Temperamental contributions to social behavior: The moderating roles of frontal EEG asymmetry and gender

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ABSTRACT

Objectives: Infant temperament is thought to provide one of the fundamental bases for social and emotional development. Few studies have examined the direct and indirect influences of early temperament and physiological disposition on later development.

Method: In this paper we present results of a longitudinal study that took place between the years 1989-1996 in which we examine the relations between maternal reports of negative reactivity at 9 months of age and maternal ratings and laboratory observations of social wariness and sociability at 4 years of age (n = 97). In addition, we examine the moderating roles of (a) frontal electroencephalogram (EEG) asymmetry as assessed at 9 months of age, and (b) the child’s gender.

Results: Negative reactivity predicted social wariness for infants with right frontal EEG asymmetry, but not for those with left frontal EEG asymmetry and for boys but not girls. The only significant predictor of sociability was gender. Specifically, at 4 years of age girls were higher on the measure of sociability than boys were.

Conclusion: The findings are discussed in terms of the roles of frontal EEG asymmetry and gender in moderating the impact of temperamental negative reactivity on later social behavior.

Keywords: negative reactivity, frontal EEG asymmetry, social wariness
Temperament is used to describe individual differences in styles of responding, both emotionally and motorically, that are present from birth, constitutionally based, and relatively stable over time (Rothbart and Derryberry, 1981; Thomas et al., 1968). These individual differences are thought to provide the basis for the emergence of trajectories of social and emotional development (Rothbart and Bates, 1998). However, the specific nature of these trajectories depends not only on the temperamental characteristics of an infant, but on intervening social and developmental processes. One of the primary goals in the study of infant temperament is to identify such processes that link early temperament to later behavior.

Despite variation amongst researchers in their emphasis on specific dimensions of temperament, most current of models of temperament include some aspect of negative reactivity (e.g., Buss and Plomin, 1984; Goldsmith and Campos, 1982; Rothbart and Derryberry, 1981; Thomas et al., 1968). Negative reactivity is used to describe signs of distress including crying, fussing, and motoric agitation. Using standardized assessment procedures, individual differences in infant irritability have been identified in the neonatal period and these early differences are predictive of later differences in global negative reactivity (Crockenberg, 1981; Riese, 1987). Negative reactivity has been implicated as the temperamental precursor for the later display of behavioral inhibition in response to novel objects, people, and events (Buss and Plomin, 1984; Calkins et al., 1996; Engfer, 1993; Kagan and Snidman, 1991).

In considering the relations between early temperament and later social and emotional development, the majority of longitudinal studies follow a direct linkage model, in which early temperament is thought to be directly and linearly related to later
adjustment (e.g. Caspi and Silva, 1995; Kagan, et al, 1984). The degree of discontinuity in temperament-adjustment linkages is, however, quite high. The variable outcomes of infants who are similar in temperament, even those in the extremes, suggest that other factors such as parent-child interactions and out-of-home care experiences may moderate the link between early temperament and adjustment. As such, temperament may be linearly related to social outcomes, albeit through indirect processes, such that the relations are moderated by other variables (Rothbart and Bates, 1998). Certain types of temperament, and even extreme temperament, may not reflect a risk for maladjustment per se, but rather a catalyst, which in combination with other factors, define trajectories of social and emotional development. In this paper we consider the influence of endogenous (frontal EEG asymmetry) and exogenous (gender) variables on the predictability of social behaviors during the preschool years from maternal temperament reports of negative reactivity gathered during the first year of life.

Frontal EEG asymmetry reflects the difference in the degree of activation between the left and right frontal regions. Patterns of frontal EEG asymmetry are thought to relate to the tendency to approach or withdraw from novel or stressful events (Fox, 1991, 1994). A variety of data from adult clinical and normal populations, as well as from infant and child studies, suggest that the two sides of the frontal cortex may be differentially specialized for approach or withdrawal tendencies. These behavioral tendencies have often been associated with the experience or expression of emotion (e.g., Davidson, 1992; Davidson and Fox, 1982). A number of these studies indicate that the left frontal area is associated with behaviors facilitating approach such as fine motor behavior, language, and the expression of certain positive emotions (Fox and Davidson,
In contrast, the right frontal area is associated with behaviors facilitating withdrawal from novel or stressful stimuli such as gross motor movement, autonomic reactivity, and the expression of certain negative affects (Fox and Davidson, 1984). These approach-withdrawal tendencies may bias the individual’s interactions with the environment such that they may initiate or withdraw from stressful situations or unfamiliar social exchanges.

For example, preschool children who displayed elevated amounts of reticent and anxious behavior during interactions with unfamiliar peers exhibited increased electrical activity in the right frontal region (right frontal EEG asymmetry) compared to their more sociable peers (Fox et al., 1995). And in a sample of school-aged children, increases in anxiety when placed in a situation designed to elicit social stress were paralleled by increases in right frontal EEG asymmetry (Schmidt et al., 1999). Based on these data and on the role that frontal asymmetry seems to play as an endogenous influence on social behavior, we hypothesized that for infants who displayed patterns of right frontal EEG asymmetry, negative reactivity would be positively related to social wariness and negatively related to sociability at 4 years of age.

There are parallel data linking activity in left frontal cortex to approach behaviors and the expression of associated affect and sociability. For example, Fox et al. (in press) report that young children who displayed consistently high levels of sociability across the toddler years were more likely to exhibit left frontal EEG asymmetry. Based upon these patterns of data, we hypothesized that for infants who displayed patterns of left frontal EEG asymmetry, negative reactivity would not be predictive of social wariness or sociability.
Another potential influence on the relation between negative reactivity and social behavior may be gender. Some reports suggest that the link between temperament and social development may be particularly strong for boys (e.g., Crockenberg and Smith, 1982; Fagan, 1990). One reason for this may be that parents respond differently to boys’ and girls’ expressions of the same behaviors and emotions (Mills and Rubin, 1990). This may be especially true for temperamental characteristics that describe behaviors with strong culturally-prescribed gender stereotypes (Hinde et al., 1985; Stevenson-Hinde and Glover, 1996). In Western cultures there appears to be a perception that distress and fearfulness is more acceptable for girls than it is for boys. For example, Hinde et al. (1985) found that shy preschool-aged boys had significantly poorer relationships both at home and at school compared to equally shy girls. Further, Rubin et al. (1993) reported that socially wary, fearful, and withdrawn boys, not girls, were more likely to express loneliness and perceive themselves as being socially incompetent and as having poor social relationships. These differences have been attributed, in part, to parents’ gender stereotypes. Fearfulness in boys may not be congruent with parental expectations and may lead to greater concern and overly intrusive interactions with caregivers (Rubin et al., in press). Parental concern and attention may serve to amplify temperamental patterns of behavior by preventing the child from developing effective strategies for coping with negative emotion (e.g., Arcus et al., 1992; Park et al., 1997; Rubin et al. 1997). We thus hypothesized that the relation between negative reactivity and social wariness would be stronger for boys than for girls.

In summary, in this study we examined the influence of maternal reports of negative reactivity in the first year of life on measures of sociability and social wariness.
taken at 4 years of age. Social wariness is used to describe one form of social withdrawal that is characterized by social reticence, which involves the combination of low levels of social interaction and the frequent production of anxious, onlooking and unoccupied, behaviors (Coplan et al., 1994). In contrast to other forms of solitary play, social reticence has been associated with overt indications of anxiety, poor performance on cooperative group tasks, and an inability to regulate negative emotions (Coplan et al., 1994; Rubin et al., 1995). In addition to examining the direct relations between early reactivity and later social behavior, we examined whether this relation was modified by (a) patterns of frontal EEG asymmetry as assessed during infancy and (b) the child’s gender. We hypothesized that the relations between negative reactivity and social wariness would be stronger for infants displaying patterns of right frontal EEG asymmetry compared to the relations for infants displaying patterns of left frontal EEG asymmetry. We further hypothesized that negative reactivity would be more predictive of social wariness for boys than for girls.

METHOD

Participants

The participants in the current study were 139 infants and their mothers, from two independent cohorts, who were taking part in a longitudinal study of the relations between temperament, psychophysiology, and social and emotional development. Participants were recruited via mailing lists. Families were sent a general letter asking them if they were interested in a study on child development. Families that mailed back a brief demographic questionnaire were contacted by phone for a laboratory appointment.
In this paper we report on the 97 infants (46 males and 51 females) who had complete data at both 9 months and 48 months of age. The families were Caucasian and of middle-class background, living in the greater Washington, DC area. Approximately 68% of the mothers and 72% of the fathers were college educated. Approximately one-third of the children were first born.

Of the 42 children excluded from analysis, 23 were excluded because they did not return to the laboratory for the 48-month visit and 19 because they were missing data at 9 months of age (12 were missing EEG data and 7 were missing maternal reports of temperament). Comparisons between the children who were included versus excluded from the analysis due to missing data, did not suggest that attrition was selective based on any of our predictor or outcome variables. Specifically, the 23 children who did not return to the laboratory at 48 months did not differ from the others in terms of 9-month maternal reports of negative reactivity, 9-month EEG, or sex distribution. Similarly, the 12 infants who did not have EEG data at 9 months were no different from the infants who did in terms of maternal reports of 9-month negative reactivity or any of the 48-month outcome measures.

**Procedures**

**9-month assessment**

At 9 months of age infants and their families visited the laboratory at which time brain electrical activity (EEG) was recorded from the infants; mothers completed the Infant Behavior Questionnaire (IBQ; Rothbart, 1981, 1986). The IBQ is an 87-item parent rating form in which parents are asked to rate the frequency of specific infant behaviors as they occurred in the previous week. Following Rothbart (1986), the Fear and
Distress to Limitations subscales were summed and used as an index of Negative Reactivity (see also Park et al., 1997).

**EEG Data Collection**

In order to minimize fussing and movement during EEG data collection, the infants sat on their mothers’ laps directly in front of a table on which a metal bingo wheel was placed. An experimenter placed different numbers of brightly colored balls (1, 3, or 7) in the wheel and spun the wheel for a series of six trials each lasting 20 s. These trials were separated by 10 s intervals in which the experimenter tapped the balls on the outside of the bingo wheel in order to keep the infant’s attention between trials. EEG was recorded for the entire 3-minute period. Previous work has found that recording epochs of this duration provide estimates of EEG power with good internal consistency (Lund, Sponheim, Iacono, & Clementz, 1995) and a reliable estimate of the subject’s frontal asymmetry index related to a bias toward approach or withdrawal behaviors (Fox et al, 1992; Tomarken et al., 1990).

Prior to the recording of EEG from each subject, a .477 V_{RMS} 10 Hz signal was input into each of the channels and this amplified signal was recorded for calibration purposes. EEG was recorded from the following sites (F3, F4, P3, P4, C3, C4, O1, O2) by placing a Lycra stretch cap of an appropriate circumference on the infant’s head. The EEG data were digitized at a rate of 512 Hz and then re-referenced using software to an average reference configuration. The digitized EEG data were artifact scored based on visual inspection of the signal in order to remove portions of the EEG record marked by eye movement or motor movement. All instances of artifact were removed from all channels of the EEG record prior to subsequent analysis.
The re-referenced, artifact-scored EEG data were submitted to a discrete Fourier transform analysis that utilized a Hanning window with 50% overlap. The result of this analysis was to produce power in picowatt ohms (or micro-volts squared) for each channel. Spectral power data in single Hz frequency bins from 1 to 12 Hz were computed for each of the stimulus conditions at each of the collection sites. Power in the 4-6 Hz frequency band was computed for each site by summing the single hertz bins in these three frequencies. The 4-6 Hz band is where the majority of power was localized. The measure of power was log transformed to normalize the distribution and the asymmetry index was computed as the difference between right and left sites (e.g. LN (F4)- LN (F3)). In this paper, we present data from the frontal and parietal sites.

**48-month assessment**

Children and their families returned to the laboratory at 4 years of age. The children were scheduled to visit the laboratory in groups of four children who were of the same gender and similar in age (within 3 months), but who were unfamiliar to one another. The procedures and methods used to observe the children’s social behaviors with one another were identical to those used with earlier cohorts of children (e.g., Fox et al., 1996; Rubin et al., 1995). Of particular interest in this study were the children’s behaviors during two unstructured free play sessions: the first occurred soon after the children arrived at the laboratory and the second took place approximately 25 minutes following the first. The experimenter began each play session by explaining to the children that they were free to play with any of the toys they wished. She then left the room, and the children were left undisturbed for the full 15-minute period, unless the children needed assistance.
Behavioral Coding

Behaviors in both the free play sessions were coded using the Play Observation Scale (POS; Rubin, 2000; Rubin, 1985; Rubin and Coplan, 1998). Ten-second intervals were coded for social participation (unoccupied, onlooking, solitary play, parallel play, conversation, group play) and the cognitive quality of play (functional, dramatic, and constructive play; exploration; games with rules). This resulted in approximately 90 coding intervals per child in each of the two free play sessions. For both cohorts, three independent observers coded the POS. Inter-coder reliability on a randomly selected group of children totaling 30% of the entire sample was calculated between pairs of observers using Cohen’s kappa. For the full variable matrix, including social and cognitive play categories, kappas ranged from .81 to .94 for the first cohort, and .87 to .94 for the second cohort.

During this visit, mothers completed the Colorado Child Temperament Inventory (CCTI; Buss and Plomin, 1984; Rowe and Plomin, 1977). The CCTI is a 30-item parent report that assesses maternal perceptions of dispositional characteristics along six dimensions. Of interest were the Shyness and Sociability dimensions. As a measure of behavior problems, mothers completed the Child Behavior Checklist (CBCL; Achenbach and Edelbrock, 1983). The CBCL is a 113-item checklist in which parents use a three-point scale to rate how descriptive a series of behavior problems are of their own child. The scale is reduced into two broadband factors assessing Internalizing and Externalizing behavior problems.
RESULTS

Formation of aggregate measures of Social Wariness and Sociability at 48-months

At 48 months of age, aggregate measures of social wariness and sociability were formed based on a combination of maternal reports and observed behaviors during play with unfamiliar peers in the laboratory. Reticent behavior during free play was calculated by summing the standardized proportions of onlooking and unoccupied behaviors during both free play sessions (Coplan et al., 1994). Prior to being used in correlational analyses, the observed reticence variable was transformed using a natural logarithm function in order to reduce the positive skew of the data and better approximate a normal distribution. Observed reticence was highly correlated with maternal reports of shyness ($r (97) = .54, p < .001$), and the two variables were standardized and summed to create a composite measure of social wariness. As in previous reports examining the relations between social wariness and other indices of social and emotional adjustment (e.g., Coplan et al., 1994; Fox et al., 1996), the aggregate measure of social wariness was positively correlated with Internalizing behavior problems on the CBCL ($r (93) = .41, p < .001$). Despite the positive correlation between Internalizing and Externalizing behavior problem scores on the CBCL ($r (93) = .47, p < .001$), the aggregate measure of social wariness was not correlated with Externalizing behavior problems ($r (93) = -.01, ns$).

Social behavior during free play was calculated by summing the standardized proportions of all group-play activities as well as conversations. Observed social play was correlated with maternal reports of CCTI sociability ($r (97) = .31, p < .01$), and a composite measure of sociability was computed by standardizing and summing the measures of observed and maternal report of sociability. The resulting composite
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The measure of sociability was negatively correlated with the social wariness composite ($r(97) = -.62, p < .001$).

**Hierarchical Regression Analyses**

Separate hierarchical multiple regression analyses were conducted in order to examine the predictive relations between negative reactivity in infancy and social wariness and sociability in the preschool years. Hierarchical analyses allowed for an examination of possible moderating effects linking negative reactivity to later social behaviors, once controlling for the main effects of negative reactivity. For each analysis, the predictors were entered into the regression equation in the following order: (1) 9-month negative reactivity, (2) 9-month frontal EEG asymmetry, (3) gender, (4) negative reactivity x frontal EEG asymmetry, (5) negative reactivity x gender, and (6) negative reactivity x frontal EEG asymmetry x gender. No main or interaction effects were found when the identical analyses were run with the parietal EEG asymmetry data, confirming the specificity of the EEG asymmetry effects to the frontal sites.

**Predicting 48-month Social Wariness**

The results of the hierarchical regression analysis predicting social wariness are presented in Table 1. The full model accounted for 18% of the variance in social wariness ($F(6, 90) = 3.35, p < .01$). The main effect of negative reactivity approached significance, reflecting the zero-order correlation between maternal reports of negative reactivity at 9 months and the composite measure of social wariness at 48 months ($r(97) = .18, p = .08$). The interactions between negative reactivity and frontal asymmetry, and negative reactivity and gender, both accounted for unique proportions of variance in the prediction of social wariness over-and-above that accounted for by the main effects of the
predictors. The three-way interaction (negative reactivity x frontal EEG asymmetry x gender) did not contribute further to the prediction of social wariness.

The interaction between negative reactivity and frontal asymmetry accounted for an additional 8% of the variance in social wariness. In order to interpret the interaction, infants were divided into two groups based on their 9-month asymmetry scores. Infants with frontal asymmetry scores less than 0 (indicative of right EEG asymmetry) formed the right frontal group, and infants with frontal asymmetry scores greater than 0 (indicative of left frontal EEG asymmetry) formed the left frontal group. The correlations between 9-month negative reactivity and 4-year social wariness were computed separately for these two groups. For the right frontal group, there was a significant and positive correlation ($r(39) = .40, p = .01$). In contrast, for the left frontal group the correlation was non-significant ($r(58) = -.01, p > .10$). The magnitude of the two correlations was compared using Fisher’s $z$-scores and since the hypotheses were directional, one-tailed tests were used to test the significance. This analysis revealed that the two correlations differed significantly ($z = 2.03, p = .02$).

In order to interpret the interaction between negative reactivity and gender, the correlation between negative temperament and social wariness was examined separately for boys and girls. For boys, there was a significant and positive correlation ($r(46) = .34, p = .02$), but for girls the correlation was non-significant ($r(51) = .01, p > .10$). The one-tailed $z$-test of the difference between the magnitude of correlations was significant ($z = 1.65, p = .05$).

**Predicting 4-year Sociability**
The results of the hierarchical regression analysis predicting sociability are presented in Table 2. Following an identical order of entry for the predictor variables and their interaction terms, the full model for sociability was significant ($F(6, 90) = 2.44, p < .05$). The main effect of negative reactivity approached significance ($\Delta R^2 = .03, p = .07$), however, the main effect of gender accounted for the greatest proportion of unique variance ($\Delta R^2 = .05, p = .03$). Unlike the analysis for social wariness, neither frontal EEG asymmetry nor gender significantly moderated the effects of negative reactivity on later sociability. Thus, despite the strong negative correlation between the composite measures of sociability and social wariness, the moderated linkage model including negative reactivity, frontal EEG asymmetry, and gender was specifically predictive of later social wariness.

**DISCUSSION**

A primary goal in the study of infant temperament is to better understand the processes through which early individual differences in temperament impact upon later social and emotional development and adaptation. Although there are several reports in the literature that show direct relations between early negative reactivity and the display of social wariness at later ages, these relations are modest at best. Clearly, the complexities associated with the measurement of both infant temperament and early social behavior may contribute to the modest levels of prediction over time. However, this aside, the more challenging task is to identify theoretically relevant variables that help determine the varied developmental pathways leading from early temperament to later social behavior (e.g., Park et al., 1997; Rothbart and Bates, 1998).
The data from the current study indicated that maternal report of negative reactivity during the first year of life, by itself, did not significantly predict either sociability or social wariness. Although the zero-order correlations did not reach conventional levels of significance, they were in the expected directions, with a positive relation between negative reactivity and later social wariness, and a negative relation between negative reactivity and later sociability. Further, both frontal EEG asymmetry and gender moderated the relation between negative reactivity and social wariness. The same interaction effects did not contribute to the prediction of sociability. The measure of social wariness reflects a specific form of low sociability, one that is associated with a combination of low levels of social interaction and negative affect and behavior problems of an internalizing nature (Coplan et al., 1994; Fox et al., 1996).

Negative emotionality was predictive of social wariness for infants who also displayed a pattern of right frontal EEG asymmetry at 9 months of age, but not for infants with a pattern of left frontal EEG asymmetry. These data follow a stress-diathesis model that involves both inborn temperament and frontal EEG asymmetry (Schmidt and Fox, 1998). High levels of negative reactivity in early infancy reflect a stressor for infants and their caregivers and right frontal EEG asymmetry, insofar as it reflects a bias to withdraw from novel or stressful stimuli, provides the diathesis that sets an infant on a pathway toward social wariness. Alternately, left frontal EEG asymmetry may serve as a protective factor that sets a highly reactive infant on a different pathway in which the child develops strategies involving approach and positive emotions. It is important to note that highly reactive infants with left frontal EEG asymmetry did not become highly social compared to their peers, as evidenced by the fact that the negative reactivity-by-
frontal EEG asymmetry interaction did not contribute to the prediction of sociability. Rather, left frontal EEG asymmetry served to attenuate the relation between negative reactivity and later social wariness to practically zero.

The influence of negative reactivity on social wariness was also moderated by gender. Specifically, negative reactivity during infancy was positively related to social wariness for boys, but not for girls. Several independent reports indicate that caregivers interact in qualitatively different ways with highly reactive sons versus daughters (MacDonald and Parke, 1984; Rubin et al., in press; Stevenson-Hinde and Glover, 1996). Together such studies suggest that socially withdrawn and highly reactive boys may have more negative and less engaging interactions with their caregivers compared to socially withdrawn and highly reactive girls.

**Study Limitations**

There are a number of limitations to the current study that should be noted. First, negative reactivity and EEG asymmetry were assessed once when the infant was 9 months of age. Although both measures have demonstrated reliability and validity, it would have been preferable to measure each repeatedly during the early infancy period. Second, negative reactivity was measured via maternal report that may provide data that is different from direct behavioral observations of temperament. Third, EEG is only an indirect measure of brain functioning. While it is impractical at this point to utilize more sophisticated neuroimaging techniques with normally developing infants, the conclusions regarding localization and function should be regarded with caution. Finally, in this study we did not assess mother-infant interaction. Lack of these data tempers our
interpretation about the mechanisms accounting for the effects of gender and asymmetry as they moderate infant negative reactivity over time.

Clinical Implications

Perhaps the most important immediate clinical implication of our work is that it highlights the importance of temperamental differences in understanding the etiology of internalizing behaviors in young children. Clinicians should attend to young infants’ dispositions toward irritability and negative emotionality and consider factors in the infant’s environment that may serve to moderate the expression of this disposition over time. Given the finding that negative reactivity was predictive of social reticence for boys, but not girls, and that previous reports have described a pattern of parental over-solicitousness in the parents of shy boys, clinicians may wish to help parents establish patterns of interaction that will encourage independence and effective self-regulation amongst highly negative boys. In addition, although our sample consisted of children from middle-class families who fell within the normal ranges of temperament and behavior problems, we believe our study has implications for infants and young children in at-risk samples. For example, it has been reported that infants of depressed women exhibit a pattern of right frontal EEG asymmetry (Field et al., 1995). Given our findings, clinicians should pay particular attention to patterns of temperamental negative reactivity in infants who may be predisposed to a pattern of right frontal EEG asymmetry or a bias toward withdrawing from novelty. Finally, it is important to note that social wariness was best predicted by the combination of early temperament with either frontal EEG asymmetry or gender, rather than by early temperament alone. Simple fussiness or irritability does not predict risk for maladaptive social behavior. It is the
interaction of this temperamental bias with other biological and social factors that best accounts for variability in social outcome.
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Table 1
Summary of Hierarchical Regression Analysis for Variables Predicting Social Wariness at 48 months (N = 97)

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<th>Predictors</th>
<th>β</th>
<th>ΔR²</th>
<th>F for ΔR²</th>
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<tr>
<td>1. 9 month negative reactivity</td>
<td>.18</td>
<td>.03</td>
<td>3.11 t</td>
</tr>
<tr>
<td>2. 9 month frontal asymmetry</td>
<td>-.12</td>
<td>.01</td>
<td>1.40</td>
</tr>
<tr>
<td>3. gender</td>
<td>-.08</td>
<td>.01</td>
<td>.56</td>
</tr>
<tr>
<td>4. negative reactivity x asymmetry</td>
<td>-1.30</td>
<td>.07</td>
<td>7.12 **</td>
</tr>
<tr>
<td>5. negative reactivity x gender</td>
<td>-1.10</td>
<td>.04</td>
<td>4.73 *</td>
</tr>
<tr>
<td>6. neg react x asym x gender</td>
<td>.69</td>
<td>.02</td>
<td>2.15</td>
</tr>
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</table>

Multiple R = .43
Total R² = .18
F(6, 90) = 3.35 **

t p < .10; * p < .05; ** p < .01
Table 2

Summary of Hierarchical Regression Analysis for Variables Predicting Sociability at 48 months (N = 97)

<table>
<thead>
<tr>
<th>Predictors</th>
<th>β</th>
<th>ΔR^2</th>
<th>F for ΔR^2</th>
</tr>
</thead>
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<td>1. 9 month negative reactivity</td>
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<td>.03</td>
<td>3.29^1</td>
</tr>
<tr>
<td>2. 9 month frontal asymmetry</td>
<td>.09</td>
<td>.01</td>
<td>.72</td>
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<tr>
<td>3. gender</td>
<td>.22</td>
<td>.05</td>
<td>4.85*</td>
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<tr>
<td>4. negative reactivity x asymmetry</td>
<td>.63</td>
<td>.02</td>
<td>1.64</td>
</tr>
<tr>
<td>5. negative reactivity x gender</td>
<td>.52</td>
<td>.01</td>
<td>1.00</td>
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<tr>
<td>6. neg react x asym x gender</td>
<td>-.79</td>
<td>.03</td>
<td>2.71</td>
</tr>
</tbody>
</table>

Multiple R = .37  
Total R^2 = .14  
F(6, 90) = 2.44*  

^1 p < .10; * p < .05