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Infants' Pre-Empathic Behaviors are Associated with Language Skills

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Abstract

Infants' responses to other people's distress reflect efforts to make sense of affective information about another person and apply it to oneself. This study sought to determine whether 12-month olds' responses to another person's display of negative affect reflect characteristics that support social learning and predict social functioning and language skills at 36 months. Measures of infants' responsiveness include congruent changes in affect and looking time to the person in distress. Attention to the examiner displaying positive affect, analyzed as a control condition, was not related to social functioning or language skills at 36 months. Neither attention nor affective response to the examiner's distress at 12 months was related to social functioning at 36 months. However, longer time spent looking at the examiner feigning distress predicted higher language scores. Moreover, infants who demonstrated a congruent affective response to distress had higher receptive language scores at 36 months than children who did not respond affectively. Importantly, these relations were not mediated by maternal education, household income, or 12-month verbal skills. These findings are consistent with the notion that adaptation to changes in a social partner's affective state supports an infants' ability to glean useful information from interactions with more experienced social partners. Infants' sensitivity to affective signals may thus be related to the ability to interpret other people's behavior and to achieve interpersonal understanding through language.

Keywords

Empathy; Infancy; Social Interaction; Language Development; Social Development

The development of behavioral responses to another person's distress has been well characterized in infants and toddlers from 10 to 25 months of age (*e.g.*, Zahn-Waxler & Radke-Yarrow, 1982; Zahn-Waxler, Radke-Yarrow, Wagner & Chapman, 1992).

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Behavioral responses include orienting toward a person in distress, self-referencing, mirroring the other person's distress, expressing sadness or worry, and offering help or comfort. Early in this developmental period, infants' responses reflect emotional contagion (Hatfield, Cacioppo, & Rapson, 1994) and self-orientation. As cognitive abilities progress, infants' responses take on other-oriented and pro-social qualities (Zahn-Waxler et al., 1992). Infants' responses to others' distress may be qualitatively different from empathy before an infant understands the self-other distinction (Bischof-Kohler, 1994) in that empathy entails some understanding that the triggering emotional experience belongs to the other person. In the same developmental window when self-other distinction crystallizes (Asendorpf & Baudonniere, 1993), the pro-social quality of distress response behaviors also increases considerably (Zahn-Waxler et al., 1992). Evidence that distress-response behaviors are correlated at the two ages suggests that primitive distress responses during infancy and later expressions of empathy are developmentally linked (Zahn-Waxler et al., 1992).

Despite evidence of short-term links with important developmental milestones, little is known about longer-term implications of distress-response behaviors during infancy (see Hutman & Dapretto, 2009). Given that negative emotions are salient for infants (*e.g.*, Hornik, Risenhoover & Gunnar, 1987) and that infants adjust their behavior in response to other people's displays of negative emotion (Campos & Sternberg, 1981; Feinman, 1982; Gunnar & Stone, 1984; Klinnert, Campos, Sorce, Emde, & Svedja, 1983; Walden & Ogan, 1988), we speculated that infants' behavioral responses to another person's distress would reflect individual differences in social attunement and a corresponding aptitude to benefit from social learning opportunities. The goal of this study was to determine whether variability in 12-month olds' response to distress was associated with the acquisition of skills such as adaptive social functioning and language, evaluated at 36 months.

The early emergence of emotion discrimination is adaptive for safety (*e.g.*, Preston & Waal, 2002) and for the achievement of emotional attunement with caregivers (Feldman, 2007). Infants are able to discriminate their mother's facial expressions of emotion at 3½ months (Montague & Walker-Andrews, 2002). They can differentiate emotions with bi-modal audiovisual presentation at 4 months using standardized videotaped stimuli (Flom & Bahrick, 2007) as well as in the context of a play interaction, such as a peekaboo game (Montague & Walker-Andrews, 2001). By 7 months, infants respond differently to negative affect than to neutral and positive affect, looking longer at fearful faces than happy faces (Nelson & Dolgin, 1985) and taking longer to habituate to fearful compared to happy faces (Nelson, Morse & Leavitt, 1979). At this age, infants show larger ERP amplitudes in response to negative facial expressions than positive ones (de Haan & Nelson, 1998; Kestenbaum & Nelson, 1992; Nelson & Nugent, 1990). Twelve-month olds demonstrate larger *Nc* amplitude – reflecting attention – in response to objects associated with negative emotion than those associated with positive or neutral emotion (Carver & Vaccaro, 2007). At the behavioral level, 10-month olds consistently orient to other people's displays of distress (Zahn-Waxler & Radke-Yarrow, 1982) and social referencing emerges at one year. That is, 12-month olds modify their behavior in response to maternal affective displays (Feinman & Lewis, 1983; Sorce, Emde, Campos, & Klinnert, 1985), especially when the maternal affect is negative (Hornik et al., 1987). In that social referencing is critical for shaping behaviors and learning rules that help infants navigate their environments safely, the accurate interpretation of affective signals may be implicated in both social and cognitive development.

There are several theoretical justifications for proposing links between infants' responses to negative affective signals, adaptive social functioning, and language skills. Responding to another person's distress involves interpreting changes in the affective state of a social partner. The ability "to perceive and respond to rapidly changing bits of affective

information” (Feldman & Greenbaum, 1997, p. 17) at 3 months was strongly correlated with three measures of symbolic competence at 24 months: symbolic play, verbal IQ, and the use of internal-state words. Perceiving and adapting to changes in a social partner’s affective state was associated with the development of skills in both the cognitive and social domains. Affective states are conceived as groupings of discrete behavioral phenomena such as facial expressions, gestures, and sounds. Abstracting from these phenomena, disregarding the differences among them, and organizing them into coherent units of understanding may contribute to the development of symbolic reasoning. Accordingly, infants who are more responsive to others’ distress, accurately categorizing the other person’s discrete behaviors, adjusting their own affect and behavior in a congruent fashion, would be expected to demonstrate superior social and language development.

Another process that may link infants’ distress-response patterns to language and social functioning is theory of mind. An infant’s response to witnessing another person’s distress may reflect his emerging awareness of and ability to intuit the other person’s perspective, especially as self-awareness and the self-other distinction coalesce (Zahn-Waxler et al., 1992). Responding to distress requires some interpretation of the social partner’s mental state and can be construed as an affective component of theory of mind, or a precursor to theory of mind. “The echoing of affects, feelings, and emotions that takes place in reciprocal interaction between young infants and their caretakers is at the origin of intersubjectivity, a necessary element to the development of more advanced social cognition, including theory of mind” (Rochat & Striano, 1999, p. 8). The ability to understand mental states has been linked with peer interaction skills and the development of friendships (Dunn & Brophy, 2005). Furthermore, demonstrated links between theory of mind and language ability are plentiful (for a review, see Milligan, Astington & Dack, 2007). Therefore, children who demonstrate understanding of the internal states of others by means of a congruent affective response to another person’s distress would be expected to develop a relatively advanced theory of mind and, thereby, to achieve superior social functioning and language skills.

Proposing a link between distress response, social, and language development is further justified by research indicating that common brain regions subserve empathic and imitative processes (Carr, Iacoboni, Dubeau, Mazziota & Lenzi, 2003). In that these brain regions are activated in the observation of another person’s pain and direct experience of pain, they may potentiate the matching of representations between observer and the object of observation (Rizzolatti & Craighero, 2004). To the extent that early empathic responses reflect shared representation of social experience at the neural level, this may support shared understanding of events co-experienced by social partners. Therefore, infants’ distress-response patterns may reflect an aptitude for shared understanding, social learning, and language acquisition.

The establishment of links between distress response and measures of social and language development would support the proposition that responsiveness to distress reflects a key component of social cognition and a mechanism of social learning. Furthermore, associating overt early behavior with subsequent social and language development would suggest a means for identifying infants who are at risk for adverse developmental outcomes and it may indicate a target for treating children who show signs of atypical social or language development.

In this study, 12-month-old infants’ responses to an examiner’s feigned distress were evaluated as predictors of language skills and social functioning at 36 months. Feshbach’s (1982) conceptual model of empathy includes a cognitive component, reflecting the ability to differentiate among affective states, as well as an emotional response. Accordingly, we measured the duration of infants’ attention to the distressed examiner’s face as a continuous

measure of interest or effort to make sense of the examiner's experience. We also evaluated congruent changes in the child's affect in response to the examiner's distress. Both attention and affective response to the examiner's distress were evaluated as predictors of language and social functioning at 36 months.

The literatures cited above indicate links between infants' classification of emotional information and symbolic competence; between theory of mind, social understanding, and development of language; and between perception of another person's affective signals and shared understanding of a painful experience. These findings suggest the hypothesis that allocation of more attention at 12 months to the face of an examiner in distress will correspond with superior language skills and adaptive social functioning at 36 months. The second hypothesis of the study is that 12-month olds who respond to the examiner's display of distress with a congruent affective response will have superior language skills and adaptive social functioning at 36 months relative to 12-month olds who do not demonstrate a congruent affective response to distress.

Method

Participants

One hundred seventy-five children enrolled in a study about the development of language and communication skills in infants at high and low risk for autism spectrum disorders (ASD). The full sample included 111 siblings of children with autism and 64 infants with no family history of autism. The inclusion of high-risk infants in the current study was intended to maximize the range of distress-response behaviors, language skills, and social functioning because siblings of children with autism and often demonstrate traits associated with autism at sub-clinical levels, most notably language delays (Bailey, Palferman, Heavey & LeCouteur, 1998). Siblings of children with autism are also at elevated risk for autism spectrum disorders (e.g., Ozonoff et al., 2011). Therefore, a subsample was selected to contribute data to the analyses reported below in accordance with the following criteria: participants provided data at both 12 and 36 months of age; they did not meet criteria for ASD at 36 months; and measures of their language and social skills were within one standard deviation of age norms to ensure that this study would shed light on factors related to typical language and social development. The subset of participants who met these inclusion criteria consisted of 53 infant siblings of children with autism and 38 infants with no family history of autism. Enrollment was limited to one child in a family to ensure independence of data points. Characteristics of the final sample are summarized in Table 1.

The procedures described in this report were approved by the University's Institutional Review Board. Caregivers of the infants who participated in this study provided informed consent before data were collected. Assessments took place in our research laboratory at the University's Medical Center within two weeks of the day that the child attained the target age.

Assessment of Child's Response to Another Person's Distress

The measures of attention and affective response to an examiner's display of distress used in this study are based on those previously described by Zahn-Waxler and her colleagues (Zahn-Waxler et al., 1992) and have been employed in previous studies in our research lab (Sigman et al., 1992; Hutman et al., 2010; 2011). The examiner and the child each took several turns playing with a toy xylophone after the examiner determined that the child was paying attention to the play interaction. After the turn-taking phase of play, the examiner pretended to hit her finger with the toy mallet and she withdrew from play, focusing on the "hurt" hand, which she held still at chest level. At the end of a 15-second suspension of the

interaction, the examiner re-engaged with the child and assured the child that she was feeling better. A video recording captured the child's behavior and facial expression during the play interaction and throughout the examiner's feigned distress. Camera operators ensured that the examiner was included in the video frame so that coders would be able to judge when the infant was looking at the examiner's face.

Behavioral Coding

Infants' Attention to the Examiner—Two undergraduate research assistants coded infants' looking behaviors for 15 seconds of playtime leading up to the examiner's feigned injury and for 15 seconds following the injury, while the examiner pretended to be in distress. Coding the two time blocks allowed us to evaluate differential relations between infants' attentiveness to other people during play vs. attentiveness to a person in distress. We used behavioral coding software (The Observer 9.0 XT, NOLDUS) to mark onset and offset of infants' fixation on the examiner's face. An administration of the task was not coded if either segment of the task lasted less than 15 seconds, *e.g.* if the accompanying caregiver interrupted the task. The coders, unaware of the hypotheses of this study, double-coded 22 instances of baseline play and the distress-response task, representing approximately 24% of the current sample. Judgments were considered to be in agreement if both coders' scored changes in the target of gaze to or away from the examiner's face within one second of each other. Coders' decisions were in agreement 92% of the time (Cohen's $\kappa = 0.82$).

Infants' Affective Response to Distress was coded by a different team of coders using a global rating of the extent to which a child's affective state changed relative to baseline in a manner suggestive of concern or distress. The coding system has been described in our earlier work (Hutman et al., 2010; Sigman, Kasari, Kwon & Yirmiya, 1992). Children's affective responses to the examiner's distress were scored on a four-point Likert scale. Scores were based on changes in infants' facial expression reflecting concern or sadness, efforts to comfort the examiner, or to receive comfort from a parent. Infants who ignored the examiner entirely and those who attended to the examiner but did not demonstrate a change in affect that could be considered congruent with the affect displayed by the examiner received a score of 0 on the affect scale. A child received a score of 1 for a brief or subtle expression of distress or concern. A score of 2 reflected a clear change in affect, including an expression of distress or concern that could still not be considered a strong affective response. Infants whose responses to the examiner's distress involved the offer of comfort to the examiner, seeking comfort for him or herself, or other strong indications of concern, worry, or distress received a score of 3. In a small number of cases, infants demonstrated an initial cheerful response to the examiner's distress, followed by concern as if the seriousness of the injury was not immediately apparent. In these cases, the response was classified on the basis of the ultimate reaction to the examiner's affective display.

Plans to analyze infant distress and concern as separate predictors of later language skill proved unworkable with this sample as displays of distress occurred so infrequently. This observation suggests that infants' affective responses to the examiner's distress were qualitatively different from emotional contagion. Accordingly, we collapsed negative affective responses into a single category that could be considered "congruent" (Eisenberg & Strayer, 1987) to the examiner's distress. Responses of discomfort, worry, and concern for the examiner were all considered congruent to the examiner's display of distress.

Two separate teams of coders implemented the affect and attention coding systems to avoid the possibility that knowledge of one scale would bias judgment of the other. The distress-response task was coded for infants' affective response at multiple time points for the full sample (Hutman et al., 2010). Therefore, a larger team of research assistants participated in affect coding than attention to faces. Six research assistants were trained on the affective-

response coding protocol by the third author. None of the research assistants who coded affective response was aware of this study's hypotheses. Forty-four videotapes of the distress task, approximately 48% of the current sample, were double-coded to ascertain inter-rater reliability. Coders' ratings were analyzed using a two-way mixed model intra-class correlation based on absolute agreement between coders. The Single Measure Reliability for 6 research assistants and the third author was 0.81 for the judgment of infants' affective response.

The Autism Diagnostic Observation Schedule – Generic (ADOS; Lord et al., 2000) and the Autism Diagnostic Interview – Revised (ADI-R; Lord, Rutter & LeCouteur, 1994) were administered at the 36-month assessment to help a clinician determine whether participants met criteria for ASD. The ADOS is a semi-structured play-based observation designed to elicit social and communicative behaviors indicative of autism. An examiner's ratings of the child's behaviors are summed to determine diagnostic classification using an empirically derived algorithm. Classification is based on social reciprocity and communication scores, as well as a cutoff for the sum of these two domains. The ADI-R is a ninety-three-item interview administered to parents or other caregivers to elicit information about children's skills and behaviors in the three domains of diagnostic significance. Examiners were trained and confirmed reliable to administer and score the ADOS and the ADI according to their authors' specifications. A clinical psychologist reviewed participants' behavioral interactions, ADOS, and ADI, and rendered a judgment as to whether or not the child met criteria for ASD according to the DSM-IV-TR (American Psychiatric Association, 2000). Participants who met criteria for ASD at 36 months were excluded from the analyses reported below. Combined scores from the communication and social reciprocity scales from the ADOS at 36 months were used to compare risk groups for autistic symptomatology. Sums of these scales did not differ between high-risk ($M = 2.52$, $SD = 1.93$) and low-risk ($M = 2.39$, $SD = 1.95$) participants ($p > 0.75$). The mean ADOS scores for both groups are considerably less than the 7-point cutoff for ASD classification.

The *Mullen Scales of Early Learning* (MSEL; Mullen, 1995) are comprehensive measures of cognitive functioning for young children from birth through 68 months, normed with a sample of 1,849 typically developing children. For the current study, the expressive and receptive language raw scores at 36 months were used as outcome measures. In order to determine the unique portion of variance in language skills at 36 months that was explained by distress-response behaviors at 12 months, we controlled for verbal mental age at 12 months. Verbal mental age is calculated by averaging age equivalents generated by the receptive and expressive language scales of the MSEL. Combining the two scales aimed at reducing the number of analyses run and minimizing experiment-wise error.

The *Vineland Adaptive Behavior Scales Survey Form* (VABS; Sparrow, Balla & Cicchetti, 1984) is a semi-structured caregiver interview used to measure the performance of communication, daily living skills, and adaptive social functioning. It was standardized with a large national sample to evaluate children from birth to nineteen years of age. A trained interviewer administers the measure to the child's primary caregiver and scores each item on the basis of the caregiver's description of the child's performance in specified behavior categories. Age equivalents from the socialization domain and the Adaptive Behavior Composite Standard Score of the VABS were used as indicators of participants' adaptive social functioning at 36 months and tested for links with infants' response to another person's positive and negative affective displays at 12 months.

Demographic Data—At their first visit to our lab, parents completed background information forms. Data from these forms that were analyzed for the current study include number of siblings, annual household income, and mothers' educational attainment. Income

information is ascertained categorically in ranges of \$25,000 in part to encourage participants' willingness to provide a response. Prior to analysis, participant responses were collapsed into three income ranges (under \$50,000; \$50,000–\$99,999; \$100,000 and over) in order to avoid small data cells.

Results

Preliminary Analyses

Because first-degree relatives of individuals with autism have demonstrated higher rates of social and communication impairments than controls (Piven, Palmer, Jacobi, Childress, et al., 1997), we compared high- and low-risk participants in the current sample to explore systematic differences on the language and social outcome measures of interest. High- and low-risk groups did not differ on the Mullen language scales or the Vineland socialization, communication, or daily living scales (p values > 0.40). Mean scores on these measures, which are included in Table 1, are not consistently lower for the high-risk group than for the low-risk group. Therefore the inclusion of high-risk participants in these analyses does not appear to account for other relations reported below.

After ruling out an effect of risk group, we evaluated several other constructs that have been associated with variability in developmental progress for associations with 36-month measures of language and social functioning in the current sample. We evaluated 12-month verbal mental age, gender, mothers' educational attainment, and household income. Gender, and mothers' educational attainment were not related to expressive or receptive language, socialization age equivalents, or adaptive social function standard scores at 36 months. High-risk participants had more siblings (mean = 1.47; $SD = 0.69$) than low-risk participants (mean = 0.55; $SD = .77$; $t(90) = 7.22$; $p < 0.001$), but number of siblings was not related to language scores or adaptive social behaviors at 36 months.

Twelve-month verbal skills were related to receptive ($r = .25$, $p < 0.05$) and expressive language ($r = 0.29$, $p < 0.01$), but not to social development measures at 36 months. Children from the lowest family income group (families earning up to \$49,999), had significantly lower receptive language scores at 36 months (mean = 31.4, $SD = 3.1$) than children from families in the highest income group (annual income over \$100,000; mean = 34.5, $SD = 4.1$). Children from families in the middle-income group did not differ from children in the higher or lower income groups in verbal skills at 36 months. Expressive language scores at 36 months were not associated with household income. Household income was not related to adaptive social functioning standard scores. Based on these preliminary analyses, 12-month verbal skills and family income were entered as covariates in subsequent analyses that indicated significant relations between distress-response at 12 months and 36-months outcome variables.

12-month olds' attention to the examiner's face

Infants looked to the face of the examiner for significantly less time during the free play condition ($M = 0.99s$, $SD = 1.35$) than during the distress condition ($M = 4.10s$, $SD = 2.96$), $t(90) = 9.18$, $p < 0.001$. Looking time to the examiner's face during the baseline play condition was not related to expressive or receptive language, socialization age equivalent, or adaptive functioning composite score at 36 months (p values > 0.60).

To test our hypothesis regarding the relationship between infants' attention to another person's distress at 12 months and verbal skills at 36 months, we ran two sets of regression analyses. We evaluated expressive and receptive skills separately as outcomes. First, we tested total duration of infants' looks at the examiner's face during the 15 seconds following feigned injury as the sole predictor of language skills. In a second step, we added verbal

mental age at 12 months and family income as covariates. All participants were assigned to one of three income groups described above (lower, middle, and higher). Including all three dummy variables in a regression model results in perfect multi-collinearity. Omitting one of the three groups from a regression analysis makes the omitted group the reference category against which the other categories are compared (Hardy, 1993). Entering only the latter two income variables as covariates in these analyses indicates the portion of the variance in language outcome that is explained by growing up in a family with middle or higher income, relative to the lower income reference group. Attention to the examiner's face at 12 months was related to both receptive and expressive language at 36 months. The relationships remained significant when 12-month language skills and family income were included in the models. When 12-month verbal mental age and duration of attention to the examiner's face are both entered as predictors in a regression model, the unique portion of the variance in 36-month verbal mental age explained is approximately 4% and 5% respectively (adjusted R^2). Results of these regression analyses are summarized in Table 2.

Looking time to the examiner's face during the distress condition was neither related to VABS socialization age equivalents nor to the Adaptive Behavior Composite standard scores at 36 months (p values > 0.50).

12-month olds' congruent affective response to distress

The distribution of affective-response scores was positively skewed: more than 70% of 12-month-olds in this sample showed little or no congruent affective response to the examiner's distress (scores = 1), a pattern consistent with prior parent-reported rates of concern and distress in a study of the development of empathy in the second year (Zahn-Waxler et al., 1992). Thus, we dichotomized the affective-response variable, dividing the sample into a group of infants who demonstrated no congruent affective response to the examiner's distress (score of 0; $n = 30$) and a group who showed some degree of congruent affective response (scores > 0 ; $n = 61$). Doing so yielded the most even split of participants that could be accomplished with the observed distribution of 12-month olds' congruent affective responses. We compared 36-month language scores between affective-response groups.

Infants who showed a congruent affective response to the examiner's distress at 12 months had marginally better receptive language scores at 36 months ($M = 33.3$, $SD = 4.1$) than infants who did not display a congruent affective response to distress ($M = 30.5$, $SD = 6.7$), $t(89) = 1.80$, $p = 0.08$. A similar pattern of results was observed when 12-month verbal skills and family income were analyzed as covariates. Despite the unequal size of comparison groups for affective response to distress, variances did not differ between groups (p values > 0.60). Congruent affective response to distress at 12 months was not related to expressive language skills at 36 months. Results of these regression analyses are included in Table 2.

VABS socialization age equivalents and Adaptive Behavior Composite standard scores at 36 months did not differ between infants who demonstrated a congruent affective response to the examiner's distress at 12 months and those who did not (p values > 0.10).

Discussion

This study explored the relationship between early 12-month olds' behavioral responses to another person's distress and measures of language and social skills at 36 months. Twelve-month olds' attentiveness and responsiveness to another person's distress were not related to parent reports of adaptive social functioning at 36 months. Infants' attention to the face of another person during a free-play condition was neither related to parent reports of social functioning nor to language skills at 36 months. In contrast, we found that 12-month olds' looking time to the face of an examiner feigning distress was positively correlated with

expressive and receptive language scores at 36 months. Infants who demonstrated a change in affect congruent with the examiner's distress had marginally higher receptive language scores at 36 months than infants who did not demonstrate a congruent change in affect. The associations between distress response at 12 months and language scores at 36 months remained significant even when household income and 12-month language ability were included in regression models as covariates.

Twelve-month olds' responsiveness to distress was not related to general social functioning as measured by the Vineland socialization domain score and Adaptive Behavior Composite score. We proposed that measures of social functioning and language at 36 months would provide evidence that infants' response to affective messages reflect aptitude for social learning. From 10 months of age, infants' interactions with strangers (Feinman & Lewis, 1983), use of toys (Gunnar & Stone, 1984; Hornik et al., 1987; Walden & Ogan, 1988; Zabatany & Lamb, 1985), and willingness to cross a visual cliff (Sorce, Emde, Campos, & Klinnert, 1985) are influenced by their mothers' facial expressions of emotion. Since caregivers' emotional signals have short-term impact on infants' behavior, we predicted that variability in responsiveness to another person's distress at 12 months would be associated with parent reports of their child's social functioning 24 months later. The null result may be attributable to our use of a standardized caregiver interview as an outcome measure: standardized instruments in general or the Vineland Scales in particular may not capture the individualized nature of parents' cumulative socialization efforts. Naturalistic observation of social skills may more accurately reflect the works parents do to shape their children's behavior.

These results raise a question about whether infants' responses to their own caregivers' distress might be associated with social development even though links were not found with displays of distress modeled by unfamiliar examiners. The possibility that infants are more responsive to their caregivers' displays of negative affect than those of an unfamiliar examiner was not supported in a previous study addressing that question (Sigman, Kasari, Kwon & Yirmiya, 1992). That study involved slightly older typically developing toddlers (Mean age = 19.8 months, SD = 8.2), who were significantly more responsive to distress displayed by examiners than to distress displayed by their caregivers.

In the current study, language skills at 36 months were related to infants' behavioral responses in the distress condition, but not in a play condition characterized by the examiner's positive affect. The inclusion of free play as a control condition addresses the possibility that the children who are most interested in other people are those with the strongest aptitude for language learning. The findings reported here suggest that individual differences in 12-month olds' response to another person's distress reflect characteristics that are useful for learning language. Selective attention to a person who is in distress may reflect an emerging understanding of the value of social partners' affective signals and their potential relevance to the infant. Infant siblings of children with autism who are unresponsive to another person's distress are at heightened risk for being diagnosed with autism (Hutman et al., 2010). Like infants who are later diagnosed with autism, typically developing infants who are unresponsive to another person's distress may also lack the ability to glean personally relevant or useful content from their interactions with others.

In this sample, infant siblings of children with autism did not score lower on measures of social functioning and language than low-risk controls. This observation was somewhat unexpected given evidence that first-degree relatives of individuals with autism show features of autism at sub-clinical levels (Piven et al., 1997). Our previous work suggests that the majority of infant siblings develop typically (Ozonoff et al., 2011) and do not demonstrate more autism-related symptoms than controls in domains such as play

(Christensen et al., 2010); response to distress (Hutman et al., 2010); and pre-verbal communication skills (Rozga et al., 2011). Piven's study of parents of multiple children with autism (1997) suggests the possibility that, in the current sample, the older sibling's autism results from a *de novo* genetic mutation, resulting in a sporadic case of autism rather than inherited or familial autism such as Piven studied. First-degree relatives of children with a *de novo* copy number variation (CNV) would not be expected to carry added risk for autism or its symptoms (Sebat et al., 2007).

Based on the observed links between distress response at 12 months and language skills at 36 months, we propose that responsiveness to others' distress may reflect an infant's capacity to parse meaningful information from their social environments. As proposed by Feldman and Greenbaum (1997), the ability to organize discrete affective phenomena such as facial expressions, gestures, and sounds into coherent units of understanding may contribute to the development of symbolic reasoning even beyond the domain of interpersonal understanding. The findings reported here are consistent with the notion that, among children who do not have autism, more responsiveness to others' distress corresponds with greater aptitude for language learning from social interaction. Infants who look longer to the distressed examiner's face may realize that there is important information to be gained from attending to the circumstances surrounding others' expressions of discomfort. The observation that infants are generally more responsive to negative expressions of emotion than positive or neutral ones, both in ERP responses (de Haan & Nelson, 1998; Kestenbaum & Nelson, 1992; Nelson & Nugent, 1990) and in overt behavior (Hornik et al., 1987), is consistent with evolutionary theory. Vigilance in the detection of others' negative emotions may protect infants from harm and optimize the chances for survival (e.g., Preston & de Waal, 2002). An alternative explanation for heightened response to negative emotion is that infants encounter it less frequently than other emotions and experience it as novel (Nelson, 1993). In either case, the results of these analyses suggest that individual differences in infants' responses to distress are relevant to their language development.

Our finding that the duration of 12-month olds' attention to another person's distress was positively correlated with receptive and expressive language skills at 36 months indicates that infants who process social-affective information for longer periods of time achieve superior language skills. More attention to distress may correspond with the allocation of more cognitive effort to understand a social partner's experience or perspective. This interpretation of the data is consistent with the observation that 7-month olds look longer at fearful faces than happy faces (Nelson & Dolgin, 1985) and take longer to habituate to fear faces than happy ones (Nelson et al., 1979). Efforts by 18–20-month-old toddlers to figure out another person's distress ("hypothesis testing") were associated with the same children's pro-social behavior when children were exposed to another person's distress again at 23–25 months (Zahn-Waxler et al., 1992). Working to understand another person's distress at the earlier time point was related to progress in the development of empathy assessed at the later time point. In the current study, more time spent observing the face of a person in distress at a younger age corresponded with better language understanding and production two years hence.

Infants' congruent affective responses to another person's distress at 12 months were marginally related to receptive language skills at 36 months. The infant's affective response to the examiner's distress suggests a sharing of that person's experience. The infant may feel vicariously that hitting one's finger evokes a pain response without having to endure pain directly. The infant's sense of sharing another person's pain fosters awareness that the other person is like me' (e.g., Meltzoff & Decety, 2003). This form of identification may be instrumental in bridging minds with language, too. The infant perceives and shares the

emotional signal sent by another person and thereby achieves an understanding of his social partner's experience. While the sharing of affect does not necessarily lead to shared meaning, a common mechanism may subserve both processes (*e.g.*, Prinz, 1977). There is some evidence that the pars opercularis of the inferior frontal gyrus is differentially activated in the observation and first-hand experience of pain (*e.g.*, Carr et al., 2003). Common coding of one's own pain and other people's pain suggests a mechanism for identification, shared representation, and interpersonal understanding (Lepage & Théoret, 2007).

In that attention and affective response to another person's distress involve perception and sharing of another person's affective experience, perhaps we should not be surprised by the observation of a stronger association with receptive than expressive language skills. To the extent that the behaviors tested at 12 months reflect the infants' work to make sense of another person's experience, they are more closely related to understanding language than to producing it. The literature on the dissociation between receptive and expressive language modalities suggests that infants' receptive language is often more closely associated with other cognitive skills than is expressive language. Even 14-month olds' gestures, which are produced communicative acts, were more closely related to language comprehension than to speech production (Bates, Thal, Whitesell, Fenson & Oakes, 1989). The work infants do to make sense of a social partner's display of distress may function like other cognitive correlates with language, such that it is related to what a child *knows* about language, more than it is related to what a the child says (Bates, Dale & Thal, 1995).

Shifting attention toward another person's display of distress and demonstrating a corresponding change in affect reflect awareness of another person's emotional experience. These behaviors are related to the development of empathy (Zahn-Waxler et al., 1992), which is itself a form of communication involving the transmission of emotion from one person who expresses the emotion to another person who observes that expression and experiences a congruent emotion. To the extent that the precursors of empathy during infancy are also predictive of subsequent language development, the findings reported here suggest that the mechanisms that enable us to identify with others and to understand their emotions may also be at work in the achievement of shared understanding through language.

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Research Highlights

1. Attention to positive affect is not related to social functioning or language;
2. Attention to distress is not related to social functioning at 36 months;
3. Attention to distress is related to receptive and expressive language skills;
4. Congruent affective response to distress is marginally related to receptive language.

Table 1

Sample Characteristics

	Autism Group (HR; n=53)	Control Siblings (LR; n=38)
Gender (% Male)	48%	61%
Race (% Caucasian)	64%	73%
Maternal Education		
High school/some college	16%	11%
College degree	42%	28%
Graduate school	42%	61%
Family Income		
Less than \$50K	12%	13.5%
\$50K to \$100K	31%	13.5%
More than \$100K	57%	73%
12-month assessment		
Chronological age (months)	12.2 (.5)	12.2 (.3)
Verbal mental age	12.2 (1.8)	11.5 (2.0)
Non-verbal mental age	14.8 (1.4)	14.6 (1.5)
36-month assessment		
Chronological age (months)	36.4 (1.0)	36.13 (.6)
Mullen Scales of Early Learning		
Verbal mental age	38.4 (5.7)	38.6 (5.4)
Non-verbal mental age	40.9 (5.3)	40.8 (4.7)
Vineland Adaptive Behavior Scales		
Socialization age equivalent	34.7 (9.2)	35.3 (5.7)
Adaptive Behavior Composite standard score	100.3 (12.8)	101.2 (9.4)

Note: Assessment-related data are presented as Mean (Standard Deviation). Chi-squared analyses and t-tests indicate no significant differences in distribution or mean scores between groups.

Table 2
Regression Analyses Predicting Receptive and Expressive Language at 36 Months

Model	Predictors	Receptive Language			Expressive Language		
		B	SE	β	B	SE	β
1	Looking time to face (free play)	-0.04	0.38	-0.01	-0.02	0.33	-0.01
2	Looking time to face (distress)	0.33	0.14	0.25*	0.25	0.11	0.25*
	12-month verbal mental age	0.41	0.22	0.19	0.27	0.17	0.17
	Highest income group	3.16	0.99	0.40**	0.68	0.79	0.11
	Middle income group	0.51	1.05	0.06	-0.21	0.84	-0.03
3	Any affective response to distress	1.44	0.83	0.17	0.58	0.70	0.09
	12-month verbal mental age	0.53	0.21	0.24*	0.50	0.18	0.29**
	Highest income group	3.66	0.97	0.45***	1.18	0.82	0.18
	Middle income group	0.74	1.04	0.09	-0.03	0.87	-0.004

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$