Running Head: SIGNS OF EMOTION

Signs of emotion: What can preverbal children "say" about internal states?

C.D. Vallotton

University of California, Davis

Harvard Graduate School of Education

Larsen Hall, Appian Way, Cambridge, MA 02138

Phone: (617) 496-6621

Fax: (617) 495-3626

vallotcl@gse.harvard.edu

Author Acknowledgements

I would like to thank the children, parents, and staff of the Center for Child and Family Studies at UC Davis for their time and patience in the studies involved in this report, as well as the dedicated research assistants who so competently collected, coded, and transcribed data, and without whom this study would have been impossible. I would also like to thank friend and colleague, Livna Grinbaum, for the use her valuable data on toddlers' symbolic gesture use. Finally, I would like to thank the mentors who guided me through both the research and writing processes to produce this paper, including Larry Harper, Linda Acredolo, Kathleen Grey, and Elizabeth Fivaz. Preparation of this manuscript was supported in part by a grant from the Eichhorn Family Trust and by the National Institute of Child Health and Human Development, grant number 1 F32 HD050040-01.

Abstract

Do infants explicitly recognize feelings and emotions in themselves and others? What would preverbal children say about internal states if they had the words? Investigation of infants' emotional understanding is limited by the challenge of understanding infant mental states before the onset of speech. I examined the use of symbolic gestures by normally-hearing preverbal children to discover whether infants and toddlers represent emotion concepts such as *sad* and *scared*, and feeling words such as *sleepy*. Participants were 22 children (5 – 28 months) in a childcare program where caregivers modeled symbolic gestures. Gesture use by children and caregivers were videotaped and coded to determine context, characteristics, and frequency. Twenty of 22 children used symbolic gestures; of these, 6 used emotion gestures, and 5 used feeling gestures. These gestures were not imitations of adult gestures, and qualitative data reveal their context and significance. Symbolic gestures reveal the sophistication of infants' internal worlds and their ability and desire to communicate thoughts and feelings. Symbolic gestures are a promising methodology for investigating early explicit mental processes. As a therapeutic communication tool symbolic gestures may help children express emotions, participate in conversations about emotion, and construct their own understanding of internal states.

Signs of emotion: What can preverbal children "say" about internal states?

Katie, 27 months old, sat at the art table in the toddler classroom with her mother and caregiver and played with the paint. Katie looked intently at the picture that she was drawing. She painted a circle and said, "Happy face," and smiled. Then, looking at her mother, she said, "Mama, you make a happy face." Katie's mother painted a circle. Katie took her paint brush and put two dots in her mother's circle; she looked up and said, "Eyes." She smiled and, taking her brush again, painted a line in the circle saying, "Smile." She added a third dot, smiled, and said, "I made a nose!" Her classroom caregiver reflected, "Katie, you finished the happy face! You put eyes and a nose and a mouth on the happy face!" Katie smiled and returned to her painting.

Meanwhile, 24 month old Gerry stood by the front door of the toddler classroom crying, and whimpered, "Mommy." He walked over to the book shelves, slapped a single hand at a few of the books, and then paused as he cried. Gerry's caregiver, Mandy, approached and sat down next to him, saying, "Gerry, I see that you are sad. You're thinking about your mom." He continued to cry and crawled onto a soft chair. Mandy asked, "Do you want to read a book?" Gerry whimpered "Yes." He climbed slowly out of the chair, walked to the books, and went directly to the book about gorillas. He carried it to Mandy, sat between her legs, looked up at her, still sad, and said "Mommy." Mandy responded, "This is the book you mom

was reading to you." With his head down and hands busy flipping open the book pages, Gerry whispered "Yes." Mandy began to read[1].

In the first observation, Katie represented the concept of happy through both her words and her drawing as she was painting with her mother. She associates the concept happy with the action of smiling and shows that she has a basic understanding of the emotion. Meanwhile, her slightly younger peer Gerry uses just a few words to tell his caregiver why he is sad and what will comfort him. Using these words he is able to actively participate in and shape a routine that will help him regulate his emotions. Most children begin to represent emotion concepts vocally around two years old, but was this the beginning of Katie's understanding of the concept of happy or Gerry's ability to actively participate in regulatory interactions? In this study I show that these children's abilities to represent and communicate about emotions and emotional events are not as new as their emotion vocabularies. Both Katie and Gerry used symbolic gestures to represent emotions, as well as other concepts, before they could speak; and they used these symbols as a way to "converse" about emotions with their caregivers, to express their own feelings, and to participate in regulatory interactions.

Though studies have shown that children understand spoken language before they vocalize words (Fenson, et al.,1994), children are not generally believed to reflect on or have an explicit understanding of emotions – either their own or others' – until after they are verbal. In this study, I examine infants' and toddlers' use of symbolic gestures in order to break the language barrier that keeps scientists, practitioners, and parents from seeing and responding to the extent of preverbal children's understanding of feelings and emotions.

---

[1] Both anecdotes are drawn from systematic child observations recorded by teachers at the UC Davis Center for Child and Family Studies. Names have been changed, but age and gender are accurate.

Young children's understanding of emotions

Young children learn about the social and emotional world in an amazingly short time. Habituation studies show that infants as young as 2 to 3 months can discriminate between positive (happy) and negative (angry or fearful) facial expressions, and by 7 months infants can even discriminate more subtle categories and intensities of emotions (as reviewed by Nelson, 1987). Social referencing studies employing a visual cliff or novel object have established that by 12 months infants understand the contextual meaning of their mothers' facial expressions and behave accordingly (i.e., Sorce, Emde, Campos, & Klinnert, 1985). Thus, infants' behaviors elicited by emotion stimuli reveal recognition of and responsiveness to emotions. Their meaningful – contextually appropriate – response to emotion, paired with the fact that preverbal children's verbal comprehension exceeds production, leads to the question, Can preverbal children explicitly think about emotions, that is, can they represent them mentally?

The development of the capacity to represent emotions – to reflect on or name emotions – is an integration of cognitive and social-emotional skills, an integration of domains which continues to develop throughout childhood. Studies examining this integration as early as the late second and early third year of life have focused on children's use of spoken words to describe the thoughts and feelings of others (Dunn, Bretherton, & Munn, 1987), and the possible causes of emotion and emotional consequences of behavior (Lagattuta & Wellman, 2001). Typically developing children begin to express emotion concepts (e.g., sad, happy) and internal feeling states (e.g., sleepy) between 18 and 20 months, shortly after the onset of verbal language, with most children acquiring the use of basic internal state words around 2 years of age (Bretherton and Beeghly, 1982; Dunn, Bretherton, & Munn, 1987). Children's articulation of emotion

understanding grows steadily as seen in spontaneous and elicited conversations with parents; as early as three years old, some children begin to understand the link between past experiences and emotions (Lagattuta, 1999) and between thoughts or memories and emotions (Lagattuta, Wellman, & Flavell, 1997). The complexity of children's explanations of emotions and their ability to link cognitive and emotional states continues to grow as increasingly related skills throughout early childhood (Harris, 1989). At around 5 years children develop an explicit Theory of Mind (ToM) – the understanding that others' have mental processes which can differ from their own including beliefs, desires, and emotions. Concordantly, typically developing 5 year olds can articulate their understanding of emotions and begin to succeed on ToM tasks indicating an adult-like understanding of the basic properties of thoughts and beliefs. Children continue to integrate this knowledge with their understanding of the causes and consequences of emotion throughout the next one to two years (deRosnay, Pons, & Harris, 2004). Finally, links have been found between use of mental state language – including emotions – and children's ToM performance. Parental mental state language has been found to predict children's later ToM (Adrian, Clemente, Villanueva, & Rieffe, 2005) and children's own mental state language is related to their concurrent ToM (Symons, Peterson, Slaughter, Roche, & Doyle, 2005) language and later ToM. Thus, young children's representations of emotion concepts may be seen an early part of the developmental path to integrating emotion and cognition.

More than simple maturational correlaries, representation skills may actually support the development of social-emotional understanding. Showing a firm, and perhaps causal, link between emotion understanding and language development, Cutting and Dunn (1999) found that preschoolers' language abilities including both receptive and expressive language were

correlated with their emotion understanding as indicated by their ability to label and predicts others' affects. Further, Pons, Lawson, Harris, and deRosney (2003) showed that age and language ability together explain most (70%) individual differences in development of emotion understanding in children followed between 4 and 11 years old. These findings suggest that children's understanding of emotions may be partially dependent upon their language abilities.

Summarizing the literature on early development of emotion understanding, a gap is revealed between the period of infancy (under 1 year) when most studies focus on children's abilities to recognize basic differences between emotions and the period of late toddlerhood or early preschool (two to three years) when studies focus on children's abilities to verbalize explicit representation and understanding of emotions. The question addressed in this study is whether preverbal children in this age gap can explicitly represent an understanding of emotion.

Preverbal children's representational repertoire: Symbolic play and gesture

Preverbal children are neither thought to *intentionally* cope with their emotions (Kopp, 1982; Aldwin, 1994; Murphy & Moriarty, 1976) nor to have an explicit understanding of others' emotional expressions – or a Theory of Mind for Emotions (ToM-E). The failure of developmental science to see these skills at younger ages may be due to a reliance on children's verbalization of emotion concepts before emotion understanding can be measured, and the assumption that children's ability to use emotion concepts effectively in social situations develops only after they can voice their feelings. What could be learned about infants' knowledge of emotions if they could express what they know in a way adults could understand?

Young children begin to use spoken words as symbols to communicate in the first half of their second year (Reich, 1986), but this is not the beginning of a child's understanding and

production of symbols. Young children have other systems of symbols available with which to represent concepts. Children's representations of objects and concepts are expressed physically (i.e. Piaget, 1952) before they are expressed vocally (Werner & Kaplan, 1963). In order to be a true symbol, a representation must communicate the concept of the referent in its absence (Werner & Kaplan, 1963). For example, a spoken or written word can communicate any concept chosen in the absence of the object to which it is referring, as long as the meaning of it is shared. Meeting this criteria, preverbal children use symbols in the absence of their referents in play when they act out concepts for which they have not yet learned the words, and use one object to represent another (Ungerer, Zelazo, & Kearsley, 1981). The use of objects as a representational medium, however, limits representation and communication to situations in which they have an object on hand that can manipulated in a way similar to the referent object. Another media of representation that is available prior to language and not so limited is gesture.

Gestures are intentional motor actions usually intended by children as communicative cues (Bates, Camaioni, and Volterra, 1975; Bakeman & Adamson, 1986). Typically, pointing emerges as the first gesture around 9 months of age (Carpenter, Nagell, & Tomasello, 1998; Crais, Douglas, & Campbell, 2004); it is a robust gesture, a version of which is even used by blind infants (Iverson, Tencer, & Lany, 2000). The "showing" gesture also emerges around 9 months (Bates, O'Connell, & Shore, 1987), and is used to engage an interaction partner. Typically developing children use gestures both as a means of requesting (i.e., requesting to be given an object out of reach), and directing another's attention (Carpenter, Nagell, & Tomasello, 1998). Though these gestures so commonly used by young children are not symbolic according

to Werner and Kaplan's criteria, they are intentional and communicative, and thus indicate the beginning of children's attempts and abilities to create shared meaning.

In addition to the common non-symbolic gestures, preverbal children are capable of learning and even inventing truly symbolic gestures, representing absent referents (Acredolo & Goodwyn, 1985, 1988). Acredolo and Goodwyn (1985) first documented the symbolic gestures of one infant, Linda Acredolo's daughter Kate, when Kate began inventing gestures for objects in her environment at 12.5 months old. Acredolo described her first observation of Kate's symbolic gestures with the following anecdote (Acredolo & Goodwyn, 1985, p. 42):

> "While about 3 feet away from [a rose bush], Kate pointed at it and sniffed. From then on the sign occurred regularly in response to many flowers and pictures (always at a distance) and in answer to various verbal prompts (e.g. "What's that?")."

Kate used the "flower" gesture in both the presence and absence of flowers, and generalized it to both real flowers and other representations (photographs) of flowers. Kate went on to use a total 29 different symbolic gestures – 13 which she invented and 16 modeled by her caregivers – before she began to talk prolifically at 18 months (Acredolo & Goodwyn, 1985).

Acredolo and Goodwyn followed this case study by investigating whether and when other children use symbolic gestures, and whether use of symbolic gestures could slow language development. An interview study with parents of 17 month olds established that the phenomenon of spontaneous use of symbolic gestures was not unique to the case-study infant; and a longitudinal parent-diary study detailed the concurrent development of gesture and language in infants from 11 to 20 months old (Acredolo & Goodwyn, 1988), showing that use of gestures to communicate faded as children began to use vocal words effectively. This study also documented that infants' first gestures were typically requests such as *up* or *outside*, followed by

gestures naming objects such as *dog* or *car* and events. Finally, Acredolo and Goodwyn used an experimental design to test the effects of symbolic gesturing on language development; an experimental group of families used symbolic gestures with their children while a control group of parents focused on their children's oral language development. Results revealed that children could learn a symbolic gesture for a given concept before the corresponding vocal word (Goodwyn & Acredolo, 1993), indicating that conceptual and representational capacities precede language development. Further, those who were taught to use symbolic gestures used vocal language earlier and scored higher on measures of expressive language (Goodwyn, Acredolo, & Brown, 2000) assuaging fears that use of gesturing would prevent children from learning vocal language, and suggesting that gesturing may help children build symbolic capacity.

Approaching these findings on preverbal children's representational capacities with an interest in the beginning of children's understanding of internal states leads to the questions: If preverbal children can use symbolic gestures to communicate desires and observations, can they also explicitly represent emotion concepts? And if so, when will these emotion gestures appear in relation to gestures for requests and objects?

The Current Study

This study examines the use of symbolic gestures by normally hearing infants and toddlers to determine whether young children can represent emotions, feelings, and time concepts in dialogue with others. Infants and toddlers were those enrolled in an early childhood education program in which symbolic gestures were modeled by caregivers.

Use of symbolic gesturing in infant and toddler care.

The children who participated in this study were in a unique university-based child care and education program in which caregivers (university students) used symbolic gestures with the children during typical routines and spontaneous interactions. Caregivers were also taught, in accordance with the program's philosophy, ways to support children's emotional and cognitive development from an attachment-theory perspective.[2] Caregivers were taught to use gestures through modeling by their classroom supervisors; they were given a list of common gestures and their descriptions; and small posters describing specific gestures were placed around the classrooms as reminders.

Children were never directed to use gestures, but learned and used the gestures modeled by caregivers in conjunction with speech during typical daily interactions. Children occasionally invented new gestures themselves, which, if understood, would then be used by the caregivers in interactions with the children. Caregivers were encouraged to respond to children's gestures regardless of how precisely children performed them, and to pay particular attention to gestures children invented in order to discover their meaning and respond appropriately.

Caregivers modeled a total of 71 symbolic gestures including signs for the feeling, emotion, and time concepts of interest in the current study: feeling concepts include *hurt*, *cold*, *loud*, *gentle*, and *sleepy;* emotion concepts include *sad*, *angry*, *scared*, and *happy;* and time concepts include *wait*, *later*, and *Popsicle Time*. Descriptions of all symbolic gestures observed in the Infant and Toddler Program during the study period can be found in the Appendix.

Defining feelings and emotions.

---

[2] Related to the program philosophy and caregivers' training, readers may note the caregivers' responsiveness to children's emotional cues in the qualitative transcripts.

Though both feelings and emotions can be internal states, there are reasons for separating them into two different categories. In accordance with the work of Bretherton and Beeghly (1982), feelings are primarily physiological sensations that can be a result of internal (sleepy, hurt) or external stimuli (cold, loud). Whereas e*motion* is used to label the more complex psycho-social internal states such as sad or happy.

The inclusion of time concepts.

It may not be readily apparent why time concepts are included in a study of feelings and emotions. However, time concepts are integral to the ability to *regulate* emotions and behavior. Self-regulation of emotions and behavior has much to do with anticipation of future events. For example, one of the definitions of self-regulation includes the ability "to postpone acting upon a desired object or goal" (Kopp, 1982, p. 199). *Waiting* is one of the primary challenges to any infant or toddler, and learning to maintain one's emotional state while *waiting* until *later*, or until a *specific time*, may be a critical task in utilizing cognitive skills in the service of self-regulation once a sense of the future becomes conscious. Waiting is also critical in the ability to get along with others – both peers who may be holding the only toy a child wants, and adults who insist on keeping schedules despite a child's immediate desires. Thus, young children's abilities to understand or symbolize time-related concepts is also of interest in this study, particularly the concepts *wait, later, and Popsicle Time. Popsicle Time* is a concept specific to the study population, referring to the program's daily routine in which parents return for their children. Children, caregivers, and parents eat popsicles (ice made from water with a little juice) together each day at the end of the program, providing the children with a specific reference for the daily event of reunion with their parents.

Questions

The spontaneous use of gestures by infants and toddlers in a childcare setting was examined to investigate whether and to what extent preverbal children – who had been systematically to the use of symbolic gestures by adults – used emotion concepts in their early communications. The questions addressed in this study are:

- Do infants and toddlers use symbols to communicate emotion state concepts such as sad, happy, and angry?
- Do they use feeling concepts, indicating a perception of internal sensations?
- Do they use time concepts, indicating an anticipation of events?
- In what contexts do young children express emotion concepts through gesture? Do they use gestures to communicate their own feelings, or comment on others' feelings?
- When do they begin to use these types of gestures in relation to other types of gestures, such as those for requests or objects?

Methods

Participants

Participants were 10 infants and 12 toddlers in an Infant and Toddler Program at the University of California, Davis Center for Child and Family Studies (CCFS) where the use of symbolic gesturing was modeled by caregivers. Infants were 7 females and 3 males; 4.5 to 11.5 months old when the study began, and 12.5 to 19.5 months of age when the study ended. Toddlers were 5 females and 7 males; 17.3 to 24.8 months of age when the study began, and between 20.8 and 28.3 months old when the study ended. Though enrollment in the CCFS Infant

and Toddler Program was open to the entire community, priority was given to the children of University students, staff, and faculty; thus many of the study participants were children of University community members.

Video-Taping Procedures

Children were videotaped during normal program routines at the Center for Child and Family Studies. Videotapes of infants were collected for 8 months, while videotapes of toddlers were collected for 3.5 months.[3] Videotapers were in the classrooms and playgrounds with the children and could move to follow the children as necessary. Children in each classroom were filmed approximately the same number of times, but the order of filming varied randomly each time the videotapers cycled through the list of participating children.

Infants. Each infant was videotaped for a five-minute period an average of 40 times over the course of 8 months. All videotapes were taken when infants were interacting with a caregiver during typical program routines: snack-time, and free-play. Snack and free-play were chosen for data collection times because these routines do not elicit specific emotions as would separation or diaper-changing routines. Thus, the timing of infant observations was designed to gather a sample of all spontaneous gesturing behavior in this classroom context, rather than specifically feeling, emotion, and time concepts. On average, each infant was filmed a total of 200 minutes (2.5 hours), an average of approximately 1% (0.93) of their 360 hours in the classroom over the 8 months of data collection.

[3] Initial data on infants and toddlers were gathered separately for two different studies on symbolic gesture use, thus the methods of initial data collection are not equivalent, though coding of symbolic gestures from the videotapes is consistent. The two sets of data are presented together in this paper because they provide complimentary information; however, analyses of the two groups are done separately, and they are not compared statistically.

Toddlers. Each toddler was videotaped an average of 15 times over the course of 3.5 months. Toddlers were videotaped during regularly-occurring distressing routines (separation from parents, diaper changes, and conflicts between children) in which they were typically interacting with a caregiver; however, presence of a caregiver was not required in the case of filming spontaneously occurring peer conflict. Videotapers shadowed each child and began filming before the anticipated distressing event (except in the case of spontaneously occurring conflict) and continued recording until the child had resumed normal play, a sign that the distress was mostly resolved for the child. Videotape lengths ranged from 0.5 to 19 minutes (m = 5.5 min). Thus, the timing of toddler observations was designed to gather a sample of emotionally relevant gesture behavior.

Coding

All videotaped episodes were coded unless there were no technical problems rendering the behavior of children or caregivers unrecognizable. Observers coded videotaped episodes in real time – that is, they marked time, in minutes and seconds, as each behavior occurred. Below I describe the coding in terms of gesture content, conversational context, and social-emotional context. Then I describe the process of coder training and reliability.

Content of coding.

Gesture content. Gestures were defined as intentional and communicative motor behaviors performed in the context of interaction. Because gestures were performed largely the same way across participants, coders recorded the concept represented by each gesture, rather than describing the form of the gesture. For example, if a child or caregiver traced a finger down her cheek from her eye, coders recorded “sad”; if she tapped her fingers against her mouth,

coders recorded "eat/snack" (see Appendix for examples of gestures and descriptions of how they are performed). In order to be sure that children's gestures were indeed meaningful rather than random motor behavior, behaviors were only recorded as gestures if they were in the context of an interaction with a caregiver as indicated by body positioning and eye contact. Each gesture performed by children and caregivers in each episode was recorded. Because the timing of each gesture was recorded, the data also include the sequence and frequency of gestures.

Categories of gestures. The gestures used by caregivers and children can be placed in 11 different categories: Action/Event, Adverb/Adjective, Emotion, Feeling, Non-Symbolic, Object, Parent, Question, Request, Time, and Yes/No. These categories reflect both the varying definitions of the gestures (i.e. those for actions such as *play* and those for nouns such as *bird*) as well as how the children typically use the symbols pragmatically. Numerous gestures could be placed in more than one category. For example, *outside* could be used by child or caregiver as an adjective (see the bird *outside*), or a request (want to go *outside*). For simplicity, I categorized each gesture in one of the 11 mutually exclusive categories listed above based on the gesture's most common use among children; for example, though the symbol for *eat/snack* may be seen as an event or a noun, it was most often used by the infants as a request, thus it is grouped as a request in the current study. Because the gestures were pre-assigned to categories, coders did not assess the categories of the gestures, but simply recorded which gestures they observed. For examples of gestures in each category, refer to the Table 5 in the Appendix.

Conversational context. In order to establish that infants were expressing their own thoughts and feelings through their gestures, rather than simply imitating gestures performed by caregivers, it was important to code whether the gesture was initiated by the infant, in reply to a

caregiver, or an imitation of a caregiver's gesture. Thus for the infant data observers also coded the conversational context of each gesture. That is, gestures were coded in one of four conversational categories: (1) Initiation: the gesture was not preceded by any other gesture in the last 5 seconds[4]; (2) Continuation: gesture was preceded by a different gesture by the same individual within 5 seconds (e.g. child gestures "mom," then he gestures "later"); (3) Response: gesture was preceded by the same gesture by a different person within 5 seconds (e.g. caregiver gestures "snack," then child gestures "snack"); and (4) Reply: gesture was preceded by a different gesture by a different person within 5 seconds (e.g. caregiver gestures "bird," then child gestures "where?"). Importantly, the Response category includes gesturing that may be imitation of another's gesture.

Social-emotional context. To examine the social-emotional relevance of children's gesturing, other child and caregiver behavior and significant events occurring in the classroom were described in real time to clarify the meaning of symbolic gestures. These descriptions include child's affect and vocalizations, caregiver's gestures and vocalizations, and events such as a mother's arrival or departure, or another child's crying.

Process of coding.

Coder training. Coders of the infant videotapes were University students who had neither interacted with the children in the study, nor with any child using symbolic gestures. Coders of the toddler data were University students who had never directly interacted with the children in the study but had observed children using gestures while collecting the videotape data. Coders

[4] Five (5) seconds was used as a conservative yet somewhat arbitrary marker of conversational timing. Through visual and auditory review of the gesturing episodes it was determined that if a child or caregiver were to respond to another's gesture, it would happen within 5 seconds, and that those occurring more than 5 seconds later were not responses as indicated by changes in attention and gesture content.

were trained to recognize gestures – symbolic and non-symbolic – by learning behavioral descriptions of the gestures and seeing examples of them on coding-training videos. If there was more than one way to perform a sign, the coders were given both descriptions and both versions of the sign were coded the same.

Inter-coder reliability. Observers obtained a Kappa of .75 or above – on the timing, content, and conversational context of each gesture – before beginning to code independently; agreement among coders was re-assessed on 15% of the episodes using Cohen's Kappa to ensure consistency in interpretation of the codes. Agreement on all codes – timing, content, and conversational context of symbolic gestures – was considered critical for the accurately interpreting their meaning. For the infant data, coders' agreement on both type (which gestures were being performed) and conversational context of gestures was assessed concurrently; that is, coders had to agree on both which gesture was performed and whether the infant had initiated, continued, responded, or replied to an adult, in order for codes to be considered in agreement. There was high agreement on both of these gesture qualities. Coders of infant data achieved inter-rater reliability scores of Kappa = .75 or above on five tapes in a row before coding independently, and upon reassessment of 15% of all tapes had Kappa scores of .83 and above. Coders of the toddlers' types of gestures (not coded for conversational context) also achieved inter-rater reliability scores of Kappa = .75 or above on five episodes in a row before coding independently, and reassessment had maintained Kappa scores above .75.

Transcripts. The coded gestures, conversational context, and descriptions of social-emotional context were used to create transcripts of the gesturing episodes that included children using emotion of feeling gestures. These transcripts are presented as qualitative data in the results

of this study; they corroborate the meaningfulness of the infants' use of emotion, feeling, and time gestures.

Results

Gestures used in the classrooms

All of the caregivers used symbolic gestures in their interactions with children. Caregivers performed a total of 71 different symbolic gestures between them, while 20 of the 22 children displayed a subset of 51 different gestures between them (A sample list of gestures observed in the classroom during the study period is presented in Table 5 in the Appendix). Most gestures by children and caregivers were observed more than once per individual; however, some were captured on videotape only once. Some gestures were more likely to be used in the infant classroom, and others in the toddler classroom, highlighting the fact that though caregivers were all trained the same way, there was no attempt to control their use of gestures, resulting in individual differences. This also means that there was no control of differences in how many times a child was exposed to a given gesture, nor whether they were exposed to it at home.

Children Represent Both Emotion States and Time Concepts through Gesture

Of the 20 children observed to use symbolic gestures, nine children used at least one emotion or feeling gesture or both. Six children used emotion gestures, the earliest recorded on video at 10.9 months of age; and five used feelings gestures, the earliest recorded at 14.7 months of age. Additionally, 11 children used time-related gestures, the earliest at 12.8 months of age. Table 1 displays the number of infants and toddlers who were observed to use each of the emotion, feeling, and time gestures, including the youngest age at which the gesture was observed to be used. The second column in Table 1 names the gesture, the third column describes

the total number of infants and toddlers (out of 22 observed) who were observed on videotape to perform the gesture at least once, and the fourth column describes the earliest age at which any child was observed on videotape to perform the gesture.

TABLE ONE ABOUT HERE

Preverbal Children Use Emotion and Feelings Gestures to Talk about Their Own and Others' Feelings in Socially Meaningful Contexts

Each episode in which a child used a gesture communicatively was transcribed in terms of its social and emotional context. There were 37 transcribed gesturing episodes (across 9 children) that included a child using emotion or feeling gestures, excluding those which included emotionally relevant content (i.e. mom leaving or returning) but did not include an emotion or feeling gesture. Based on the transcription of the child's behavior, caregivers' behavior, and salient events in these episodes, it was possible to discern whether a child was representing her own internal state or the internal state of another for 26 of the 37 episodes. The numbers of episodes about self and other, as well as those which could not be determined due to insufficient information are presented in Table 2. Column 1 of Table 2 identifies each of the nine children who was observed to use emotion or feeling gestures during a videotaped interaction; columns 2, 3, and 4 indicate the number of episodes for each individual child in which the emotion gestures were judged to be about the child's own emotions (column 2), the emotions of another (column 3), or whether there was insufficient information to make such a determination (column 4). Columns 5, 6, and 7 provide the same information about episodes that included feeling gestures.

TABLE TWO ABOUT HERE

To conservatively test whether children's use of emotion and feeling gestures could be random rather than meaningful, I tested whether the number of interpretable episodes (26) was greater than chance. Testing conservatively, I assumed that all 11 episodes in which the use of emotion and feeling gestures could not be determined as self- or other-referent were random, or not meaningful behavior. In a binomial distribution, the 70% (26/37) observed to be contextually appropriate is statistically above chance ($p < .01$).

Table 3 presents 6 samples of the transcribed observations of children's use of feeling and emotion gestures. Five of the observations in Table 3 were selected from the 26 socially meaningful episodes transcribed from the videotapes; however, Observation 4 was recounted by the UC Davis Academic Child Development Specialist. These qualitative observations demonstrate infants' ability to articulate their own internal states, as well as reflecting on the internal states of others.

TABLE THREE ABOUT HERE

Further qualitative interpretation of the transcripts showed that three children demonstrated the beginnings of explicit empathy by commenting on the emotional expressions of another child; the earliest age at which this appeared was 15.4 months; an example of this is seen in Observations 5 and 6 in Table 3. Further qualitative analysis of the other transcribed observations revealed that two children demonstrated the ability to distinguish between negative emotions by correcting their caregivers as to *which* emotion they were feeling (i.e. *mad* not *sad*), as described in Observation 4 in Table 3. And two children demonstrated an understanding of the causes of sadness by describing what another child needed in order to feel better. The earliest age at which this was observed was 15.5 months, as described in Observation 6 in Table 3.

Emotion Gestures Used Earlier than Time and Feeling Gestures.

Only data from the infant participants were used to describe the order in which each gesture category appears because only the infants were observed from their first exposure to symbolic gestures, whereas many toddlers had been exposed to symbolic gestures during the previous year if they had been enrolled in the program as infants. In order to describe the developmental sequence of the appearance of gesture categories, I determined the age at which each child was first observed to use a gesture in each category. I then averaged the ages of first use across children within each category. Figure 1 displays the sequence of gesture category development according to average age at first observation. The dark black bars show the median age for each category, the top and bottom of the grey boxes show the 25th and 75th percentile of ages, the horizontal lines above and below the boxes show the oldest and youngest ages at which children were first observed to use each category of gesture, and the black circle below the Yes/ No bar represents and outlier. The numbers (N) below each bar are the numbers of infants who were observed to use at least one gesture in that category.

FIGURE ONE ABOUT HERE

By ordering the gesture categories according to average earliest age of appearance across infants the following order of appearance is found: (1) non-symbolic gestures at 9.83 months, (2) request gestures at 10.32 months, (3) gestures naming objects at 11.37 months, (4) gestures naming actions or events, 13.52 months, (5) gestures representing questions, 13.60 months, then (6) gestures naming emotions at 13.83 months, (7) yes and no gestures, 14.16 months, followed by (8) time concepts at 14.23 months, (9) Mom and Dad at 14.82 months, and (10) feelings/ sensations at 14.70 months. These results are consistent with and suggest an elaboration of the

sequence of appearance reported by Acredolo and Goodwyn (1988) who described the development of naturally occurring (rather than intentionally modeled) symbolic gestures as reported in parent interviews. According to the parents' reports, objects and requests were the most common categories of symbolic gestures observed, and infants' use of requests preceded gestures for objects and events by an average of .59 months.

Not Just Imitation: Infants Initiated More than Imitated Symbolic Gestures.

In order to be certain that infants' expression of emotion, feeling, and time concepts through gestures were not simply a result of imitation of adult gestures, the conversational context was assessed for each of these categories of gestures. I used a binomial distribution to test whether the infants' emotion, feeling, and time gestures were as likely to be imitations as non-imitations, as judged by coders. Results are presented in Table 4.

TABLE FOUR ABOUT HERE

As seen in Table 4, infants' use of emotion, feeling, and time gestures were rarely imitations of an adult gesture. That is, infants' use of emotion, feeling, and time gestures were not preceded by an adult gesture in the prior 5 seconds.

Discussion

This paper began with two stories of toddlers' use of words to communicate about emotions. Katie used her drawing and words to initiate a conversation with her mother about the concept of happy, and Gerry used a few simple words to draw comfort from his caregiver when he was sad that has mother had left. The question I posed was whether their concepts of and abilities to communicate about emotions were predicated upon the children's use of words, or whether, given the right tools for representation, these children might have communicated their

understanding of emotions before they could talk. The results of this study indicate that preverbal children exposed to the systematic use of symbolic gestures can use these gestures to represent and communicate about their own and others' emotions, initiating and maintaining meaningful emotion-related explicit interactions with their caregivers.

This study provides a first report on preverbal children's use of emotion gestures. In interpreting the results, it is important to remember that the data was collected as an observation of children's spontaneous behavior and thus describes what preverbal children in this unique classroom context *did,* rather than testing what they were capable of doing when their gesturing behaviors are elicited and supported. Below I address the limitations of the study, then describe both the theoretical implications and potential clinical applications of the results.

Limitations

Can we generalize to other children and other contexts? The most important limitations of the current study are to generalizability. Even more critical than the small sample size is the unique culture of the UC Davis Center for Child and Family Studies. The findings that at least some preverbal infants and toddlers can use gestures to represent feelings, emotions, and time concepts must be contextualized by the highly gesture-rich environment in which gestures were consistently modeled and responded to. There is no reason to believe that this aspect of the context could not be replicated in other childcare centers or the home environment, but the current results must be interpreted with specific context in mind. With the growing popularity of the Baby Signs Program (Acredolo & Goodwyn, 1992) among both parents and childcare centers in the United States and other nations, there are growing opportunities to further the study of preverbal children's use of symbolic gestures in interaction contexts.

Additionally, the generalizability of the findings on the order of symbolic gesture development is limited by the somewhat cross-sectional nature of the current study design. Though infants were followed intensively for 8 months, and toddlers for 3.5 months, in order to understand the development of different symbolic gestures and emotion concepts over time, a larger sample of children should be followed for approximately 2 years – from before the beginning of non-symbolic gesture use to after the beginning of word use.

Why were there so few observed uses of emotion and feeling gestures? One limitation of this study is that the data most likely underestimated the number of children in this sample who could and did use emotion, feeling, and time gestures, as well as the number of times each child used the gestures. Rather than constructing a circumstance in which children's emotion gestures were specifically elicited, testing whether all infants were capable of using them, I gathered a sample of spontaneous gesturing behavior as it was used in everyday caregiver-child interactions in this real but unique classroom environment. I observed only 1% of the children's time in the classroom, and likely only 1% of infants' gesturing behavior; but these observations were typical of everyday use of gesturing behavior within the daily routines around which data collection was structured. Though this design was limited in its ability to verify the full abilities of each child, it describes meaningful behavior by children and caregivers in the important context of childcare. Future studies should be designed with complementary controlled tests of elicited gestures as well as observation of spontaneous gesturing in an interaction context.

How do we know infant gestures are really meaningful? I did not construct a situation in which infants could name the wrong emotion, thus I did not test children's discriminatory abilities and confirm that they can always name the correct emotion when faced with a choice. A further challenge of this type of observation is that even if an emotion gesture was observed that did not seem to fit the social circumstance of the child, it would be very hard to say that the child was incorrectly using the gesture because the child might be responding to internal (invisible) stimuli – such as a memory or their own current internal state. With no way to verify what the child is responding to, we have to take their word for it, so to speak. Thus, there is no way to verify in this type of observation that 100% of children's emotion gestures were appropriate to their social-emotional context. However, the qualitative transcripts (such as the examples in Table 3) provide valuable information on children's abilities to represent emotions in a meaningful, context-appropriate way. By describing instances in which children's symbolic gestures do match the social-emotional context – including the child's own internal state or the emotional state of a peer – I have illustrated the ability of symbolic gestures to make visible children's social-emotional understanding. Confirming the meaningfulness of children's symbolic gesture use, in 26 of 37 (70%) episodes children's use of feeling or emotion gestures could be determined as self- or other-referent as determined by the social context.

Finally, if infant gestures were indeed random, or lacked meaning to the infants, then one would expect that children would more frequently perform one of these meaningless gestures in imitation of another's gesture, rather than performing symbolic gestures coded as "initiations" or "replies." The test of infants' imitation of adult gestures showed that infants were far less likely to imitate symbolic gestures than to initiate them, including emotion, feeling, and time gestures.

Thus, I conclude that in most instances, children's use of emotion, feeling, and time gestures are meaningful to the infant and appropriate to the social and emotional context.

Limitations of observation of spontaneous behavior in the child care classroom setting. There are two limitations of the observational design I used in the classroom setting. First, because of the nature of the childcare setting and the procedures for filming – almost all episodes of children's use of symbolic gestures were in the context of interaction with a caregiver. Thus, I did not observe how infants may use gestures with other children or by themselves. Second, although the children were all in the same program with caregivers who were trained the same way, there was no way to control differences in how many times a child was exposed to a given sign, nor how much they were exposed to the use of gestures at home. This limits confidence about which gestures would come first – particularly within the emotion and feeling categories. However, the current study provides a first look at a context in which children demonstrate their social-emotional understanding through symbolic gestures. This information can serve as a guide in developing meaningful experimental procedures to elicit more of these behaviors to further our study of the integration between cognition and emotion in preverbal children.

Theoretical and Research Implications

Are children representing internal states or external expressions? These results bring up a number of questions about the details and sophistication of children's explicit understanding of emotion. Could infants simply be describing actions that are the results of emotions, rather than truly representing internal states? For example, when children use the *sad* gesture, are they instead saying "cry," and when they use the *tired* gesture, are they instead saying "sleep"? This may seem logical, particularly since Werner and Kaplan (1963) argued that our symbols are built

upon action. However, this cannot be the case for all of the emotion gestures. For example *scared* and *angry* have no obvious or consistent specific actions beyond facial configurations that consistently accompany them. Thus, the symbols used in this setting by children and caregivers to say "scared" or "angry" do not directly mimic an emotion-related action, but are somewhat more abstract. Further, as seen in Observation 2 (Table 2), when children refer to themselves as *sleepy* they are most likely referring to an internal state rather than an action, because to refer to the self performing the action of sleep (which is not happening at the moment the child is gesturing) would indicate hypothetical projection of self into the past or future, thus demonstrating explicit memory or imaginative play. Future studies should test whether gestures with specific feeling/emotion-related actions (such as sleep and cry) develop *before* the more abstract ones (such as fear and anger).

Early emotion-cognition integration. Children in this study used emotion gestures to express internal states including sadness, anger, hurt, sleepiness, and fear. Additionally, the qualitative observation data showed that infants demonstrated emotion understanding by using emotion gestures in context-specific ways; for example, 3 children showed what could be seen as the beginnings of empathy by gesturing to their caregivers about the emotions of another child. Two children used gestures to communicate both their own and another's state. These findings challenge the view that *explicit* awareness of emotions, as well as complex and differentiated emotional experiences, develop later in childhood.

Infants' use of symbolic gestures representing emotions and feelings catalyzes another line of questions regarding the potential of symbolic gestures to help children integrate cognitive tools (symbols) with emotional experiences. These findings show an early link between

cognition and emotion, using representation for emotional experience. Given the literature reviewed earlier showing that language skills support emotion understanding, future research should test whether the early opportunity to apply symbol skills (gestures) to the social-emotional domain in infancy leads to earlier or more complex emotion understanding in preschool children.

Overcoming methodological limitations. Granting the foregoing interpretation of the data, and if children's use of emotion gestures can be further verified in other populations, symbolic gestures may give us the opportunity to overcome two barriers to the study of emotional understanding and social development in preverbal children. First, investigators of child development have had trouble breaking the language barrier in order to examine children's conscious or explicit knowledge of emotions prior to the 3rd year of life, and how that knowledge might affect behavior. It would be particularly useful to see if and how preverbal children's explicit knowledge of emotions affects their coping strategies with their own emotions and their reactions to the emotional signals of others. If we can verify the position that preverbal children can use symbols to represent internal states, we can look earlier in development to examine the role of symbol skills in social development. If Vygotsky (1934/1986) is correct in the proposal that symbols act as the "psychological tools" of our higher mental processes, tools with which we think, reflect on, and modify our behavior, we may expect that a child who has a useable symbol system at an earlier age will be able to use those symbols to understand her experiences and modify her behavior in a way she did not before.

The second methodological barrier which could be overcome by symbolic gestures is that of experimenting with children's language development. Although many studies have shown a

correlation between the domains of children's language and social development (i.e., Zeidner, Matthews, Roberts, & MacCann, 2003; Baldwin & Moses, 2001; Cassidy, Werner, Rourke, Zubernis, & Balarman, 2003), none have experimentally examined the nature of this relation because all typical children develop language. In order to understand how these two domains of development – symbolic competence and social skills – are related, we must separate them somehow. Symbolic gestures may give us the opportunity to experiment with the relation between language and social development by providing one group of children symbols prior to their ability to produce verbal language and comparing their reflective functioning and social-emotional skills to a comparable group of children who are not using symbolic gestures. Thus we can explore the putative causal relations between language development and social skills.

Further research on early symbol use and emotion. First, children's ability to use symbolic gestures to express emotion concepts should be verified, both in other populations of children, and in situations designed to elicit specific emotion gestures. For example, children could be provided stimuli related to specific emotions and be tested on their spontaneous responses. Additionally, children's ability to distinguish matching emotions and correct mismatched labels could be tested by experimentally correctly labeling and mis-labeling emotion stimuli and testing whether children will more often correct a mistaken label.

After such experimental verification of infants' abilities to accurately use and understand emotion-related gestures, I suggest that experimental design with longitudinal data collection could answer some questions useful to application. By providing one group of children with consistent modeling in symbolic gestures and comparing their cognitive and social-emotional behavior to a group of children who are not provided with this gesture-rich environment, we may

be able answer such questions as: 1) Do children who had earlier developing symbol systems including emotion gestures show more competent reflective functioning – i.e. explicit understanding of internal states such as emotions, desires, thoughts, etc. – later in development? And, 2) Do children who had earlier developing symbol systems including emotion gestures show more competent social functioning – i.e. prosocial behavior, self-regulation, empathetic responses to peers, etc. – later in development?

Clinical implications of the use of symbolic gestures with preverbal children

There are several possible clinical implications for the use of symbolic gestures as a communication tool between parents and children. Because further study should first verify use of emotion gestures in additional populations of children, the clinical applications reliant on children's use of emotion gestures should be taken as speculative. I propose four clinically applicable benefits of using symbolic gestures with preverbal children. Each of which could potentially be achieved within the context of either a parent-child or a non-parental caregiver-child relationship.

Using symbolic gestures in general: Enhanced communication and reduced frustration. Incidental to their seminal study of young children's symbolic gesture use, Acredolo and Goodwyn (1988) heard from many parents about the relationship benefits of using the Baby Signs Program® - involving systematic use of symbolic gestures similar to the use at the CCFS. Qualitative interviews with parents verified that the use of symbolic gestures with their preverbal children eased their relationships (Acredolo & Goodwyn, 1992) during a time of typically frequent frustration – when children's receptive language is developing rapidly, but expressive language is not. Parents reported that the use of the Baby Signs Program ® allowed their toddlers

to communicate their needs and desires instead of becoming frustrated by less effective pointing and nonspecific grunts. Though they did not include gestures for emotions in their study, the results of Goodwyn and Acredolo's parent interviews have promising implications for enhancing parent-child communication about emotions. This finding should be investigated experimentally to more clearly understand how the early parent-child relationship could be affected by the use of symbolic gestures.

Using symbolic gestures for emotions: Expressing, conversing, and constructing understanding of emotion. In addition to the benefits of clearer adult-child communication at an age during which frustration is the norm, the use of emotion gestures specifically may have additional clinical applications: 1) *Expressing emotions:* emotion gestures could be used to encourage children to express their own emotions, in both positive and challenging circumstances. Programs such as Early Head Start and NAEYC-accredited childcare classrooms include expression of emotions as part of their curriculum standards, however, these curricula and practices are typically developed only for verbal children. 2) *Conversing about emotions:* Use of emotion gestures could create opportunities for children to initiate and hold two-way conversations with their caregivers about their own and others' emotions, potentially overcoming caregivers' tendencies to avoid talking about negative emotions with their very young children. 3) *Constructing an understanding of emotions and internal states:* Vygotsky (1934/1986) proposes that words – or symbols – are mental tools for actively constructing understanding of experiences and knowledge of the world. Thus, the use of emotion gestures may go beyond communicative tools for expression of emotions to be mental tools for constructing

understanding of emotions. If so, then early use of emotion gestures may help advance the development of a Theory of Mind for Emotions (ToM-E).

Summary

The current study provides a first report on preverbal children's use of symbolic gestures to represent emotion concepts. In addition to opening a new set of questions about preverbal children's explicit social-emotional concepts, these results reveal further the sophistication of the infant's social-emotional experience and understanding, as well as demonstrate the potential of symbolic gesture as a methodology for understanding the intersection of emotional and cognitive development prior to the onset of vocal language.

References

Acredolo, L., & Goodwyn, S. (1985). Symbolic gesturing in language development: A case study. *Human Development, 28*, 40-49.

Acredolo, L., & Goodwyn, S. (1988). Symbolic gesturing in normal infants. *Child Development, 59*, 450-466.

Acredolo, L., & Goodwyn, S. (1992). *Baby Signs: How to Talk with Your Baby Before Your Baby Can Talk*. Chicago, IL: Contemporary Books.

Adrian, J.E., Clemente, R.A., Villanueva, L., & Rieffe, C. (2005). Parent-child picture-book reading, mothers' mental state language and children's theory of mind. *Journal of Child Language, 32*, 673-686.

Aldwin, C.M. (1994). *Stress, coping, and development: An integrative perspective.* New York, NY: The Guilford Press.

Bakeman, R. & Adamson, L.B. (1986). Infants' conventionalized acts: Gestures and words with mothers and peers. *Infant Behavior & Development, 9*, 215-230.

Baldwin, D., & Moses, L.J. (2001). Links between social understanding and early word learning: challenges to current accounts. *Social Development, 10*, 309-239.

Barrera, M., & Maurer, D. (1981). The perception of facial expressions by the three-month-old. *Child Development, 52,* 203-206

Bates, E., Camaioni, L., and Volterra, V. (1975). The acquisition of performatives prior to speech. *Merrill-Palmer Quarterly, 21*, 205-226.

Bretherton, I. & Beeghly, M. (1982). Talking about internal states: The acquisition of an explicit theory of mind. *Developmental Psychology, 18*, 906-921.

Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development, 63*, v-176.

Cassidy, K.W., Werner, R.S., Rourke, M., Zubernis, L.S., & Balarman, G. (2003). The relationship between psychosocial understanding and positive social behaviors. *Social Development, 12* 198-221.

de Rosnay, M., Pons, F., & Harris**,** P.L. (2004). A lag between understanding false belief and emotion attribution in young children: Relationships with linguistic ability and mothers' mental-state language. *British Journal of Developmental Psychology, 22,* 197-218.

Dunn, J. Bretherton, I. & Munn, P. (1987). Conversations about feeling states between mothers and their young children. *Developmental Psychology, 23,* 132-139.

Fenson, L., Dale, P., Reznick, J.S., Bates, E., Thal, D., & Pethick, S. (1994). Variability in early communicative development. *Monographs for the Society for Research in Child Development, 59,* v-173.

Goodwyn, S., & Acredolo, L. (1993). Symbolic gesture versus word: Is there a modality advantage for onset of symbol use? *Child Development, 64*, 688-701.

Harris**,** P.L.(1989). *Children and emotion: The development of psychological understanding.* Cambridge, MA: Basil Blackwell.

Harris, P.L., de Rosnay, M., & Pons, F.(2005). Language and Children's Understanding of Mental States. *Current Directions in Psychological Science, 14*, 69-73.

Harris, P.L., Johnson, C.N., Hutton, D., Andrews, G., & Cooke, T. (1989). Young children's theory of mind and emotion. *Cognition and Emotion, 3,* 379-400.

Harris, P.L., & Lipian, M.S. (1989). Understanding emotion and experiencing emotion. In C. Saarni & P.L. Harris (Eds.), *Children's understanding of emotions* (pp. 241-258). New York, NY: Cambridge University Press.

Jenkins, J.M., Turrell, S.L., Kogushi, Y., Lollis, S., & Ross, H.S. (2003). A longitudinal investigation of the dynamics of mental state talk in families. *Child Development, 74,* 905-920.

Kopp, C. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology, 18,* 199-214.

Lagattuta, K. H. (2001). Thinking about the Past: Early Knowledge about Links between Prior Experience, Thinking, and Emotion. *Child Development, 72,* 82-102.

Lagattuta, K.H. (1999). The development of young children's understanding of the causes of emotions: Experimental and natural language studies. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 60(5-B).

Lagattuta, K.H., Wellman, H.M., & Flavell, J.H. (1997).Preschoolers' understanding of the link between thinking and feeling: Cognitive cuing and emotional change. *Child Development, 68*, 1081-1104.

Murphy, L.B., & Moriarty, A.E. (1976). *Vulnerability, coping, and growth: From infancy to adolescence.* New Haven, CN: Yale University Press.

Nelson, C.A. (1987). The recognition of facial expressions in the first two years of life: Mechanisms of development. *Child Development, 58,* 889-909.

Piaget, J. (1952). *Play, Dreams and Imitation in Childhood.* New York, NY: Norton & Co.

Pons, F., Lawson, J., Harris, P., & deRosney, M. (2003). Individual differences in children's emotion understanding: Effects of age and language. *Scandinavian Journal of Psychology,44*, 347-353.

Reich, P.A. (1986). *Language Development.* Englewood Cliffs, NJ: Prentice Hall.

Sorce, J.F., Emde, R.N., Campos, J.J., & Klinnert (1985). Maternal emotional signaling: Its effects on the visual cliff behavior of 1-year-olds. *Developmental Psychology, 21,* 195-200.

Symons, D.K., Peterson, C.C., Slaughter, V., Roche, J., & Doyle, E. (2005). Theory of mind and mental state discourse during book reading and story-telling tasks. *British Journal of Developmental Psychology, 23,* 81-102.

Taumoepeau, M., & Ruffman, T. (2006). Mother and infant talk about mental states relates to desire language and emotion understanding. *Child Development, 77*, 465-481.

Ungerer, J.A. Zelazo, P.R., & Kearsley, R.B. (1981). Developmental changes in the representation of objects in symbolic play from 18 to 34 months of age. *Child Development, 52*, 186-195.

Vygotsky, L.S. (1934/1986). *Thought and Language.* A. Kozulin, Ed. Cambridge, MA: The MIT Press.

Werner, H. & Kaplan, B. (1963). *Symbol Formation.* Oxford, England: Wiley.

Zeidner, M., Matthews, G., Roberts, R., & MacCann, C. (2003). Development of emotional intelligence: Towards a multi-level model. *Human Development, 46,* 69-96.

Table 1

Number of children who used emotion, feeling, and time gestures

GESTURE		*NUMBER OF CHILDREN USING GESTURE*		*EARLIST AGE OF OBSERVED USE*
		TOTAL	*INFANTS / TODDLERS*	
EMOTION	*HAPPY*	1	1 INFANT, 0 TODDLERS	12.9 MONTHS
	*MAD**	0*	0 INFANTS*, 0 TODDLERS	*9.0 MONTHS
	SAD	6	3 INFANTS, 3 TODDLERS	10.9 MONTHS
	SCARED	2	2 INFANT, 0 TODDLERS	11.1 MONTHS
FEELING	*SLEEPY*	1	1 INFANT, 0 TODDLERS	14.7 MONTHS
	COLD	4	0 INFANTS, 4 TODDLERS	18.7 MONTHS
	GENTLE	1	0 INFANTS, 1 TODDLER	19.2 MONTHS
	HURT	2	1 INFANT, 1 TODDLER	16.7 MONTHS
	LOUD	1	1 INFANT, 0 TODDLERS	17.5 MONTHS
TIME	*POPS*	9	4 INFANTS, 5 TODDLERS	12.8 MONTHS
	WAIT	3	1 INFANT, 2 TODDLERS	17.2 MONTHS
	LATER	5	1 INFANT, 4 TODDLERS	15.2 MONTHS

* Though the *mad* gesture did not appear in our quantitative data, infants' use of the *mad* gesture has appeared in systematically collected transcripts of child behavior in this cohort of children.

Table 2
Number of episodes in which each child used symbolic gestures to describe internal states of self and other

Child ID	Emotion Word Episodes			Feeling Word Episodes		
	About Self	About Other	Insufficient Information	About Self	About Other	Insufficient Information
Infant I-3	1	-	2	-	-	-
Infant I-9	-	-	1	-	-	-
Infant I-10	4	3	4	2	-	-
Toddler T-1	-	-	-	1	-	-
Toddler T-3	-	-	-	6	-	2
Toddler T-4	-	-	-	1	-	-
Toddler T-7	-	3	-	-	-	-
Toddler T-9	1	-	-	1	1	2
Toddler T-12	2	-	-	-	-	-

Table 3

Samples of transcribed observations of children communicating emotion concepts through symbolic gestures

NOTES: All gestures used by children in the following transcripts are **bolded and underlined** for easy reference. Names of children have been changed, but ages are accurate.

	CATEGORY/ INTERPRETATION	*TRANSCRIPTION*
1.	*Reflecting on own internal state in past experiences.* In this observation, Cathy spontaneously expresses her fear of spiders to her caregiver, using the prop of a stuffed animal spider and the "scared" gesture. Though many successful communication exchanges end with a smile, this one does not, which is congruent with the child's affective state.	Cathy (11.13 months) picked up a small spider stuffed animal on the floor and looked at it for a while. She looked at her caregiver and said, "Me!" "Yeah, you are holding a spider, Cathy," her caregiver said. Cathy looked at the spider with her fist pounding on her chest (the gesture for **scared**). Then, she looked back at the caregiver. "It seems that you are telling me that you are sacred of the spider," the caregiver said. Cathy **nodded** without a smile.
2.	*Expressing own current internal state.* *In this observation,* Alana expresses her internal state, "sleepy," clarifying that it is her*self* that is sleepy by adding the word "me." There may be some question as to whether the sleep/nap gesture describes an action or a feeling. Here the child is talking about herself, and since she is not napping, she is not saying "I'm napping," using the gesture as a verb/action (unless she were engaging in pretend or imaginative play); thus, we conclude that she is saying "I'm sleepy." She is not reflecting on a behavior, but rather an internal state.	Alana (15.33 months) was lying on the changing table and made the gesture for **sleepy/nap**. Her caregiver asked if she was tired; then Alana repeated the **sleepy/nap** gesture. Another child's caregiver was setting up a diaper table nearby and oversaw Alana make the gesture for nap. The second caregiver asked, "Are you tired, Alana? It's Monday, and I'm always tired on Mondays. Are you tired on Mondays?" Alana smiled and said, "Me?" in the tone of a question while **pointing to herself**. The second caregiver said, "Yes, that's right. You're pointing to yourself and saying, 'Me.'" Alana smiled and repeated "Me," and **pointed to herself**, followed again by the gesture for **sleepy/nap**.
3.	*Expressing internal thoughts that have emotional salience.* This child shows us that she knows what she's feeling (sad), and why (missing dad). In addition, she uses a gesture, the relaxed "mom/dad" gesture, when she is *alone*, whereas most gestures observed are in a person-to-person conversation. (Is she using the gesture to *think out loud*?) Elsie also demonstrates that she knows that the caregiver will need a more clear version of her gesture in order to understand her – she articulates her gesture more clearly when she makes eye contact with the caregiver.	The children and caregivers were in the outdoor play area. Elsie's caregiver was sitting on the edge of the sand area, watching some of the infants sitting in the sand. Elsie (14.9 m) was walking around the infant yard by herself. Her mouth was curled down and her eyes pointed downward. She had her right hand up near her ear in a relaxed fist position (a relaxed version of the **mom/dad** gesture). She walked slowly over toward the sandbox where her caregiver was sitting. When she came within about 3 feet of her caregiver she made eye contact and very quickly she put her thumb to her forehead with the other four fingers extended and gestured the sign for **dad**. She turned her mouth down and pushed her eyebrows together. Her caregiver said, "You look like you are thinking of your mom and dad. You look sad." Elsie turned and walked away.

Table 3

Samples of transcribed observations of children communicating emotion concepts through symbolic gestures

NOTES: All gestures used by children in the following transcripts are **bolded and underlined** for easy reference. Names of children have been changed, but ages are accurate.

	CATEGORY/ INTERPRETATION	*TRANSCRIPTION*
4.	*Clarifying own internal state after caregiver mis-interpretation.* This child distinguishes between "sad" and "mad," revealing the infants' capacity not only to be aware of their internal states, but to differentiate between two different negative emotions. NOTE: This observation did not come from a videotaped transcript but was recounted by the Academic Child Development Specialist at the Child Lab at UC Davis, rather than transcribed from videotapes as were the other observations.	Sophie (9 months) sat in the outdoor infant garden on a mat; a few manipulative toys lay close, but she showed no interest or engagement in them. Sophie sat slumped at the shoulders, crying with a low constant hum in her voice. One of her caregivers sat down across from Sophie, and she paused in her sobs and looked at the caregivers face with an open mouth and eyes drawn down at the sides. The caregiver said "Sophie, I hear you crying and I am wondering if you are sad?" while she gestured **hear** (index finger tap at the ear) and **sad** (finger tracing a tear down cheek from eye). While focusing her gaze on the caregiver's face, Sophie brought her right hand with fingers slightly separated into a claw like position up to her face, the gesture for **anger**. The caregiver responded "I see you are angry, what can I do to help?" while using the gesture for **angry** (claw hand over face drawing down) and **what** (turned palms up with hands on top of knees).
5.	*Noticing others' emotion-related behaviors.* In this observation you see that the toddler shows an intense interest in the other child's apparent emotional state, and enquires about it with the caregiver. He uses the "sad" gesture to initiate a conversation with his caregiver about the causes of being sad.	Allen (24 m) stood there and watched Cathy as she cried after she had just fallen down. He walked a little closer to her and then hesitated for a moment, still watching Cathy with her caregiver. He squinted his eyes a little as he stood there with his mouth open a bit. Then he looked over at his caregiver and walked over to where she was sitting. He pointed over to where Cathy was and made the gesture for **sad,** with his finger under his eye. He also had a sad look on his face as his eyes drooped a little and his mouth was shut, showing no sign of a smile. His caregiver said to him, "Allen, you see that Cathy is **sad,** don't you?" He looked at the caregiver with the same expression on his face and slowly **nodded** his head. She said back to him, "I think she fell down and bumped her **head**," as she brought her hand to her head. He looked at his caregiver and did the same **gesture, bringing his hand to his head** and said, "bumped head."
6.	*Reflecting on cause or solution for the emotions of another.* In this observation, Ellie demonstrates an understanding of the reasons someone might feel bad, or what would make him feel better.	Ellie (15.5 m) stopped as she was walking across the room, and made the gesture for **hear.** Her caregiver commented that she heard Billy crying. Ellie then made the gesture for **sad.** The caregiver said, "Yes, Ellie, I think Billy is sad. Emily is going to hold him and make him feel better." Ellie looked at her caregiver and made the signs for **bottle** and **sleepy/ nap.** The caregiver said, "I think you are right. Maybe Billy needs a bottle and a nap," while repeating the gestures. Ellie looked at the caregiver and pointed at Billy, as she again gestured **sad, bottle,** and **sleepy/nap** directly following one another.

Table 4

Results of Binomial statistics testing whether children's emotion, feeling, and time gestures were imitations of adults' gestures.

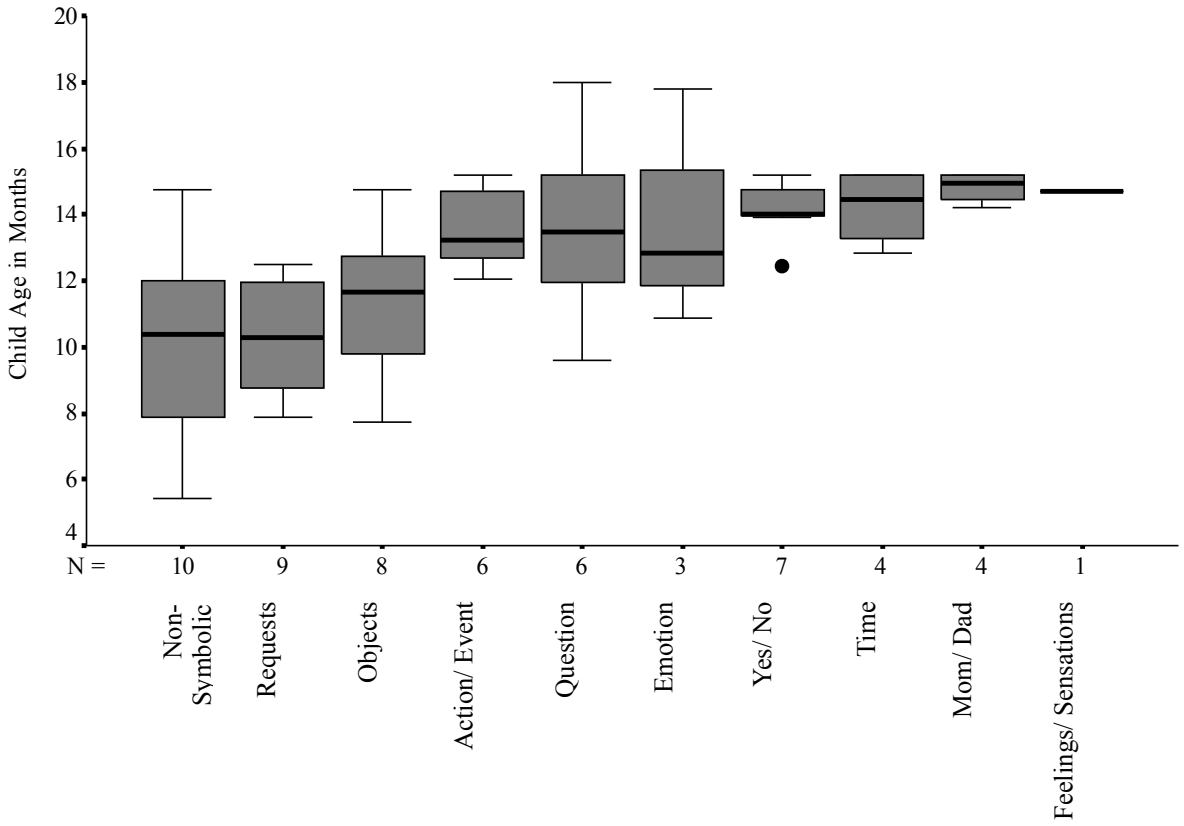
Gesture Category	Conversational Context	Results of binomial test		
		Observed	Expected	Statistical significance (2-tailed)
Emotion	Response/Imitate	1	6.5	$p < .01$
	Initiate, Continue, Reply	12	6.5	
	Total	13		
Feeling	Response/Imitate	0	2	$p = .125$†
	Initiate, Continue, Reply	4	2	
	Total	4		
Time	Response/Imitate	0	4	$p < .01$
	Initiate, Continue, Reply	8	4	
	Total	8		

† There were too few instances of feeling/sensation gestures to obtain a valid estimate of statistical significance. Minimum observations to detect statistical significance at the $p < .05$ level using Binomial test is 6.

Figures

Figure 1.

Order of appearance of gesture categories as measured by the average age at which each gesture category was first observed to be used by each child.



Appendix

Table 5.
Samples of gestures in each category used by caregivers and children in the study population.

NOTES: All emotion, feeling, and time gestures are described, rather than just a sample; these are marked in grey. *Italicized* gestures were used only by caregivers, as recorded either in our data or in data collected by the program.

GESTURE DESCRIPTIONS BY CATEGORY

CATEGORY	*GESTURE*	*DESCRIPTION*
ACTION / EVENT	*Diaper Change*	*Pat hip*
	Play	Closed fist with pinky and thumb sticking out, hand rotating
	Wash	Two hands rubbing together as if running after water
EMOTION	Happy	Open hands, palm out, to frame sides of face
	Mad	Clawed hand running in front of face (accompanied by furrowed brows)
	Sad	Draw forefinger down cheek
	Scared	Open palm tapping chest
FEELING/ SENSATION	Cold	Arms to side shaking as in “Brrr”
	Gentle	One hand stroking the other hand
	Hurt	*Closed fist tapping chest*
	Loud	Hands over ears
	Sleepy	Folded hands laid against cheek
NON-SYMBOLIC	Point	Using finger to point at something or someone
	Wave	Waving good-bye or hello
OBJECT	Ball	Palm of hand down, motioning up and down as if bouncing a ball
	Bird	Arms or hands fluttering
	Car	Mimicking steering a wheel
PARENT	Dad	Open palm, thumb tapping forehead (left side)

Table 5.
Samples of gestures in each category used by caregivers and children in the study population.

NOTES: All emotion, feeling, and time gestures are described, rather than just a sample; these are marked in grey. *Italicized* gestures were used only by caregivers, as recorded either in our data or in data collected by the program.

Gesture Descriptions by Category		
Category	*Gesture*	*Description*
	Mom	Open palm, thumb tapping chin (left side)
Question	Where?	Palm of hands up next to shoulders
Request	More	Bunched fingers of both hands tapping together
	Outside	Fingers in claw shape (as if gripping doorknob), twisting
	Snack	Fingers of one hand together tapping mouth
Time	Later	Rotated right thumb/forefinger in open left hand
	Popsicle Time	Tapping back of palm to chin
	Wait	Right fist tapping open left hand
Yes / No	No	Head shaking from side to side as if saying “No”
	Yes	Nodding head up and down as if saying “Yes”