, seeming to hold out for clarification from the baby. The baby looked at her intently, and with effort nodded no. The adult grinned, tickled the baby's leg, and asked again "Do you wanta do it?" The baby pushed the box toward the adult, looking at it.

The adult teased, "Don't want to play with that anymore?" and took the box off the tray onto her lap. The baby opened his mouth wide, leaned to look over the edge of the tray to the box, and pushed at it with his foot. The adult lifted the box and turned the handle while the baby watched intently. His hands were quite still, not reaching, and he opened and closed his jaw as he watched (shades of Piaget's daughter with the matchbox?). When the bunny popped out, the baby leaned to reach for the box, the adult grinned and handed it to him, and he immediately got to work putting the bunny back in the box.

In summary, the data on the manner in which babies attempted to influence adults suggest that even as young as 4-6 months, babies may use multiple means to use adults to implement their goals. While most of the means at the earliest ages involve using the adult as a tool without obvious acknowledgement of the existence of the other person as a person, as young as age 6 months babies may use more sophisticated strategies that

are less direct and more communicative, such as self-initiated eye contact and symbolic gestures. It is not until the end of the first year, however, that the babies used sustained and complex conventional symbols such as symbolically demonstrating the action to be performed or using words or nods.

Persistence and success of the babies' efforts to use adults instrumentally

Even at the youngest ages, the babies were persistent in their attempts to influence adults, and appeared to adjust their strategies to clarify their goals and fit their means more appropriately to the goals. We coded the episodes in terms of showing adjustment of means to be increasingly effective, intense, or clear; showing persistence without adjusting the means to the situation; or using a single effective means or simultaneous cluster of means. Most of the episodes at all ages were coded as showing adjustment (100%, 66%, 62%, and 69%). It is interesting that the use of a single means or a simultaneous cluster of means occurred primarily in the older two age groups (in 5 episodes after 9 months, and in 1 episode before 9 months). This may indicate that such simplicity of means may be less effective at the earlier ages. Or it may indicate that the observers required more evidence than this at the early ages to be convinced that an episode was indeed an example of instrumental interaction (rather than an adult imposing an action on the baby, or the baby accepting whatever action the adult offered without having a specific goal). At the younger ages, the observers may have required the evidence of persistence or adjustment in the application of means to be convinced that the baby was attempting to influence the adult. This interpretation is consistent with the data on developmental changes in the success of the babies' efforts.

At all ages, the babies' efforts were generally successful. It appeared that success was more frequent at the younger ages than the older ages. Of the episodes from 4 to 8 months, 92% were successful, but only 69% of the episodes from 9 to 15.5 months were successful. It is unlikely that young babies meet with greater success in general in getting their way or influencing adults than do older babies. More likely is the explanation that in order to infer the intent to influence an adult at the younger ages, observers depended on the information provided by confirmation by the baby when the goal was satisfied. In cases of failure, the baby's reaction may be less useful than the acknowledgement of reaching the goal that is common in the successful episodes, since the baby may simply look away from the adult or 'fret out' when efforts fail.

This finding underlines the importance of remembering that comparisons across age groups involve inferences based on operationalizations of constructs that may fit more closely with the skills of the more sophisticated subjects. Our developmental findings can be safely summarized as showing that older babies more frequently meet our criteria of instrumental interaction, and that the means employed differ with the age of the babies. But it would not be appropriate to make the inference that younger babies are less likely to use adults instrumentally. While would be an easy conclusion to make, it must be remembered that as observers we have more difficulty interpreting the behavior of the younger babies. It is possible that they attempt to use adults instrumentally but have difficulty in communicating their goals, implementing effective means to use adults instrumentally, or pursuing the goal in the face of distraction.

SUMMARY

In this study we have examined developmental changes in two babies' efforts to use adults instrumentally, from 4 to 15.5 months of age. The findings indicate that observers have more difficulty in agreeing on episodes of instrumental interaction until the second half-year of life.

The number of episodes of instrumental interaction increased four- or five-fold from age 4 to 6 months to age 11 to 15.5 months. The goal of getting the adult to facilitate an activity employing an object did not occur at the earliest months, but by the end of the first year of life, it became much more prevalent than the other goals (getting an adult to carry out an activity not involving an object, or to provide access to an object). At 11 months and later, the babies used more total means per episode to try to enlist an adult's help and more different means per episode than they did at earlier ages. The babies' strategies for influencing adults became more sophisticated with age: They increased their use of self-initiated eye contact and decreased their avoidance of eye contact. And they increased the use of sophisticated symbolic gestures such as offering an object to invite assistance, demonstrating the desired action to be performed on the object, and using words and head nods.

While the use of these symbolic gestures, conventional vocalizations, and self-initiated eye contact increased with babies' age, it is important to note that symbolic gestures and self-initiated eye contact were frequently employed by babies as young as 6 to 8 months of age.

This study suggests that even quite young infants effectively attempt to employ adults as tools in attaining their own goals. Such instrumental interaction requires skill on the part of adults in referencing the meanings and intents transmitted by babies, and skill on the part of babies in clarifying their purposes and the role the adults are to fill.

TABLE 1. Agreement between observers.

AGE (months)	NUMBER OF DYADS	AVERAGE FOOTAGE	% OF FOOTAGE AGREED	% OF FOOTAGE DISAGREED	AGREED EPISODES PER 100 FEET
4-6	6	105	0	13	0
6.5-8	5	110	6	7	0.7
9-10.5	5	167	18	10	1.1
11-15.5	5	111	19	7	1.6

TABLE 2. Frequency of instrumental episodes at each age.

AGE (months)	NUMBER OF DYADS	DYADS WITH NO EPISODES	NUMBER OF EPISODES	MEAN EPISODES PER 100 FEET
4-6	6	3	3 (X=.5)	.5
6.5-8	5	1	9 (X=1.8)	1.6
9-10.5	5	0	13 (X=2.6)	1.6
11-15.5	5	1	13 (X=2.6)	2.3

TABLE 3. Frequency and examples of the purposes of the episodes.

PURPOSE	NUMBER OF EPISODES	EXAMPLE
Access to object:begin	8	The baby tries to get the adult to give him the jack-in-a-box.
Access to object:cease	0	
Activity with adult:continue	2	The baby tries to regain the adult's attention and continued interaction.
Activity with adult:cease	11	The baby tries to get the adult to stop blowing in his hair.
Activity with object:begin	14	The baby tries to get the adult to work the jack-in-a-box.
Activity with object:cease	3	The baby tries to get the adult to change activities.

TABLE 4. Percentage of episodes with the purpose of approach or avoidance using self-initiated eye contact or avoidance of eye contact.

AGE	NUMBER OF EPISODES		SELF-INITIATED EYE CONTACT		AVOIDANCE OF EYE CONTACT	
months)	approach	avoid	approach	avoid	approach	avoid
4-6	2	1	50	0	0	100
6.5-8	5	4	60	100	0	75
9-10.5	6	7	50	86	0	57
11-15.5	11	2	100	50	0	0

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