The Development of Infant Detection of Inauthentic Emotion

By

Eric Alf Walle

A dissertation submitted in partial satisfaction of the
requirements for the degree of
Doctor in Philosophy
in
Psychology
in the
Graduate Division
of the
University of California, Berkeley

Committee in charge:
Professor Joseph J. Campos, Chair
Professor Dacher Keltner
Professor Elliot Turiel

Spring 2012
Abstract

The Development of Infant Detection of Inauthentic Emotion
by
Eric Alf Walle
Doctor of Philosophy in Psychology
University of California, Berkeley
Professor Joseph J. Campos, Chair

Appreciating authentic and inauthentic emotional communication is central to the formation of trusting and intimate interpersonal relationships. However, when infants are able to discriminate and respond to inauthentic emotion has not been investigated. The present set of studies was designed to investigate infant sensitivity to three specific cues of inauthenticity: the contextual congruency of the emotion, the degree of exaggeration of the emotion, and the clarity with which the emotion is communicated. In each experiment, 16- and 19-month-old infants were presented with an emotional communication in which an inauthentic cue was present or absent. Infant behavioral responding to the emotional context was observed and coded. In all three experiments, 19-month-old infants, but not 16-month-old infants, detected inauthentic emotional communication and differentially responded to the environment accordingly. These findings demonstrate that infants do not simply take all emotional communication at face value and are sensitive to features of emotional contexts beyond what is expressively communicated by the adult. Possible developmental mechanisms that may account for the observed developmental shift in infant emotional development are proposed, and implications for the present findings on future research in emotion and emotional development are highlighted.
Dedication

To my mother, for giving me the curiosity to ask the question.
To my father, for giving me the diligence to seek the answer.
Acknowledgements

Work on this paper was supported by grants from the Amini Foundation for the Study of Affects and the National Institute of Child Health and Human Development (HD-62766). I gratefully thank Joseph Campos, Dacher Keltner, and Elliot Turiel, as well as Alexandra Main, Ryan Jensen, Audun Dahl, and Minxuan He for their comments on earlier drafts of this paper.
Authenticity is an ideal we strive for in many Western-European and North American societies. We value the person who is sincere, who is straightforward, who is not manipulative, who strives to practice what he or she preaches, and, above all, whom we can trust. Lack of authenticity is usually considered socially undesirable and a mark of deviousness in social interaction. However, societies also sometimes encourage inauthenticity for the purpose of maintaining social harmony and smooth interpersonal interactions. For instance, we expect inappropriate emotions to be concealed (e.g., we are expected not to show disgust at a disfigured person, and the recipient of an undesirable gift is expected to show enthusiastic, but inauthentic, glee to the recipient). In many cases, societies prescribe the expression of emotions that are, in fact, the opposite of an individual’s true experience.

The study of authentic and inauthentic emotional communication is a central element for understanding social interactions. From a definitional perspective, this report conceptualizes inauthenticity as the display of an unfelt emotion or the deliberately manipulated manifestation of a felt one. In what follows, I highlight the importance of detecting inauthentic emotional communication for human development, review the existing empirical literature investigating authenticity, and describe a set of studies that investigate the development of infant detection of inauthentic emotion.

**The Importance of Detecting Inauthentic Emotion**

Authentic displays of emotion help provide the basis for reliable relationships in human interaction. Infant detection of authentic and inauthentic emotion displays is essential for helping to form positive, trusting relationships with others that will enable the infant to effectively navigate social contexts. Infants must be able to identify individuals in the environment to reference for information, seek out when distressed, and from whom to learn social norms in order to develop into a competent social participant (see Saarni, Campos, Camras, & Witherington, 2006). For the infant, this initial relationship is typically formed with the attachment figure, such as the mother. Attachment security comes not only from provision of havens of safety and secure bases of exploration (Bowlby, 1969), but also from the recognition by the child that the caregiver’s emotional signals are reliable and trustworthy, especially when the child encounters uncertainty. The child’s working model of attachment from past social and emotional experiences helps organize interpretation and understanding of future interactions (Bretherton, 1996). For example, Murray (1992) found that infants of depressed mothers often show insecure attachment styles and a lack of emotional expressivity. By way of contrast, longitudinal research by Raikes and Thompson (2006) indicates that secure attachments lead to increased child understanding of emotion, and positive parenting styles are correlated with positive social functioning in infants and toddlers and believed to significantly impact the child by 18 months or younger (Spinrad et al., 2007).

Clearly the emotional climate created by the adult impacts the child’s emotional development. However, does the infant detect when a parent is openly sarcastic? Can the infant tell when the parent is putting on a happy face during a difficult divorce? Caregivers who display inauthentic emotions may affect their child’s formation of trusting relationships and ability to detect inauthentic emotion due to increased experience with such displays. Investigating the

---

1 This is not to say that one’s intentions when displaying inauthentic emotion are necessarily insincere or malicious. The present definition views the sincerity of one’s intentional state as independent from whether the manifestation of emotional communication is congruent and canonical with one’s emotional state. For example, one’s intentions to refrain from laughing inappropriately at a funeral may be sincere, while at the same time the manifestation of emotion (e.g., a solemn face) is in fact inauthentic, as it is incongruent with the individual’s emotional state.
development of infant detection of inauthentic emotion is essential for understanding the whole story of how different emotional environments affect infant emotional development.

**Adult Detection of Inauthentic Emotion**

In considering the importance of detecting inauthentic emotional communication for human development, it is useful to first consider the fully developed skills present in adults. Adults have a great deal of control over the expression and quality of their emotional communication. Even so, observers are sometimes capable of recognizing when an emotional display is inauthentic. Research on deception identifies several key behavioral cues that people use to detect deception, including speech cues, nonverbal behavior cues, and a combination of both (Ekman & O’Sullivan, 1991). These include increased pupil dilation, increased blinking, gaze aversion, increased fidgeting, delay in verbal response, stuttering, and smiles that are out of place or of inappropriate in intensity (Anderson, Ansfield, & DePaulo, 1999; Ekman & O’Sullivan, 1991). Masking of a felt emotion, in which one displays an emotion contrary to one’s internal experience (Matsumoto, Yoo, Hirayama, & Petrova, 2005), may also lead to slight leakage of the felt emotion, or overcompensation in intensity of the display of the unfelt emotion (Friedman & Miller-Herringer, 1991; Gross & Levenson, 1997).

However, the presence of such cues does not guarantee successful detection of inauthentic communication. Adult competence for detecting deception in strangers has consistently been found to vary between 54% and 57% (Bond & DePaulo, 2006; Kraut, 1980; Vrij, 2000). Given that by chance alone detection should be 50%, it is plain that detection of authenticity can be difficult. Many common details adults look for in deception, such as gaze aversion, stammering, and fidgeting are often unreliable in predicting who is lying (Strömwall, Granhag, & Hartwig, 2004; DePaulo et al., 2003; Vrij, 2000). More effective strategies used by adults typically attempt to connect someone’s verbal statements with other available information, such as information from a third party, physical evidence, and nonverbal communication (Park, Levine, McCormack, Morrison, & Ferrara, 2002; Vrij & Mann, 2005). Reliance on nonverbal communication is believed to be crucial in deception detection because these behaviors are constant and persistent in interpersonal interactions, even when verbal communication is absent (DePaulo & Kirkendol, 1989).

To what extent the amount and quality of exposure to inauthentic displays is sufficient for the layperson to detect inauthentic displays is unclear; what is clear is that there must be a relation between the two. In other words, increased exposure to inauthentic emotional communication may make one more competent at detecting when an individual is inauthentic. For example, Ekman and O’Sullivan’s (1991) comparison of Secret Service agents with other groups of law enforcement agents found that the Secret Service agents were significantly better at detecting inauthentic displays of emotion, presumably because their occupation requires a great deal of attention to these cues.

With such a plethora of potential cues for the perceiver to authenticate, some researchers have suggested that the processing load involved in detection may be too great in many situations (Millar & Millar, 1995). In support of this view, research with aphasics (persons unable to understand words) found a significant increase in lie detection in comparison to control subjects (Etcoff, Ekman, Magee, & Frank, 2000). Though this finding may be due to increased brain growth in compensatory skills of recognizing non-verbal behavior, it is in line with many findings by Ekman and colleagues (Ekman & Friesen, 1976; Ekman, Friesen, & O’Sullivan, 1988; Ekman, O’Sullivan, Friesen, & Scherer, 1991) that nonverbal communication contains more cues of deceit than verbal communication. This finding also supports Millar and Millar’s
(1995) view that selective attention to specific cues increases detection of inauthenticity. This emphasizes the need to isolate each cue when investigating infant detection of inauthentic displays.

A crucial distinction between the adult literature on detecting inauthentic emotion and the set of studies in the present empirical investigation lies within the intent of the observed inauthentic display. Research with adults typically presents an inauthentic display that is intended to deceive (i.e., the person displaying the inauthentic emotion was trying not to get caught). The methodologies in the present investigation will attempt to highlight and make obvious the inauthentic features for the infant and create a context in which their detection is likely to result in differentiated behavioral response than if the cues were unnoticed.

**Detection of Inauthentic Emotion in Childhood**

Much of early socialization is characterized by learning what, where, and when to display certain types of behavior. This is often characterized by certain display rules that adults are able to utilize with great ease (Ekman & Friesen, 1975), but which young children have considerable difficulty. Children understand at 6-7 years of age the motivations that a character in a story may have to display an unfelt emotion, as well as the consequences that such changes in display would have on others viewing that character (Gosselin, Warren, & Diotte, 2002; Harris et al., 1986). Development of the production of inauthentic positive and negative emotion displays has been found to emerge at 6 years of age, progressively improving during the elementary years into adulthood (Halberstadt, Grotjohn, Johnson, Furth, & Greig, 1992; Feldman, Jenkins, & Popoola, 1979). For example, Saarni (1984) found that 7-year-old children are able to spontaneously produce inauthentic smiles in response to receiving a boring toy. Of note is the child’s early understanding of a need to display unfelt emotions by 6 years of age (Halberstadt et al., 1992), even though the ability to convincingly produce such a display is lacking (Saarni, 1984). This suggests that inauthentic detection may precede inauthentic production.

Developmental research on detecting inauthenticity typically focuses on phenomena that are readily amenable to experimental manipulation. These phenomena include lying and truth telling, “masking” emotions to fit cultural expectations, and the disconnect between the linguistic and the paralinguistic (i.e., what one says and how one says it). Moreover, these studies center on individuals who have a well-developed conceptual and symbolic level of mentation. Typical paradigms often use short stories read to the child, in which the child must identify a character’s internal state, determine how best for the character to behave, and how others will perceive the character. In a story-based paradigm, Gnepp (1983) found that when facial expressions and contextual information were in conflict, preschool children relied on facial expressions of emotion to determine a characters internal experience of emotion, but 6th grade children use the conflicting cues equally. Additionally, the older children were better at assimilating multiple types of cues, as well as reconciling conflicting cues when describing the situation, particularly by explaining the conflict in terms of the character masking his or her felt emotion. Research also indicates that school-aged children are better at detecting inauthentic negative displays (i.e., dislike, disgust) than inauthentic positive displays (Soppe, 1988).

Though informative, the above developmental research using school-aged children relies on paradigms demanding advanced cognitive and linguistic abilities to follow the plot of a story and verbalize a response. Infancy research calls for a different set of paradigms.

**Detection of Inauthentic Emotion in Infancy**

Infants are able to discern normative social interactions early in life. Extensive research by Tronick and colleagues has demonstrated infant sensitivity to situations in which social
expectations are violated (e.g., Gusella, Muir, & Tronick, 1988; Tronick, Als, Adamson, Wise, & Brazelton, 1978; for reviews, see Adamson & Frick, 2003; Muir & Lee, 2003; Tronick, 2003). Furthermore, research by Walker-Andrews (1986) has found that infants are sensitive to the congruency of facial and vocal communication of emotion at 7 months of age, preferentially looking to a facial display of emotion that matches a vocalization of emotion. With these early capacities in mind, investigations of infant understanding of pretense and parent interactions may provide further insight into infant detection of inauthentic emotion. Infant understanding of pretense develops markedly between 15 and 24 months of age (see, Haight & Miller, 1992; McCune, 1995; Walker-Andrews & Kahana-Kalman, 1999). When engaging in pretend behaviors, mothers demonstrate increased smiling and looking toward their infant (Lillard & Witherington, 2004) and infants are able to correctly identify pretend and real behaviors at as young as 2.5 years of age (Ma & Lillard, 2006). These experiments relied on infant facial reactions or explicit identification of the discrepant events. However, it is essential to observe not only whether the infant notices discrepant displays of emotion, but also how noticing this discrepancy affects and regulates the child’s instrumental behavior toward the emoting individual or the referent of the emotion. Highlighting this point is the research by Ma and Lillard (2006), who found that although 2-year-old infants did not explicitly differentiate pretend and real eating behaviors, these infants exhibited more spontaneous swallowing and lip licking while viewing the real eating behavior. This suggests that infants may demonstrate detection of pretense when functional behavioral responses are analyzed.

However, one should note the passive role of the infant in such experiments, who is relegated to looking from one stimulus to another. In fact, a meta-analysis of adult research investigating detection of inauthentic emotion did not reference a single study that included a behavioral dependent variable of the participant’s response to an inauthentic emotion (DePaulo et al., 2003). Behavioral measures are likely essential for determining whether an infant can appropriately appraise a situation and respond accordingly.

Anecdotal and empirical reports in which infants did not behave as one would expect in response to adult emotion motivated the present investigation. For example, 18-month-old infants occasionally respond to adult emotions with opposite behavioral responses than would be predicted, such as laughing at a parent’s display of fear (M. D. Klinnert, personal communication, July 2007) or smiling at parental distress (Zahn-Waxler, Radke-Yarrow, & Chapman, 1992). These peculiar responses are often dismissed as indicating that infants did not understand the emotion. I offer a different interpretation: these responses may have occurred because infants did not believe the sincerity of emotional the communication. Thus, it is possible that the ability to detect and respond to inauthentic emotion may develop around 18 months of age.

**The Present Set of Studies**

The above review of the literature demonstrates that research investigating the detection of inauthentic emotional communication has largely been done with adults, and what developmental research does exist has used preschool and school-aged children. Furthermore, existing developmental research has failed to investigate the ontogeny of how infant detection of such discrepancies regulates infant social behavior. Although the importance for accurately appreciating the authenticity of emotional communication is clear, a distinct gap in the literature exists in our understanding of how this important skill develops. In light of the existing developmental literature indicating that 18-month-old infants occasionally respond with unexpected behaviors to emotional communication, as well as emerging understanding of
pretense at this age, the research below compared 16- and 19-month-old infants ability to detect inauthentic emotional communication.

Review of the adult literature has identified potential cues of, and strategies for, detecting inauthentic emotion displays. Three factors that differentiate an authentic from an inauthentic emotional display are: (1) the authentic display is contextually appropriate—one that fits the circumstances the perceiver of the display is encountering; (2) the authentic display is of the right intensity for the level of emotion called for under the circumstances—intense when the danger is intense, weak when the danger is weak, and intermediate when the threat is middling; and (3) the authentic display is conveyed unambiguously, without confound by a prior, simultaneous, or subsequent signal that “leaks” an alternative emotional message. Infants were tested in three distinct paradigms in which one of the above cues was experimentally manipulated. Each paradigm was specifically designed so that infant detection of the inauthentic emotion would result in differential behavioral responding between emotion conditions. As such, it should be emphasized that it was this differential behavioral responding between conditions within each age group, not “improvement” between age groups, which was of central interest.
Study 1: Infant Detection of Contextually Incongruent Emotion

Congruency of Context and Emotion

Adults use a variety of cues when appreciating the emotional state of another individual, one of the most important of which is the situational context. Observers may use scripts (Abelson, 1981) that rely on available contextual elements to aid in the identification of emotions (Fehr & Russell, 1984). Although the literature is mixed as to whether context trumps emotional expression, or vice versa, in observers’ identification of another’s emotional state (for a review, see Matsumoto & Hwang, 2010), research clearly demonstrates that context plays an influential role in this process (e.g., Matsumoto, Hwang, & Yamada, 2012; Aviezer, Hassin, Bentin, & Trope, 2008; Carroll & Russell, 1996). However, little research exists examining how contextual features of the environment affect infant behavioral responding to emotional signals.

Infant Sensitivity to Emotions in Context

While the importance of contextual cues for appreciating others’ emotional communication is clear, research to date has not explored at what point in development infants use such features to identify and respond to another person’s emotional state. For example, while visiting a zoo an infant may identify her father’s display as fear (affect specificity) in response to a charging polar bear (referential specificity), but also notice that a secure Plexiglas barrier is present to prevent harm, and consequently smile and approach the glass to examine the animal. Thus, the infant has demonstrated a behavioral response opposite to the emotional communication concerning the danger of the referent, but sensitive to the context within which this information is provided. Such a response would indicate that the infant used cues other than emotional and referential communication, such as the significance of the emotion in the present context. Previous developmental research suggests that young children more accurately identify emotions based on situational causes and consequences (e.g., Balconi & Carrera, 2007; Reichenbach & Masters, 1983; Widen & Russell, 2004) than facial displays (though see Widen & Russell, 2010 for an exception). While the existing literature investigating infant use of contextual versus expressive cues has primarily used static images of facial displays or vignettes, prior studies have not manipulated the relation between the emotion and the contextually relevant features of the environment within which the infant is actively participating.

Some evidence does hint that infants may be sensitive to contextual cues of emotion. A peculiar finding from Carolyn Zahn-Waxler and colleagues’ research investigating infant prosocial responding to distressed individuals provides one such instance. In this classic paradigm, the infant observes a caregiver or researcher hurt herself and express pain. Infant’s behavioral responding is then observed to determine whether the infant appreciated the other’s distress by responding with concern and prosocial action. This research has found that infants at 14 months of age respond to a distressed individual with concern and prosocial behaviors, and that these behaviors become more prevalent and specific to the individual’s distress during the second year of life (Zahn-Waxler et al., 1992). However, of particular interest is a finding reported in the same study that 14- and 19-month-old infants were as likely to respond to adult distress with “empathic concern” as they were with “positive affect.” These responses of positive affect may signify that infants picked up on other features of the environment beyond the surface level features of the distress display. Thus, rather than failing the task, these infants may have actually exceeded the task by recognizing that the distress was simulated and appreciated the
emotion as playful. The specific cue(s) the infants may have used to reach this conclusion remains unknown.\(^2\)

**Aims of Study 1**

Study 1 examined whether 16- and 19-month-old infants are sensitive to the contextual congruency of an emotion, specifically parental distress, when cues in the environment provide evidence that the emotional display is not credible. This study utilized a variant of the classic Zahn-Waxler paradigm, in which infants observed their parent either perceptibly hit or miss her hand with a toy hammer. In both conditions parents displayed pain and distress following the hammer strike, and infant behavioral responding to parents’ distress was coded. It was hypothesized that infants witnessing the parent hit her hand with the hammer would demonstrate more prosocial responses and expressions of concern, whereas infants witnessing the parent miss her hand with the hammer would display more positive affect and aggressive/playful behaviors toward the parent. Additionally, it was hypothesized that 19-month-old infants would demonstrate greater differential responding as a function of the perceived authenticity of the emotion display than 16-month-old infants.

**Method**

**Participants**

Thirty-five 16-month old infants (20 female, \(M_{\text{age}}=16.1, SD=0.67\)) and 30 19-month-old infants (14 female, \(M_{\text{age}}=19.1, SD=0.74\)) participated in Study 1. Infants were randomly assigned to either the Hammer Hit (16-month-olds: \(n=14\); 19-month-olds: \(n=14\)) or Hammer Miss condition. Infants were recruited from the San Francisco Bay Area. The average parent had a college degree and the average family income was $100,000.

**Procedure**

Prior to the experiment, parents were instructed how to clearly express pain and distress through the face, voice, and posture, as well as with gestures. The experiment took place in a 2 m x 2 m space in which the parent and infant were situated kitty-corner at a 0.5 m x 1.25 m table, 0.35 m in height. Separate cameras captured the infant and the parent and were split into a single frame so that both angles could be viewed simultaneously.

The parent was instructed to play with a small plastic hammer toy in view of their child. The hammer toy consisted of a plank board with 5 cm supports on both ends and 6 pegs that could be pounded through on either side, and a plastic hammer. After observing the parent, infants were allowed a turn to play with the hammer toy to provide experience of the actions and force required to pound the pegs. The parent then took the toy back from the infant and, in clear view of the child, either hit or missed her hand with the hammer while attempting to pound the pegs. In both conditions the parent expressed a multimodal display of pain following the hammer strike for 30 seconds, during which infants were free to respond to the parent.

**Coding**

**Internal Validity Check.** A researcher reviewed all participants to: (1) ensure that the infant saw whether the parent hit or missed her hand, and (2) determine whether the parent actually hit or missed her hand. Only infants who attended to the experimental manipulation were included in the final sample. Additionally, parents who did not adhere to the experimental condition were reclassified as necessary (e.g., parents who were instructed to hit their hand but actually missed their hand were placed in the Hammer Miss group).

\(^2\) Zahn-Waxler et al. (1992) suggested that infants may have laughed because parent simulations of distress were exaggerated, but no data on parent’s affective credibility or intensity of distress was reported. Infant sensitivity to exaggerated emotion is specifically investigated in Study 2.
Parent Emotional Display. Parent emotional displays were coded separately for credibility and intensity in three 10-second epochs using a 3-point scale modeled after the measures used by Young, Fox, and Zahn-Waxler (1999). Interrater reliability was assessed using a naïve independent coder who scored 25% of participants. Reliability scores for each measure are provided in parentheses.

1. Credibility ($r = .74$, $M_{\text{difference}} = 0.14$) was coded as: 0 = not credible (significant break in character); 1 = passable (simulation appears spontaneous, believable, and has no breaks in character); 2 = very believable (simulation is particularly believable, and has no breaks in continuity).

2. Intensity ($r = .89$, $M_{\text{difference}} = 0.11$) was coded as: 0 = little or no expression evident; 1 = moderate levels of expression; 2 = very strong expression (e.g., shrieking vocalization, vigorous hand shaking).

Only parent expressions coded as 1 or above for both credibility and intensity were included in the final sample.

Infant Behavioral Responding. Four distinct infant behaviors in response to parents’ distress were coded. Interrater reliability was assessed using a naïve independent coder who scored 25% of participants. Reliability scores for each measure are provided in parentheses.

1. Concerned facial expressions ($r = .87$, $M_{\text{difference}} = 0.05$): Affective expressions of concern for the victim were coded on a 5-point scale (0 = neutral; 1 = sobering of attention; 2 = brow furrowing with no oral component; 3 = brow furrowing with oral component; 4 = crying facial configuration).

2. Prosocial responding ($k = .81$): The presence of behaviors demonstrated by the infant in the service of alleviating the victim’s distress (e.g., hugging, kissing hand, providing a toy/object).

3. Positive affect ($k = .87$): The presence of infant displays of positive affect (i.e., smiling, laughter).

4. Aggressive/playful behaviors ($k = 1.0$): The presence of infant aggressive or playful behaviors toward the victim while the infant was smiling (e.g., hitting the parent with the hammer, pulling on the parent).

Results

Of central importance to the present investigation was whether infants within each age group differentially responded between conditions, not whether differences were present between ages within conditions. This reduces the utility of interpreting overall main or interaction effects. Thus, planned comparisons tested our a priori hypotheses for each variable. Nonetheless, analyses of main and interaction effects for each variable are included for completeness.

Preliminary Analyses of Parent Emotional Expressivity

Parent credibility and intensity of distress were compared between conditions to ensure that the emotional presentations were similar. No significant differences were found between conditions for parent credibility (Hit = 2.46; Miss = 2.56), $t(65) = 0.92, p = ns$, or parent intensity (Hit = 2.40; Miss = 2.61), $t(65) = 1.94, p = ns$.

Infant Concerned Facial Expressions

A 2 (Age) x 2 (Authenticity) analysis of variance (ANOVA) examined infant displays of concerned facial expressions (see Figure 1). Analyses revealed a significant main effect of Authenticity, $F(1,64) = 20.58, p < .000$, but no main effect of Age, $F(1,64) = 1.33, p = .25$, or Age x Authenticity interaction, $F(3,64) = 1.54, p = .22$. Pairwise comparisons of the main effect
of Authenticity confirmed that both 16- and 19-month-old infants displayed significantly more concern when the parent hit her hand than when the parent missed her hand with the hammer (16 months: Hit = 2.20, Miss = 0.62; t(33) = 4.23, p < .000; 19 months: Hit = 2.17, Miss = 1.27; t(28) = 2.25, p = .03.

**Infant Prosocial Responding**

Differences in infant prosocial responding were examined by entering Age, Authenticity, and Age x Authenticity into a logistic regression (see Figure 2). Analyses revealed a significant main effect of Authenticity, $\chi^2(1) = 22.41, p < .000$, and a significant Age x Authenticity interaction, $\chi^2(1) = 7.72, p = .01$, but no main effect of Age, $\chi^2(1) = 0.23, p = .63$. These findings were more closely examined within each age group. Chi-square analyses revealed that 16-month-old infants were significantly more likely to respond with prosocial behavior when the parent hit her hand, $\chi^2(1) = 23.58, p < .000$. Nineteen-month-old infants behaved similarly, but this finding did not reach statistical significance, $\chi^2(1) = 2.04, p = .15$.

**Infant Positive Affect**

Differences in infant positive affect were examined by entering Age, Authenticity, and Age x Authenticity into a logistic regression (see Figure 3). Analyses revealed a significant main effect of Authenticity, $\chi^2(1) = 10.58, p = .001$, but no main effect of Age, $\chi^2(1) = 0.02, p = .88$, or Age x Authenticity interaction, $\chi^2(1) = 1.81, p = .18$. These findings were more closely examined within each age group. Chi-square analyses revealed no difference in the likelihood for 16-month-old infants to display positive affect in response to the parent hitting or missing her hand, $\chi^2(1) = 1.94, p = ns$. However, 19-month-old infants were significantly more likely to display positive affect when the parent missed her hand, $\chi^2(1) = 9.02, p = .003$.

**Infant Aggressive/Playful Behaviors**

Differences in the presence of infant aggressive/playful behaviors were examined by entering Age, Authenticity, and Age x Authenticity into a logistic regression (see Figure 4). Analyses revealed a trend for the main effect of Authenticity, $\chi^2(1) = 3.24, p = .07$, and a significant Age x Authenticity interaction $\chi^2(1) = 5.23, p = .02$, but no main effect of Age, $\chi^2(1) = 0.82, p = .37$. These findings were more closely examined within each age group. Chi-square analyses revealed no difference in the likelihood of 16-month-old infants to display aggressive/playful behaviors in response to the parent hitting or missing her hand, $\chi^2(1) = .67, p = ns$. Nineteen-month-old infants, on the other hand, were significantly more likely to respond with aggressive/playful behaviors when the parent missed her hand, $\chi^2(1) = 5.25, p = .02$.

**Discussion**

Findings from the present study indicate that 16- and 19-month-old infants are sensitive to contextually relevant features of emotional communication. Infants in both age groups were more likely to respond with concerned expressions and prosocial actions when the parent hit her hand than when the parent missed her hand. Interestingly, 19-month-old infants, but not 16-month-old infants, also responded with increased positive affect and aggressive/playful behaviors when the parent had missed her hand. This suggests that the older infants not only perceived parental distress as less concerning in the Hammer Miss condition, but evaluated this context as one of play, evident by their positive affect and playful behaviors.

The mixed findings for 16-month-old infants, who demonstrated decreased concern and prosocial acts in the hammer-miss condition, but lack of positive affect and aggressive/playful behaviors, may suggest that these infants noticed that something about the parent’s distress in the Hammer Miss condition was out of the ordinary, but were unsure as to the appropriate response. Also, although 19-month-old infants responded more often with prosocial actions to parent
distress in the Hammer Hit condition than in the Hammer Miss condition, this effect did not reach significance. It is possible that the prevalence of infant helping behaviors in both conditions is indicative of the bias of infants this age to default to help those in need (e.g., Warneken & Tomasello, 2009). Alternatively, it is also possible that older infants were practicing a script in which one helps the distressed individual (the present study was not able to differentiate sincere versus script-rehearsing helping).

In summary, the findings of the present study indicate that: (1) 16- and 19-month-old infants are sensitive to the contextual appropriateness of parental distress, and (2) 19-month-old infants are more likely to appreciate such parental distress as playful, suggesting a developmental transition between 16- and 19-months of age in infants’ appreciation and use of contextual features when responding to others’ emotions.

**Limitations and Future Directions**

This study is a useful first step in investigating infant sensitivity and use of contextual features relevant to emotional communication. However, the above study examined only a single emotion with the manipulation of a single contextual cue. It has been proposed that specific emotion-relevant cues may vary in importance and usage as a function of age and emotion (Russell & Widen, 2002; Widen & Russell, 2004). Infant appreciation of other contextual cues related to other emotions could be examined to determine whether this ability is specific to particular emotions at different points in development, or if utilization of contextually relevant cues is a more general capacity. This research may also assist in the design of experiments aimed at understanding infant development of emotional scripts. For example, presenting infants with an experimenter who acts out a cause and consequence scenario that varies in congruency with typical emotion scripts (e.g., pride versus sadness upon winning a game) would further our understanding of infant appreciation of emotion.

**Contexts of Empirical Inquiry**

While this study focused on infant sensitivity to contextual cues, its implications are relevant to both developmental and adult research of emotion. Individuals do not simply respond to outward expressions of emotion, but utilize a host of other emotionally relevant cues, such as context, to appreciate the significance of an emotional display. An emotion that is inappropriate in a particular context may elicit confusion, as observed when mothers display sadness toward infant approach of a visual cliff (Sorce, Emde, Campos, & Klinnert, 1985). Additionally, researchers may wish to consider the contextual features of the environment when assessing the validity of an emotional stimulus. Emotion researchers consistently urge that emotions be placed back into context (see Avviezer et al., 2008). The above findings not only emphasize the importance of context, but also the care required in its construction.
Study 2: Infant Detection of Exaggerated Emotion

Detection of Exaggerated Emotion

The pioneering work by Ekman and others (e.g., Ekman & Friesen, 1971) revealed that adults are able to identify discrete emotions communicated through the face. Accordingly, studies of emotion commonly use emotional displays based on those used by Ekman and others to investigate adult identification of emotional expressions. However, such maximally intense stimuli are likely discrepant from those encountered in everyday life (see Carroll & Russell, 1996, 1997). Prior research has found that adults are able to correctly identify exaggerated emotional displays from masked and genuine emotion displays, and observers report being very confident of such classifications (Hadjistavropoulos, Craig, Hadjistavropoulos, & Poole, 1996). Thus, while adults readily identify obvious and exaggerated displays of emotion, they do not necessarily take the communicative value of such displays at face value, specifically with regard to the perceived degree of authenticity. Infants may also use the degree of exaggeration with which an emotion is communicated to evaluate the authenticity of an emotional display.

The Development of Infant Detection of Exaggerated Emotion

Empirical investigations of emotional development typically utilize variations of social referencing paradigms involving the communication of a specific emotion by an adult directed toward a toy or object. Such studies commonly use emotion displays of maximal intensity to help facilitate the recognition of the emotion by the infant. This body of research indicates that emotions are effective regulators of infant behaviors by 8.5 to 12 months of age (e.g., Boccia & Campos, 1983; Walden & Baxter, 1989). However, anecdotal evidence also suggests that while emotions such as fear may prevent an infant from crossing the deep side of a cliff, 18-month-old infants will occasionally respond to such maximal displays with laughter (M. D. H. Klinnert, personal communication, July 2007). Such instances of positive affect may be indicative of infants’ evaluation of these displays as inauthentic. Coincidentally, research on the development of pretense has found that this understanding develops around 18 months of age (see, Haight & Miller, 1992; McCune, 1995; Walker-Andrews & Kahana-Kalman, 1999), and that parents typically use exaggerated behavioral displays in pretend play (Lillard & Witherington, 2004). While the literature reviewed in the previous section demonstrates that adults use the degree of exaggeration to determine the authenticity of an emotional signal, it remains to be investigated when the capacity to utilize this cue develops.

Aims of Study 2

Study 2 examined whether infants use the exaggeration of an emotional display to evaluate its perceived authenticity. Sixteen- and 19-month-old infants were presented with a novel stimulus in the presence of their parent. Parents were instructed to display either a normative (authentic) or exaggerated (inauthentic) fearfu display toward the stimulus. It was predicted that infants in the exaggerated emotion condition would be more likely to display positive affect in response to their parent’s emotional display than infants in the normative emotion condition. It was also predicted that 19-month-old infants would demonstrate more differentiated behavioral responding than younger infants as a function of the authenticity of the emotion.

Methods

Participants

Seventy-nine parent-infant dyads completed Study 2. Thirty-eight 16-month-old infants ($M_{age} = 16.24$ months, $SD = 0.65$ months) were randomly distributed to either the Normative ($n = 16$; 8 female) or Exaggerated ($n = 22$; 12 female) condition, and 41 19-month-old infants ($M_{age} =$
18.87, SD = 0.69 months), randomly distributed to either the Normative (n = 19; 13 female) or Exaggerated (n = 22; 11 female) condition. Families were recruited from the San Francisco Bay Area. The average parent held a college degree and the average household income was $96,000.

**Procedure**

Parents were instructed to express either a normative or exaggerated display of fear through their face, voice, posture, and gesture. The experimenter described typical attributes of a fearful expression based on common features of fearful displays (e.g., Ekman & Friesen, 1976). Parents in the normative condition were instructed to display fear of normal intensity as they might in regular daily interactions. Parents in the exaggerated condition were instructed to display fear in an exaggerated manner (increased facial contortion, vocalic elongation of words, and exaggerated gestures). Exaggeration instructions commonly included phrases such as, “make each the channels with which you would typically communicate bigger and over the top” or “imagine your typical display of fear and then ramp it up 10-fold.”

During the experiment the parent and child were seated across from one another at a 0.8 m x 0.8 m table within a 2 m x 1.5 m testing area. A 12 cm x 12 cm x 12 cm rubber toy (multicolored with a soft rubber base, from which several soft rubbery protrusions radiated outward), previously occluded from view, was lowered from the ceiling and came to a rest on the table between the parent and child, but out of reach of both. As it was lowered the parent displayed either a typical or exaggerated fear display, and maintained the display for 15 seconds while the toy was on the table. After the 15 seconds, the toy was raised back up to ceiling and the parent expressed relief.

**Coding**

**Parent Emotional Display.** Parent emotional displays were coded separately for clarity and exaggeration. Interrater reliability was assessed using a naïve independent coder who scored 25% of parents.

*Clarity of Parent Emotional Display.* A manipulation check ensured that parents clearly expressed fear during the emotion presentation. First, coders selected one of five emotions (i.e., sadness, disgust, joy, fear, anger) that the parent was believed to have expressed though the face, body, and voice. Interrater agreement was very good (k = .78). Coders then rated the clarity of the parent’s emotional display as clear, weak, or ambiguous (i.e., presence of a conflicting emotion). Interrater agreement was very good (k = .79). Only infants whose parents clearly expressed fear, and no other emotions, were included in the final sample.

*Exaggeration of Parent Emotional Display.* The degree of exaggeration of parent fear displays was coded to ensure that parents appropriately displayed either a normative or exaggerated display consistent with the condition to which they were assigned. A research assistant naïve to the parent’s experimental condition coded the level of exaggeration of the parent’s display of fear on a 3-point scale: unexaggerated (normative facial display, steady vocalic envelope, tight movement pattern of hands and body), indeterminable (no definitive determination of exaggeration could be made), or exaggerated (big hands, side-to-side movements, frequent vocalic fluctuations, caricature facial display). Interrater agreement was very good (k = .86). Parents scored as unexaggerated were placed in the unexaggerated condition (n = 28); parents scored as exaggerated were placed in the exaggerated condition (n = 33); parents scored as indeterminate were placed in the condition to which they were originally assigned (n = 18).

**Infant Behavioral Responding.** Infant positive and negative affect and approach of the toy were coded. Peak infant positive and negative affect was coded in three 5-second epochs.
while the toy was present. Interrater reliability was assessed using a naïve independent coder who scored 25% of infants.

*Positive Affect.* Infant positive affect was coded as: 0 = neutral, 1 = slightly positive (slight smile, eyes of engagement), 2 = moderately positive (clear positive display, but no laughter), and 3 = very positive (clear positive display, audible laughter). Interrater reliability was very good ($r = .97, M_{\text{difference}} = .04$).

*Negative Affect.* Infant negative affect was coded as: 0 = neutral, 1 = slightly negative (slight frown, furrowed brow, or concerned/widened eyes), 2 = moderately negative (clear negative display, but no crying), 3 = very negative (clear negative display with crying and/or screaming). Interrater reliability was very good ($r = .93, M_{\text{difference}} = .04$).

*Reaches to Toy.* The frequency of infant reaches was coded while the toy was present. Infant reaching was defined as an attempt by the infant to touch or obtain the toy. Interrater reliability was very good ($k = .95$).

**Results**

Again, it is important to emphasize that this investigation was designed to examine whether infants within each age group differentially responded between conditions; not whether differences were present between ages within conditions. The analyses below include planned comparisons to test our *a priori* hypotheses for each variable. Analyses of main and interaction effects for each variable are included for completeness.

**Infant Positive Affect**

A 2 (Age) x 2 (Authenticity) ANOVA examined infant positive affect in response to parent fear displays. Analyses revealed a marginally significant main effect of Authenticity, $F(1,78) = 3.60$, $p = .06$, but no main effect of Age, $F(1,78) = 0.99$, $p = .32$, or Age x Authenticity interaction, $F(3,78) = 0.35$, $p = .56$ (see Figure 5).

Planned comparisons tested our *a priori* hypothesis that 19-month old infants, but not 16-month-old infants, would demonstrate increased positive affect to exaggerated fearful displays. Sixteen-month-old infants did not differ in their display of positive affect in the Exaggerated (mean positive affect = 0.74, $SD = 0.88$) and Normative (mean positive affect = 0.48, $SD = 0.66$) condition, $t(36) = 1.01, p = ns$. However, 19-month-old infants demonstrated greater positive affect in the Exaggerated condition (mean positive affect = 1.06, $SD = 1.01$) than in the Normative condition (mean positive affect = 0.56, $SD = 0.91$), but this effect was only marginally significant, $t(39) = 1.66, p = .11$.

**Infant Negative Affect**

A 2 (Age) x 2 (Authenticity) ANOVA examined infant negative affect in response to parent fear displays. There were no main effects of Age, $F(1,78) = 0.07, p = .796$, or Authenticity, $F(1,78) = 1.34, p = .25$, but a significant Age x Authenticity interaction emerged, $F(3,78) = 9.49, p = .003$ (see Figure 6).

Again, planned comparisons tested our *a priori* hypothesis. Sixteen-month-old infants did not significantly differ in their display of negative affect in the Normative condition (mean negative affect = 0.25, $SD = 0.46$) and Exaggerated condition (mean negative affect = 0.59, $SD = 0.90$), $t(36) = 1.53, p = ns$. However, 19-month-old infants displayed significantly greater negative affect in the Normative condition (mean negative affect = 0.84, $SD = 1.16$) than in the Exaggerated condition (mean negative affect = 0.09, $SD = 0.26$), $t(39) = 2.76, p = .01$. 

Infant Reaches to the Toy

A 2 (Age) x 2 (Authenticity) ANOVA examining infant reaching revealed no main effects of Age, $F(1,78) = 0.79, p = .38$, or Authenticity, $F(1,78) = .15, p = .70$, but did uncover a significant Age x Authenticity interaction, $F(3,78) = 12.54, p = .001$ (see Figure 7).

Planned comparisons further explored differences between conditions within each infant age group. Sixteen-month-old infants reached significantly more often in the Normative condition (mean reaches = 1.44, $SD = 1.31$) than in the Exaggerated condition (mean reaches = 0.73, $SD = 0.88$), $t(36) = 1.99, p = .05$. However, 19-month-old infants demonstrated the opposite effect, reaching significantly more in the Exaggerated condition (mean reaches = 1.32, $SD = 1.17$) than in the Normative condition (mean reaches = 0.42, $SD = 0.84$), $t(39) = 2.85, p = .007$.

Discussion

The present study found a developmental shift in infants’ appreciation of normative and exaggerated adult fearful displays between 16 and 19 months of age. Sixteen-month-old infants showed no significant difference in their display of positive or negative affect between the normative and exaggerated displays. In contrast, 19-month-old infants displayed more positive affect in response to the exaggerated fearful display and significantly more negative affect in response to the normative fearful display. Differences in responding were also evident in infants’ approach and avoidance of the stimulus. Sixteen-month-old infants reached significantly more frequently toward the stimulus in response to the normative display than in response to the exaggerated display. However, the reverse was found for 19-month-old infants, who reached significantly more frequently in the exaggerated condition. Taken together, these findings indicate that infants differentially respond to normative and exaggerated displays of emotion by 19 months of age.

This study suggests a key difference in how infants of each age group appreciate emotional communication. For 16-month-old infants, more is more. Specifically, parents who were more animated in their fearful displays were more effective in eliciting infant avoidance of the stimulus. This suggests that 16-month-old infants may be more likely to respond with avoidant behaviors to fearful displays when the emotion is communicated in a clear, obvious, and animated manner. However, 19-month-old infants perceived the exaggerated fearful display to be less credible. These older infants may have appreciated the emotional context as one of pretend or play, not threat. Thus, for 19-month-old infants, more is sometimes less.

Limitations and Future Directions

Further research is needed to investigate a number of specific features relevant to Study 2. First, it is not known whether infants appreciate other exaggerated emotions (e.g., anger, sadness) in the same fashion as they appreciated fear in this experiment. Additionally, it is possible that sensitivity to different exaggerated emotions emerges at different points in development. One might also wonder if specific modalities are particularly effective in communicating the believability of an emotional display. For example, existing research indicating that the voice is particularly effective in communicating emotional information (Mumme, Fernald, & Herrera, 1996; Vaish & Striano, 2004) might suggest that the vocalic envelope was the key feature in infants’ differentiation between the normative and exaggerated fearful display. Further research is needed to tease apart these emotional cues to determine what specific features infants use to determine whether an emotional display is exaggerated. Finally, although the use of a familiar caregiver provided the child with an assumed baseline of comparison for the display presented in the experimental context, it increased the variability
within each condition. It is recommended that future research follow up these findings using a trained experimenter to ensure greater consistency within conditions.

**Clarity Versus Validity of Emotional Expressions**

The extensive research investigating universal recognition of emotional displays has helped move the field of emotion many steps forward. However, blurring the line between emotion recognition and emotion responding will likely result in empirical investigations that fail to effectively investigate the phenomenon of interest. In light of the present findings, researchers of emotion may wish to reassess whether their stimuli are optimally designed for emotion recognition or emotional responding. In the case of the former, the exquisite work by Ekman and others stands at the forefront of empirical science. However, for researchers of the latter, stimuli that ensure validity, even at the expense of perfect reliability, may be optimal.
Study 3: Infant Detection of Masked Emotion

Detection of Masked Emotion

Masking one’s emotion is a common form of emotion regulation (Butler & Gross, 2004) in which an emotion is concealed through the display of an emotion that one is not experiencing (Matsumoto et al., 2005). As with other forms of emotion regulation, masking represents a form of inauthentic expression in which the goal is to achieve some form of psychological or social gain (Hrubes, Feldman, & Tyler, 2004). Observers use emotional leakages or delays in responding as indicators of when someone is displaying a masked emotion (Scherer, Feldstein, Bond, & Rosenthal, 1985; Zuckerman, DePaulo, & Rosenthal, 1981). For example, a bitter face of disappointment may initially slip out upon first hearing that a colleague received a competitive research grant that you did not, which is then followed by the more appropriate display of happiness for the colleague. The astute colleague, who notices the leaked disappointment, may respond by taming further jubilation while in your company. Thus, the more accurately individuals appreciate the experienced and communicated emotions of others, the more appropriately they will be able to respond in social contexts.

The Development of Detecting Masked Emotion

While these social skills may help adults interpret and navigate social situations, such abilities are equally important for the developing child. Although research has investigated children’s understanding of, and ability to, mask emotion (e.g., Josephs, 1994; Saarni, 1984), no research to date has examined the development of infants’ ability to detect masked emotion. As with other aspects of emotional development in the second year of life, detection of masked emotion may be facilitated by factors relating to the child’s socio-emotional environment. For example, children’s exposure to specific emotions early in life, such as anger, impacts later appreciation and understanding of emotion communication (Pollak, Messner, Kistler, & Cohn, 2009). Therefore, differences in parents’ use of specific emotion regulation strategies may differentially expose infants to inauthentic emotions and allow some infants to more readily detect regulated emotion. Furthermore, regulated emotion in which the expressive display is modified (i.e., masking or suppression) may specifically attune infants to the detection of such displays, whereas parent use of regulatory strategies that focus on cognitive aspects of emotion (i.e., reappraisal) may not.

Aims of Study 3

Study 3 investigated the development of infant detection of masked emotion. The experimental paradigm was designed to mimic a situation likely relatable for most parents – specifically, trying to get one’s child to eat something that you yourself do not enjoy. Sixteen- and 19-month-old infants watched an actress respond to a novel food with either positive enjoyment, a brief disgust response masked by positive enjoyment (i.e., masked disgust), or disgust. Infants were then presented with the novel food and their behavioral responses were coded to assess whether infants responded with differential behaviors as a function of the perceived authenticity of the emotion display. It was predicted that 19-month-old infants, but not 16-month-old infants, would detect the masked emotion and regulate their response to the food accordingly by avoiding the food, evident by decreased exploration of the food in response to adult masked disgust and disgust in comparison to positive emotion.

Additionally, all parents completed the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). This measure explored how infants’ socio-emotional climate may affect their detection of masked emotion. In conjunction with the process model described by Gross (1998), it was predicted that infants whose parents reported high use of regulating their emotions using
suppression (which focuses primarily on response modulation) would be more likely to detect the masked emotion, but parents’ use of reappraisal (which focuses primarily on cognitive modulation) would have no effect.

Method

Participants
Fifty-four 16-month old infants (26 female, $M_{age} = 16.00$, $SD = 0.56$) and 54 19-month-old infants (28 female, $M_{age} = 18.93$, $SD = 0.65$) completed Study 3. Eighteen infants of each age group were randomly assigned to one of three conditions: Positive Emotion, Masked Disgust Emotion, or Disgust Emotion. Infants were recruited from the San Francisco Bay Area. The average parent had a college degree and the average family income was $110,000.

Procedure
Infants were seated in a highchair at a table, directly facing a television monitor. The parent was seated 0.5m away from the infant, facing the opposite direction. Parents completed the ERQ during the experiment and were told not to look up or interact with their infant.

Infants were shown a 22-second video in which a plate of novel looking food (cold, bright green, spiral pasta) slid out toward a female adult, a professional actress trained in the presentation of emotion displays. The adult looked at the food, picked up a piece, brought the piece to her face, and took a bite. The adult then expressed either:
1) 8 seconds of positive affect/pleasure toward the food (Positive condition),
2) 1 second of disgust toward the food followed by 8 seconds of positive affect/pleasure toward the food (Masked Disgust condition)
3) 8 seconds of disgust toward the food (Disgust condition).
The emotions were communicated through the face, voice, and posture. The adult then set the food back on the plate and the plate slid away from her and out of frame. A similar looking plate of food, previously occluded by a curtain, slid out from underneath the television, timed such that its appearance gave the illusion that it was the same plate that was shown in the stimulus video and that the social context was interactive. The plate stopped 0.05 m from the infant and infants were allowed 30 seconds to explore the food. During this time the actress remained on the television and looked straight ahead while displaying neutral affect.

A professional actress was used in the stimulus presentation, rather than a parent or familiar adult, due to the complex nature of the emotion displays used in the study, particularly the masked disgust display. Similar methodology has been used in a number of previous studies (e.g., Mumme & Fernald, 2003; Shutts, Kinzler, McKee, & Spelke, 2009).

Coding

Internal Validity Check. A researcher reviewed all infant recordings to ensure that the infant watched the video clip. Only infants who attended to the experimental manipulation were included in the final sample.

Physical Exploration of the Food. Infant food exploration was coded on a 5-point scale: 0 = no touching of the food; 1 = touching the food on the plate; 2 = lifting the food off the plate; 3 = bringing the food close to face; 4 = ingesting the food. Peak infant food exploration was coded in two 15-second epochs and the two scores were averaged to obtain the overall level of infant food exploration for the 30-second period. Interrater agreement was very good ($r = .90$, $M_{difference} = 0.00$).

Parents’ Emotion Regulation. The ERQ, an instrument with acceptable psychometric properties provided by Gross and John (2003), was administered to index parents’ self-reported use of suppression and reappraisal emotion regulation strategies.
Results

To reiterate, this experiment was designed to investigate whether infants within each age group responded with differential behaviors between conditions, not whether differences were present between ages within conditions. The analyses below specifically tested our a priori hypotheses. The inclusion of main and interaction effects for each variable are again included for completeness.

Infant Food Exploration

A 2 (Age) x 3 (Emotion Condition) ANOVA revealed a significant main effect of Emotion Condition, $F(2,102) = 3.94, p = .02$, but not Age, $F(1,102) = 0.06, p = .80$, or Age x Emotion Condition, $F(2,102) = 1.80, p = .17$. Separate one-way ANOVAs tested for the main effect of emotion condition within each age group. Results indicated a significant effect of Emotion Condition for 19-month-old infants, $F(2,51) = 5.67, p = .01$, but not 16-month-old infants, $F(2,51) = 0.20, p = .82$ (see Figure 8).

Subsequent planned comparisons tested our a priori hypothesis that 19-month old infants, but not 16-month-old infants, would demonstrate differentiated behavioral responses to the Positive and Masked Disgust conditions, but not to the Masked Disgust and Disgust conditions. Sixteen-month-old infants did not differ in their exploration of the food between the Positive (mean exploration = 1.83, SD = 1.35) and Masked Disgust conditions (mean exploration = 1.64, SD = 1.42), $t(34) = 0.42, p = ns$, Positive and Disgust conditions (mean exploration = 1.44, SD = 1.20), $t(33) = 0.91, p = ns$, or Masked Disgust and Disgust conditions, $t(33) = 0.44, p = ns$. In contrast, 19-month-old infants demonstrated significantly greater exploration of the food in the Positive condition (mean exploration = 2.42, SD = 1.51) than in the Masked Disgust condition (mean exploration = 1.44, SD = 1.17), $t(34) = 2.16, p = .04$, and Disgust condition (mean exploration = 0.97, SD = 1.23), $t(34) = 3.15, p < .000$. Importantly, infants in the Masked Disgust condition did not differ from infants in the Disgust condition in their exploration of the food, $t(33) = 1.18, p = ns$, demonstrating that infants appreciated these conditions similarly.

Infant Food Ingestion

Differences in infant ingestion of the food were examined by entering Age, Emotion Condition, and Age x Emotion Condition into a logistic regression. Analyses revealed a trend for the effect of Emotion Condition, $\chi^2(2) = 4.92 p = .09$, but not Age, $\chi^2(1) = 0.00, p = .99$, or Age x Emotion Condition, $\chi^2(2) = 3.93, p = .14$. The effect of Emotion Condition was more closely analyzed within each age group using logistic regression. A significant effect of Emotion Condition was found for 19-month-old infants, $\chi^2(2) = 8.50, p = .01$, but not 16-month-old infants, $\chi^2(2) = 0.50, p = .78$ (see Figure 9).

Again, planned comparisons were used to test our a priori hypotheses. Sixteen-month-old infants did not differ in their likelihood to ingest the food between the Positive and Masked Disgust conditions, $\chi^2(1) = 0.12, p = ns$, Positive and Disgust conditions, $\chi^2(1) = 0.13, p = ns$, or Masked Disgust and Disgust conditions, $\chi^2(1) = 0.50, p = ns$. However, 19-month-old infants were significantly more likely to eat the food in the Positive condition than in either the Masked Disgust condition, $\chi^2(1) = 4.05, p = .04$, or the Disgust condition, $\chi^2(1) = 7.48, p = .01$. Again, of great importance is the finding that 19-month-old infants did not differ in their ingestion of the food between the Masked Disgust and Disgust conditions, $\chi^2(1) = 0.64, p = ns$.

Individual Differences in Infants’ Responding to Masked Emotion

Infant Food Exploration. Sixteen- and 19-month-old infants’ food exploration in the Masked Disgust condition was not correlated with parents’ self-reported suppression (16 month
olds: $r = 0.23, p = ns$; 19 month olds: $r = -0.13, p = ns$) or reappraisal (16 month olds: $r = 0.08, p = ns$; 19 month olds: $r = 0.20, p = ns$) of emotion.

**Infant Food Ingestion.** A closer examination compared infants in each age group who did or did not ingest the food in the Masked Disgust condition. Sixteen-month-old infants in the masked emotion condition did not differ in their eating of the food as a function of parent suppression of emotion (no ingestion = 2.98; ingestion = 2.75), $t(16) = 0.58, p = ns$, or reappraisal (no ingestion = 5.24; ingestion = 5.74), $t(16) = 1.20, p = ns$. Interestingly, parents of 19-month-old infants who did not eat the food reported suppressing their emotions significantly more than parents of infants who ate the food (no ingestion = 3.71; ingestion = 2.60), $t(16) = 2.46, p = .03$. No difference in parent reappraisal between the two groups was found (no ingestion = 5.31; ingestion = 5.23), $t(16) = 0.13, p = ns$.

**Discussion**

The present study found a developmental difference between 16- and 19-months of age in infant detection of masked emotion directed toward a novel food. Nineteen-month-old infants demonstrated decreased exploration and ingestion of the food in the masked disgust condition that was similar to behaviors demonstrated in response to authentic disgust. However, 16-month-old infants did not differentially respond to the food as a function of the emotion display.

Additionally, infants’ socio-emotional environment appeared to affect detection of the masked emotion. Parents of 19-month-old infants who detected the masked disgust reported suppressing emotions more frequently than parents of 19-month-olds who did not detect the masked disgust. However, parent use of reappraisal did not differ between these groups. This is consistent with theories of emotion regulation (see Gross, 1998), in which suppression involves modulating one’s expression of emotion, likely perceptually similar to masking (see Matsumoto et al., 2005), but reappraisal involves modifying one’s cognition. These findings suggest that exposure to parental suppression may impact infant detection of masked emotions.

**Limitations and Future Directions**

The findings from Study 3 suggest the need to further investigate a number of related topics. First, investigations using other emotions are needed to explore whether infants are able to detect masked emotions other than disgust (e.g., sadness, joy). Second, it would be worthwhile to examine whether infant detection of masked emotion varies depending on prior experience with the individual. For example, infants may be more likely to “forgive” false emotional communication from a trusted caregiver than a stranger (e.g., Corriveau & Harris, 2009). Third, the individual differences reported above, while intriguing, warrant cautious interpretation and call for naturalistic observations to explore how infants’ socio-emotional environment relates to emotional responding.

Finally, there exists a puzzling finding in the present results: 19-month-old infants demonstrated increased exploration and ingestion of the food in the positive condition in comparison with 16-month-old infants. This difference appears to create the observed differences between conditions and age groups. However, because younger infants’ failure to differentially respond was demonstrated by minimal exploration and ingestion in all conditions, older infants’ differentiation would likely only be represented by an increase in responding to the positive condition. Younger infants’ lack of differential responding to positive and disgust emotions directed toward the food underscores the need for further research investigating infant appreciation of emotional communication directed toward food.
**Implications for the Study of Emotion Regulation**

The existing empirical literature is lacking in the study of how individuals respond to regulated emotions. The contexts within which emotions occur are typically social (Gross, Richards, & John, 2006) and individuals communicating these emotions often have the underlying goal of regulating an observer’s response (see Hrubes et al., 2004). Whereas the majority of empirical research on emotion regulation is conducted in solitary settings (Campos, Walle, Dahl, & Main, 2011), masking inherently requires a social context. Research on the use and detection of masked emotion offers the opportunity to explore an understudied topic related to emotion regulation in interpersonal contexts. Such studies would complement existing research investigating basic processes of emotion regulation strategies by examining how the use of regulated emotion impacts the behaviors of social partners and subsequent interpersonal relations.
General Discussion

Prior research on emotional development has assumed that infants appreciate and respond to emotional communication regardless of discrepant information from the context or the quality of the emotional display. The present set of studies call this assumption sharply into question.

Emotional communication varies in its perceived authenticity, and appreciation of cues relating to authenticity powerfully affects one’s response to others’ emotion signals. This investigation examined the ontogeny of infant appreciation of three distinct cues related to the perception of emotional authenticity. The present findings indicate a developmental shift in infant appreciation and use of cues relating to the contextual congruency, expressive quality, and communicative clarity of an emotional display. In each study, 19-month-old infants, but not 16-month-old infants, differentially responded to the emotional presentation as a function of its perceived authenticity based on these cues.

In Study 1, 19-month-old infants utilized the contextual congruency of the emotion with the preceding events to determine the authenticity of a pain display. Study 2 demonstrated that infants of this age are also sensitive to the degree of exaggeration with which an emotion is communicated when judging the believability of a fearful display. Finally, Study 3 showed that 19-month-old infants are also sensitive to the clarity of emotional communication and are able to detect when an adult attempts to mask her disgust with a positive display. This set of studies demonstrates that 19-month-old infants are sensitive to the perceived authenticity of emotional communication and coordinate distinct behavioral responses specific to whether the emotional communication is appreciated as authentic or inauthentic.

Taken together, it is clear that infants appreciate emotional communication beyond simply its outward expression and are more sensitive to features of the emotional environment than previously believed. In what follows, potential underlying mechanisms that may facilitate this capacity are proposed and implications of these findings for the study of emotion and emotional development are highlighted.

Potential Mechanisms for the Detection of Inauthentic Emotional Communication

The development of infant sensitivity to cues relevant to emotional communication is likely facilitated by a number of underlying processes. While all possible mechanisms cannot be outlined in the present report, I suggest four below that warrant further inquiry.

Understanding of Pretense. Infant understanding of pretense is likely very relevant for appreciating inauthentic emotional communication. Research indicates that infant understanding of pretense develops significantly during the second year of life, particularly between 15 and 24 months of age (see, Haight & Miller, 1992; McCune, 1995; Walker-Andrews & Kahana-Kalman, 1999). This supports our conclusion from Study 1 that 19-month-old infants used the cue of the parent missing her hand as an indication of pretend play, whereas 16-month-old infants noticed the discrepant event, but not its significance as a pretend act. A similar conclusion may be drawn from Study 2, in which 19-month-old infants appreciated parent exaggerated fear displays as comical. Lillard (2007) found that mothers’ movements and vocalizations tend to be exaggerated during pretense. Although Lillard did not find that parent pretend behaviors changed between 15 and 24 months of age, it is possible that infants need a few months of experience to effectively understand pretense in different contexts. It is also possible that parent use of pretense may vary across contexts. For example, parents may pretend using physical objects earlier than they display pretend emotions in social interactions. Lillard and Witherington (2004) have found that parents change functional movements when interacting with objects during pretense. It is possible that functional behaviors related to emotional communication might also be altered in

...
such contexts. Research is needed to more closely examine parent use of pretend emotions in everyday interactions with their infant, as well as examine how specific expressive behaviors change during such instances.

**Understanding of False Beliefs.** Infants’ understanding that individuals may have beliefs contrary to the appearance of a situation may also be relevant. In each of the above studies one might suppose that the infant effectively disentangled the outward expression of emotion from the perceived internal emotional state of the individual. Recent research indicates that infants as young as 18 months have some comprehension that others may have beliefs contrary to reality (Scott, Baillargeon, Song, & Leslie, 2010; Scott & Baillargeon, 2009). Investigations exploring possible links between infant false-belief understanding and the present research are called for.

**Cultural Differences in Emotion Displays.** Infant exposure to situations in which specific cues are more helpful than others for accurately appreciating emotional communication may increase sensitivity and utilization of those cues. The individual difference findings from Study 3 suggest that parents’ increased use of suppression was related to infant detection of masked emotion. Matsumoto and Hwang (2011) recently documented positive training effects for detecting micro-expressions of emotion, which could suggest that one’s exposure and attention to specific micro-expressions may facilitate their detection. Recent research also indicates that individuals from different cultures selectively attend to specific features of facial displays of emotion (Jack, Caldara, & Schyns, 2012). Individuals from cultures that use a specific form of inauthentic expression more often than another may have individuals who are more adept at detecting a specific cue or feature of emotion expression. For example, one might predict that a culture in which exaggerating emotions is more prevalent would be composed of individuals who more accurately infer an individuals’ emotional state when the expressive display is exaggerated. Detection of inauthentic emotions may also be emotion specific. For example, exposure to a specific, regularly inauthentic emotion may result in more attentional resources to ascertain the authenticity of the emotion, or specific attention to cues specific to the evaluation of the authenticity of the emotion.

**Socialization Practices.** Shifts in parenting practices designed to teach social norms may also result in infant exposure to and understanding of inauthentic emotion. Caregivers routinely engage in socialization practices throughout infancy designed to teach infants acceptable social behaviors (for a review, see Eisenberg, Cumberland, & Spinrad, 1998). During the present investigation, parents routinely reported using inauthentic emotion to create teachable moments for informing their infant of appropriate interpersonal behaviors. Instances of such lessons by parents instructing infants on how to act and respond in social settings may facilitate script learning of appropriate social interactions, as well as opportunities to play pretend games designed to teach such social norms. For example, a parent may exaggerate her pain after being hit by the child to emphasize that hitting is bad and results in pain, and provide the context for the child to demonstrate an appropriate response (e.g., prosocial responding, saying sorry). Examining the distinction between genuine helping and script helping is an area open for research.

**Implications for Research on Emotion**

This empirical investigation focused on three distinct features relating to emotional communication. However, the implications for this research are likely far broader than any single cue and relevant to emotion research with both developmental and adult populations.
From a developmental perspective this research is relevant at two levels of empirical significance. First, these findings stress that researchers pay careful attention to the contextual relevancy of the emotional presentation, quality with which the emotion is displayed, and the clarity with which the emotion is communicated when designing studies to investigate emotional development in infancy. Second, this research lays the foundation for a wealth of future research to further explore infant appreciation of each cue studied above, as well as the possible mechanisms related to its functioning. Furthermore, while a great deal of progress was made during the 1980s and early 1990s to understand infant emotional development, it is important for researchers to recognize that very basic issues related to emotional development have yet to be investigated.

More generally, the emphasis of the above research on individuals’ appreciation of and response to other’s emotions highlights the value of examining “emotions as behavior regulators” (Klinnert, Campos, Sorce, Emde, & Svejda, 1983). This perspective advocates for empirical studies of emotion to take place in socially relevant contexts in which the participant may flexibly respond to a personally relevant and ecologically valid stimulus. The “limitations” of developmental paradigms, which typically necessitate empirical contexts in which the participant actively engage with and respond to the environment, reveal themselves as strengths for providing contexts that capture the significance of emotions in human interactions.
References


Figures

Figure 1. Mean amount of infant concerned facial expressions in each age group in the Hammer Hit and Hammer Miss conditions (error bars represent +/- 1 standard error of the mean).

Figure 2. Percentage of infants in each age group who demonstrated prosocial responding in each age group in the Hammer Hit and Hammer Miss conditions.
**Figure 3.** Percentage of infants in each age group who displayed positive affect in each age group in the Hammer Hit and Hammer Miss conditions.

**Figure 4.** Percentage of infants in each age group who demonstrated aggressive/playful behaviors in each age group in the Hammer Hit and Hammer Miss conditions.
Figure 5. Mean amount of infant positive affect in each age group in the Normative and Exaggerated fear conditions (error bars represent +/- 1 standard error of the mean).

Figure 6. Mean amount of infant negative affect in each age group in the Normative and Exaggerated fear conditions (error bars represent +/- 1 standard error of the mean).
Figure 7. Mean number of infant reaches in each age group in the Normative and Exaggerated fear conditions (error bars represent +/- 1 standard error of the mean).

Figure 8. Mean amount of food exploration by infants in each age group in the Positive, Masked Disgust, and Disgust emotion conditions (error bars represent +/- 1 standard error of the mean).
Figure 9. Percentage of infants in each age group who ingested the food in the Positive, Masked Disgust, and Disgust emotion conditions.