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Examining the Familial Link Between Positive Affect and Empathy Development in the Second Year

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Abstract

Within a sample of 584 twins aged 12 to 25 months (292 pairs) studied longitudinally, positive affect measured through two laboratory pleasure episodes and maternal report at 12 and 22 months significantly predicted empathy-related helping and hypothesis testing assessed between 19 and 25 months. Girls showed significantly more concern than did boys, whereas boys engaged in hypothesis testing significantly more than did girls. Behavior-genetic analyses indicated substantial shared environmental influences for positive affect and empathy composites of helping and concern. Genetics and the nonshared environment influenced empathy-related hypothesis testing. The best fitting bivariate model included shared and nonshared environmental influences on positive affect and helping, with environment accounting for the covariation between the two traits. The covariation between positive affect and hypothesis testing was genetically influenced.

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Keywords

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ALTRUISM, voluntary behavior with the intention of assisting another person without expectation of personal gain (Eisenberg, 1988), is an admirable human attribute. The development of empathy fosters this unselfish desire to alleviate another's distress, serving as a catalyst for prosocial, moral action (Hoffman, 1982). During the second year of life, children typically possess the required cognitive, affective, and behavioral capabilities for concern and helping behavior directed toward distressed others (Zahn-Waxler, Robinson, & Emde, 1992). As children develop, their self-distress reaction is increasingly overshadowed by this more adaptive response of concern for others. Altruistic behaviors increase with age largely because associated competencies of role taking, moral reasoning, and affect regulation also increase with age (Eisenberg, 1988; Eisenberg & Fabes, 1992).

In this study, we examine the role of early positive affect in children's empathy development. Our use of twins allows us to examine genetic and environmental influences on positive affect, empathy, and their association.

The Construct of Empathy

Empathy has been conceptualized as a multifaceted construct consisting of both cognitive and affective components (Preston & DeWaal, 2002). Empathy refers to a vicarious affective response that relies on a developed cognitive sense of others (Hoffman, 1988). *Cognitive empathy*, the ability to effectively comprehend a distressing situation as well as recognize another's emotions and assume that person's perspective, represents an essential initial component of prosocial behavior. Recognition and understanding of another's personal distress is a prerequisite for subsequent empathy, prosocial responding, or helping. *Affective*, or *emotional empathy*, requires an individual to experience an emotional response to another's expressed emotion (Duan & Hill, 1996). Hoffman (1988) defines this emotional response as more appropriate to the situation of the other person. The emotional reaction resulting from experiencing empathy can be other-oriented, self-oriented, or both. *Sympathy* refers to an other-oriented reaction, such as concern, and personal distress represents a self-oriented response, such as anxiety or negative affect (Eisenberg et al., 1989; Eisenberg et al., 1998).

Children who lack a developed sense of empathy are inclined to display aggressive, antisocial behavior. Jolliffe and Farrington (2004) found that low cognitive empathy was significantly related to higher rates of violent offending in a meta-analysis of studies considering these constructs. Measures of affective empathy were only weakly related to higher rates of violent offending. Individuals who are prone to aggressive, antisocial behaviors, are unlikely to show characteristics of empathetic behavior, particularly cognitive empathy. The ability to take the perspective of a distressed other seems to greatly reduce the likelihood that one will be the source of another's pain or discomfort.

Heritability of Empathy

Biological factors influence both empathy and altruism (Eisenberg, 1988). Zahn-Waxler, Schiro, Robinson, Emde, and Schmitz (2001) examined the empathy development of 14- to 36-month-old monozygotic (MZ, identical) and dizygotic (DZ, fraternal) twins and found genetic influences on observational measures. In addition, shared environmental influences on empathy development were evident with maternal report. In behavior-genetic analyses, shared environment can refer to the effect of any process jointly experienced by siblings.

Questionnaire measures of adults' altruism and empathy revealed greater MZ than DZ similarity (Rushton, Fulker, Neale, Nias, & Eysenck, 1986; Rushton, Littlefield, & Lumsden, 1986), with 50–70% of the variability attributed to genetic factors and virtually none to shared environmental factors. The separate components of empathy, affective and cognitive, can be genetically explored as well. Among 839 pairs of high school-aged twins, affective empathy (empathic concern) was genetically influenced, although cognitive empathy (perspective taking) was not (Davis, Luce, & Kraus, 1994).

Sex Differences in Empathy Development

Females in general exhibit higher degrees of empathetic, prosocial responding and concern compared with males (Hoffman, 1977; Zahn-Waxler, Robinson, et al. 1992). In addition, girls are often rated as being more sympathetic (Eisenberg, Fabes, Murphy, et al., 1996) and prosocial (Eisenberg, Fabes, Karbon, et al., 1996) than are boys. However, girls do not seem to possess greater capabilities for assessing another's affective or cognitive perspective (Hoffman). That is, although girls display more affective empathy and prosocial helping behavior than do boys, their levels of cognitive empathy are similar. This gendered finding of affective empathy and prosocial responding varies cross-culturally, with the greatest gender discrepancy existing in the United States (Strauss, 2004). These findings suggest that a gender effect on the display of empathic behaviors might largely be due to socialization. In the United States, females may be socialized to display greater concern and prosocial behavior toward others compared to males, as the converse antisocial responses are largely considered less acceptable in females than in males (Parke & Slaby, 1983).

Positive Affect and Empathy Development

Although all children are capable of empathy, genetic factors contribute to individual differences (Hastings, Zahn-Waxler, & McShane, 2006). Some aspects of children's heritable temperament influence the development of empathetic responding. *Temperament* refers to individual differences in the behavioral dimensions of activity, emotionality, and approach or withdrawal, which appear in infancy and are somewhat stable over time (Goldsmith et al., 1987). In addition, children's temperament influences the degree of socialization of morality that they receive (Kochanska, 1997). Specifically, the temperamental dimension of positive affect has been associated with greater empathy (Zahn-Waxler, Cole, Welsh, & Fox, 1995). Positive affect has also been linked to both an increase in, and maintenance of, empathic responding in children (Robinson, Zahn-Waxler, & Emde, 1994). Positive affect is positively related to helping behavior among pre-school to sixth-grade children (Chapman, Zahn-Waxler, Cooperman, & Iannotti, 1987), and teacher reported sympathy among kindergarten to second-grade children (Eisenberg, Fabes, Murphy, et al., 1996). Although the link between positive affect and empathy in the first 2 years of life has been established (Robinson et al., 1994; Young, Fox, & Zahn-Waxler, 1999), the mechanism(s) involved in this relation have received relatively little attention. Positive affect is positively intercor-related with empathy-related, prosocial helping behavior, perhaps due to shared variance with the construct of social competency. Children rated as sympathetic were also rated as socially competent both concurrently and up to 6 years previously (Murphy, Shepard, Eisenberg, Fabes, & Guthrie, 1999). Prosocial children tend to exhibit high-quality social skills and demonstrate low negative emotionality (Eisenberg, Fabes, Karbon, et al., 1996). Socially competent children likely possess a heightened ability to attend to social situations and the needs of others around them, as well as to regulate their own negative emotionality (Eisenberg, Fabes, Karbon, et al., 1996).

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Individual Differences in Positive Affect

Gender can influence a child's level of positive affect and temperamental characteristics in general. Often gender differences in temperament arise as a result of socialization. Boys are socialized to value agentic traits such as competition, whereas girls are socialized to value more communal ones such as warmth (Cohn, 1991). Concerning the dimensions of positive and negative affect, girls are more often portrayed as positive and boys as negative. The results of a large meta-analysis examining gender differences with respect to temperament revealed small effect sizes for positive mood that favored girls, yet boys scored slightly higher than did girls with respect to high-intensity pleasure (Else-Quest, Hyde, Goldsmith, & VanHulle, 2006). Smiling, a marker of positive affect, was more evident in girls, but no gender difference was evident in children prior to adolescence (Else-Quest et al.).

Individual differences in positive affect can also be attributed to genetic and environmental factors. The Smiling and Laughter scale on the Infant Behavior Questionnaire (IBQ; Rothbart, 1981) administered in infancy was largely influenced by both shared environmental and genetic factors (Goldsmith, Lemery, Buss & Campos, 1999). This finding was in contrast to hedonically negative dimensions of temperament, such as IBQ Distress to Limitations and Distress to Novelty scales, which yielded moderate additive genetic influence and no shared environmental influence (Goldsmith et al.). The Pleasure scale on the Toddler Behavior Assessment Questionnaire (TBAQ) also revealed substantial shared environmental influence on positive affect among toddlers (Goldsmith, Buss, & Lemery, 1997). In adulthood as well, some studies show the shared environment exerting a greater influence on positive affect than genetic factors (Baker, Cesa, Gatz, & Mellins, 1992). Environmental factors seem to play a significant role in positive temperament.

The Present Study

We sought to replicate the relation between children's positive affect and development of empathic responding in a longitudinal sample of young twins. We expected positive affect to predict higher concurrent as well as later empathic responding. On the basis of previous research (Goldsmith et al., 1997), we hypothesized that positive affect would be significantly influenced by the shared environment at this age. As reviewed above, prior genetically informed research on empathy and its components is mixed; affective components are likely to be heritable. Extrapolating from these basic predictions, we further hypothesized that the shared environment would largely account for most of any association between early positive affect and components of empathy.

Following the literature, we expected girls to show slightly more positive affect than boys. We expected levels of affective, behavioral, and cognitive empathy components to increase from 19 to 25 months of age, with girls displaying greater affective and behavioral empathy than boys.

Method

Participants

Participants were 584 (305 girls, 279 boys) 12- to 25-month-old twins (292 pairs) participating in the Genetics of Emotional Ontogeny (GEO) twin project, a longitudinal study of social and emotional development. At least one of the twins from each pair completed an empathy induction at 19 (n = 441), 22 (n = 432), or 25 (n = 384) months of age. There were 94 MZ pairs, 194 DZ pairs (106 same sex), and four pairs of unknown zygosity, proportions that are near population frequencies. The sample was primarily Caucasian (91.4%) with the remainder divided approximately equally between the categories of Hispanic, African-American, and Other. Most participants were from intact middle-class families (Hollingshead index = 46.88), with the mother and father each completing on average approximately 15 years of formal schooling (12.6% of mothers and 17.5% of fathers completed high school, and 32.1% of mothers and 29.3% of fathers were college graduates).

Procedure

Children participated in a total of four laboratory visits. The first visit occurred at 12 months of age (*M* = 53.51 weeks, *SD* = 2.21 weeks) and consisted of a series of locomotor Laboratory Temperament Assessment Battery (LabTAB) episodes (Goldsmith & Rothbart, 1999). We used two episodes to assess pleasure. At this visit, parents received the IBQ and later returned it by mail. The last three visits were at 19 (*M* = 83.48 weeks, *SD* = 1.22 weeks), 22 (*M* = 96.58 weeks, *SD* = 1.37 weeks), and 25 months (*M* = 109.73 weeks, *SD* = 1.37 weeks). We included an episode designed to elicit empathy adopted from Zahn-Waxler, Robinson et al. (1992) at each of the toddler ages. At the 22-month laboratory visit, we gave parents the TBAQ to complete and return by mail.

Questionnaire Measures

Zygosity diagnosis—We used the Zygosity Questionnaire for Young Twins (Goldsmith, 1991), which yields over 95% agreement with genotyping and is a practical alternative to more expensive methods (Forget-Dubois et al., 2003; Price et al., 2005). In cases where any ambiguity remained after examination of the questionnaire, additional information was obtained from medical records (e.g., placenta type), examination of photographs or videos, and re-administration of the zygosity questionnaire. In a few cases, we used commercial genotyping of a series of highly polymorphic markers. After these procedures and group discussions among investigators, the zygosity of four pairs (1.4%) remained uncertain, and these pairs were not used in the genetic analyses.

Positive affect—We administered the IBQ (Rothbart, 1981), a caregiver-report temperament measure, in its entirety but only the Smiling and Laughter scale is relevant to the hypotheses of our study. Caregivers indicated, on a 7-point Likert-type scale (1 = *never*; 7 = *always*) how often during the last week the child smiled or laughed in specified situations. For maternal report on the Smiling and Laughter scale, Rothbart reported a 9-to 12-month stability of .72; in our sample, the internal consistency estimate was $\alpha = .83$ for the 15-item scale. Both the mother and father received the IBQ to complete at the 12-month lab visit. We instructed parents not to discuss the questionnaire with one another and to consider each twin separately. As the mothers represented the primary caregiver for the overwhelming majority of the sample, we considered only the mothers' IBQs in the analysis.

We also administered the TBAQ–short form (Goldsmith, 1996), a 78-item, parent-report instrument designed to measure temperament in 18- to 24-month-old children. The TBAQ is similar to the IBQ in construction technique and item type. From the TBAQ we examined the Pleasure scale. In our sample, the internal consistency estimate for maternal report on the Pleasure scale was $\alpha = .70$ for the 10-item scale.

Laboratory Measures

Modified peek-a-boo game (LabTAB; Goldsmith & Rothbart, 1999)—Children were observed interacting with their primary caregiver, most often the mother, and the experimenter during a scripted game of peek-a-boo at the 12-month laboratory visit. The child was seated in a highchair and the mother was situated approximately 1 m away behind a large plywood screen containing four hinged doors. A small piece of paper marked with an "X" was affixed to the back of each door to indicate where the mother should place her nose. The door backs also contained numbers to indicate a prearranged "hiding" sequence. After the mother was out of the child's sight behind the screen, the experimenter began the episode by saying: "(Child's name), (child's name), where is mommy, where is she, where did she go?" After a 3 s pause, the experimenter knocked on the correct door and opened it to reveal a smiling mom who playfully responded "Peek-a-boo!" The door was left open for an additional 5 s. This procedure was repeated five times representing a total of six trials, or coding segments. The mother did not appear at the door during the fourth and fifth trials, when the experimenter said, "She's not there."

Puppet game (LabTAB; Goldsmith & Rothbart, 1999)—Children were observed during an experimenter-led puppet interaction at the 12-month laboratory visit. The child was seated in a highchair at a table, and the primary caregiver was seated approximately 1 m to the child's left. A familiar experimenter, seated at the child's immediate right, began the episode by simultaneously bringing two puppets (a bunny and a giraffe) out from underneath the table and reading a standard dialogue. The 90 s script was read using two voices of contrasting tone, one for each puppet. Interjected into the script were three "tickles," each beginning a new coding segment ranging from 10 to 20 s each, where the experimenter caused the puppet(s) to touch the child's midsection. If the child became distressed upon contact, subsequent "tickles" were made further from the child's body (e.g., at the edge of the table). After the dialogue was completed, the experimenter began the fifth and final 30 s coding segment by placing the puppets on the table directly in front of the child. The child was given 30 s to manipulate the puppets without further engagement from the experimenter.

For both the modified peek-a-boo and puppets episodes, the following behaviors were coded from videotape on a presence/absence basis for each coding segment: smiling, laughter, positive vocals, and positive motor acts. Intensity of smiling was scored in each coding segment on a 0–3 scale where a 3 represented the highest intensity smile. Coders were required to maintain a kappa of at least .70 for all coded behaviors. At least 10% of all cases were double coded by a master coder. Composites were formed representing the latencies, peaks, and means for smiling, laughter, positive motor acts, and positive vocalizations for each episode. The values for latencies were converted into speed scores [1/(sqrt)latency]. Missing data, resulting from early termination or technical issues, were estimated using SPSS Missing Value Analysis expectation maximization (EM) algorithms. A principal component analysis (PCA) of each of these sets of composites resulted in two single factor solutions—one for peek-a-boo and one for puppets.

Empathy—We observed children during three identical laboratory empathy episodes, adapted from Zahn-Waxler, Robinson et al. (1992), at approximately 19, 22, and 25 months of age. The primary caregiver pretended to pinch her finger in a clipboard and feigned pain for 30 s. Experimenters had briefly trained caregivers to simulate pain facially and vocally. During the pain phase, helping behavior, concern, negative affect, and hypothesis testing were examined every 5 s over a period of 30 s. We took codes for helping and hypothesis testing directly from Zahn-Waxler, Robinson et al. (1992). We modified codes for concern in that we collapsed the scale from the original 1–4 scale to a dichotomy from the same source. This restricted range helped maintain reliability in the coding. The code for negative affect was not taken from Zahn-Waxler, Robinson et al. (1992) but was developed specifically for this study. Coders were required to maintain reliability with a master coder, meaning kappa values for all the behaviors were .70 or above. At least 10% of the cases were double coded by a master coder to continually monitor reliability.

Helping behavior—Helping behavior was coded on a 1–3 scale. A code of 1 represented no attempt to help. A 2 captured at least one partial attempt to help (the child began to help or seek help, but the action was not completed in a coherent fashion). Children received a 3 for helping behavior if at least one spontaneous action directed toward helping or seeking help was completed. We averaged the codes received for each of the 5 s segments to create a mean helping score for each child at each of the assessment ages (19, 22, and 25 months).

Empathic concern—We assessed empathic concern on a 1–2 scale. A code of 1 represented an absence of concern for the mother. A 2 signified slight to high intensity expressions of concern. We defined concern as sobering expressions, brow furrows, and sadness–sympathetic responses directed toward the mother. We averaged the codes for each of the 5 s segments to create a mean concern score for each child at each of the assessment ages (19, 22, and 25 months).

Negative affect—All hedonically negative affect states, which were different from empathy–sympathy directed at mother, we scored using a 1–3 scale. Those states included fearfulness, anger–aggression, and emotional contagion from another's distress. Children who received a 1 exhibited no negative affect. A 2 indicated mild expressions of negative affect, and a 3 represented definite expression of negative affect (either sustained or high intensity). We averaged the codes for each of the 5 s segments to create a mean negative affect score for each child at each of the three assessment ages.

Hypothesis testing—Hypothesis testing, the amount of effort children spent trying to comprehend their mothers' distress, was scored on a 1–4 scale. A code of a 1 represented no effort to comprehend the situation. A 2 was scored on occasions when children made simple, nonverbal attempts to understand the problem (e.g. looking from mother's finger to face). A 3 was given in instances when combinations of nonverbal and verbal exploration, or sophisticated verbalizations, were evident. A code of 4 represented repeated, sophisticated attempts to comprehend the problem defined as verbalizations that were suggestive of solutions, or behaviors that indicated an attempt to ascertain cause. We averaged the codes as for the other behaviors.

Behavior Genetic Statistical Analysis

To estimate genetic and environmental contributions to positive affect, helping, concern, and hypothesis testing composites, we used the structural equation modeling (SEM) software Mx (Neale, 2003), which yields maximum likelihood estimates of scale means and parameters for variances and covariances from the raw data matrix. We started with the full, univariate model that evaluates the effects of additive genetic influences (A), shared environmental influences (C), and nonshared environmental influences (E), allowing estimates to differ by sex. We then equated sex effects, and used the likelihood-ratio chi-square test to compare the fit of the two nested models. A nonsignificant difference in the chi-square values between the two models implied that the additional specification (e.g., equating male and female parameters) did not significantly reduce the fit; thus, the new, more restricted model was accepted as the more parsimonious model. We also used Akaike's Information Criterion (AIC) as a fit index, with smaller AICs associated with better fit. If sex effects could be equated, we regressed out the effects of sex and fit reduced models because of our limited sample size. Specifically, we fit the reduced AE, CE, and E models to determine the significance of each influence on trait variation. For example, if the fit of the AE model was not significantly worse than the ACE model, then we concluded that the C influence could be dropped from the model. Again, we used the likelihood-ratio chi-square test to select the most parsimonious model. In addition, we fit bivariate genetic models to decompose significant covariation between positive affect and the empathy composites of helping and hypothesis testing.

Results

Positive Affect Measure

We computed a multimethod measure of positive affect from the mean of the *z* scores of the 12-month IBQ Smiling and Laughter scale, the 22-month TBAQ Pleasure scale, and the two 12-month laboratory principal component scores. We used both parental report and observational measures of positive affect to obtain greater generality in our measurement. This multimethod measure was constructed on the basis of the highly correlated nature of these four assessments of positive affect. Boys and girls did not differ significantly on this overall pleasure measure, $t(509) = -1.21$, $p = .22$.

Development and Gender Effects for the Empathy Components

Table 1 depicts the descriptive statistics for the empathy components at each of the assessment ages for the children who completed all three assessments. For each of the four dependent variables (helping, concern, negative affect, and hypothesis testing), we used the SPSS General Linear Model (GLM) procedure to calculate a repeated measures analysis. The between–subjects factor in each analysis was gender. The within–subject effects were age of testing and the Age × Gender interaction. *F* values were obtained for each of these three effects and tested with the relevant degrees of freedom. For helping, a repeated measures analysis of variance (ANOVA) for all subjects with complete data showed a significant effect of age of testing, $F(2, 548) = 12.86$, $p < .001$. That is, children's mean level of helping varied significantly across the 19, 22, and 25 month assessments. Age did not significantly interact with child gender, $F(2, 548) = 0.48$, $p = .62$, and there was no main effect of child gender, $F(1, 274) = 0.08$, $p = .78$. For concern, the repeated measures ANOVA failed to show a significant main effect of age of testing, $F(2, 518) = 0.86$, $p = .43$. The interaction of age and child gender was also nonsignificant, $F(2, 518) = 0.96$, $p = .39$. The main effect of child gender trended toward significance, $F(1, 259) = 3.42$, $p = .07$, with girls displaying higher levels of concern than boys. For negative affect, the repeated measures ANOVA revealed a significant main effect of age, $F(2, 524) = 5.73$, $p < .001$. Children's mean level of negative affect decreased with age. Age of assessment did not significantly interact with child gender, $F(2, 524) = 0.33$, $p = .72$, and there was no main effect of child gender, $F(1, 259) = 1.08$, $p = .30$. For hypothesis testing, a modestly significant main effect of time of assessment was evident from the repeated measures ANOVA, $F(2, 544) = 3.08$, $p = .05$, and the main effect of gender trended toward significance, $F(1, 272) = 2.13$, $p = .15$, such that boys showed slightly more hypothesis testing than girls, although the difference was not significant. There was no significant interaction of age and child gender, $F(2, 544) = 0.73$, $p = .48$.

The temporal correlations for the same empathy components across 19 to 25 months of age were significant, with the exception of negative affect. Table 2 shows that the higher correlations were these cross-age, same-component associations (noted in bold font). The modest nature—and often near-zero size—of the off-diagonal correlations suggests relative independence of the four empathy components (helping, concern, negative affect, and hypothesis testing).

We then made three composite scores, averaging across 19 to 25 months, for each of the components of helping, concern, and hypothesis testing on the basis of their stability across this period of time. We did not compute a composite for negative affect over time because of the relative instability of the construct. The descriptive statistics for these empathy composites are shown in Table 3. Overall, girls showed significantly more concern than did boys, $t(430) = 3.05$, $p < .001$, whereas boys did significantly more hypothesis testing than did girls, $t(430) = -2.67$, $p = .01$.

Prediction of Empathy Components by Positive Affect

Turning to the main analysis, positive affect significantly correlated with the empathy composites of helping and hypothesis testing (see Table 4). It is interesting that the relation between positive affect and empathy appeared to differ for boys and girls in that correlations were significant for one gender but not the other. We re-ran this correlation of the pooled sample with two randomly selected halves of the sample to test for possible effects of twin dependence. The average difference between these six correlations was 0.07, suggesting that the twin design of our study did not affect the relation between positive affect and empathic responding. However, returning to the issue of gender differences, the moderation of the correlation of positive affect with the empathy variables by gender was not significant in any of the three comparisons. That is, the z transforms of the male versus female correlations were not significantly different at $p < .05$ (two-tailed).

Genetic and Environmental Influences on Positive Affect and Empathy Composites

Table 5 provides the intraclass (twin similarity) correlations for MZ and DZ twins for each of the composites. DZ correlations were more than half MZ correlations, indicating that the shared environment had an impact on variation. With the exception of helping, MZ correlations were greater than DZ correlations, indicating possible genetic influences on variation. To further understand these influences, we used SEM model fitting to decompose the variance of each trait into genetic and environmental components.

We compared full ACE models, where parameters were allowed to vary by sex, to models where parameters were constrained to be equal for girls and boys. The likelihood-ratio chi-square test indicated that setting parameters equal did not significantly reduce fit for positive affect, $\Delta\chi^2(3) = 3.10$, $p = 0.38$, AIC = –2.90, helping, $\Delta\chi^2(3) = 9.52$, $p = 0.02$, AIC = 3.52, concern, $\Delta\chi^2(3) = 0.78$, $p = 0.86$, AIC = –5.22, and hypothesis testing, $\Delta\chi^2(3) = 8.44$, $p = 0.04$, AIC = 2.44. Thus, because of our limited sample size, we decided to regress out the influence of sex on these variables, and proceeded to fit reduced models.

A series of nested models were fit next; parameter estimates and fit statistics are given in Table 6. For positive affect, the ACE model yielded a nonsignificant estimate for additive genetic influence, leading to CE being the best fitting reduced model. Similarly, the additive genetic influences on helping and concern were non-significant, and the CE model best represented the data for both of these traits. In contrast, the best fitting reduced model for hypothesis testing involved significant additive genetic and nonshared environmental influences, with no influence of the shared environment.

Bivariate Analyses for Positive Affect and Empathy-Related Helping and Hypothesis Testing

For bivariate analyses, we considered the two components of empathy that showed the strongest, albeit modest, relation with positive affect. We first fit a bivariate biometric model to positive affect and helping (phenotypic $r = .16$, $p < .01$, with sex effects removed) to consider the extent to which the same factors contributed to both dimensions. The first trait, positive affect, was influenced by the first set of ACE latent factors, and the second trait, helping, was influenced by the same first set of ACE latent factors as well as a second set of independent ACE latent factors. The full model yielded –2LL(952) = 1509.35. Next, nonsignificant paths were dropped, and the fit of the reduced model was compared to the full model using the likelihood-ratio chi-square test. The significance of each path was tested by establishing that the path could not be dropped from the model without a significant decrement in fit.

The best fitting bivariate model included shared and nonshared environmental influences on both traits, with both types of environmental influence accounting for the covariation between the two traits (see Figure 1 for standardized squared path coefficients). All genetic influences were nonsignificant. The fit of the reduced model was –2LL(955) = 1513.24, comparing the full to the reduced model yielded $\Delta\chi^2(3) = 3.89$, $p = 0.27$, AIC = –2.11. Given the small phenotypic association between positive affect and helping, only 3% of the shared environmental (and 2% of the nonshared environmental) influence on helping was shared with positive affect.

Second, we fit a bivariate biometric model to positive affect and hypothesis testing, which were correlated (corrected for sex), $r = .11$, $p < .05$. The full ACE–ACE model yielded a fit of –2LL(893) = 1706.86. We then systematically dropped paths to test for their significance, yielding a final reduced model with a fit of –2LL(897) = 1713.97, comparing the full to the reduced model yielded $\Delta\chi^2(4) = 7.11$, $p = 0.13$, AIC = –0.90. Figure 2 displays the standardized squared path coefficients. The best fitting model retained ACE influences on positive affect, with A (additive genetic) influences accounting for the small covariation between positive affect and hypothesis testing, and hypothesis testing also having unique E influences.

Discussion

Our results support previous findings that early positive affect is related to greater empathy (Robinson et al., 1994; Zahn-Waxler et al., 1995). Positive affect was positively intercorrelated with the behavioral and cognitive empathy components of prosocial helping behavior and hypothesis testing. This finding regarding positive affect and helping behavior has been anticipated in the literature (Chapman et al., 1987; Robinson et al.). The nature of this relation differed by gender. For girls, positive affect correlated with the composites of helping and concern. For boys, only hypothesis testing was related to positive affect. Confirming our prediction, girls displayed higher levels of affective empathy and prosocial helping compared with boys. Boys did somewhat more hypothesis testing than did girls, although the difference was not significant. These findings correspond with Hoffman's (1977) conclusions that, although girls exhibit greater affective empathy and prosocial behavior than do boys, they are no more cognitively capable of empathic responding. Contrary to our prediction, girls and boys did not significantly differ in level of positive affect. However, the lack of gender differences in positive affect is unsurprising given the small effect sizes found by Else-Quest et al. (2006) in a meta-analysis of gender differences in children's temperament.

We did note an increase in the mean levels of helping, concern, and hypothesis testing and a decrease in level of negative affect from 19 to 25 months, as previous literature has suggested (Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992; Zahn-Waxler et al., 2001). However, we did not find the expected increase in empathic concern over time. This may reflect the use of a dichotomous rating scale in the present study in contrast to the research of Zahn-Waxler and colleagues (Zahn-Waxler et al., 1992; Zahn-Waxler et al., 2001) who used a more differentiated (4-point) rating scale.

The genetically informative design of this study allowed us to examine genetic and environmental influences on positive affect and empathy. Behavior-genetic analyses indicated shared environmental effects for positive affect and the empathy composites of helping and concern, as predicted. The strongest genetic factor was for hypothesis testing. The environmental effects on positive affect are largely consistent with previous work (Baker et al., 1992; Goldsmith et al., 1997; Goldsmith et al., 1999). Zahn-Waxler et al. (2001) anticipated this presence of a shared environmental component in empathy development stemming from socialization practices that promote concern and others' well being. Although initial models (ACE) indicated a modest genetic component for the helping and concern components, we found a nonsignificant difference in fit when we dropped the genetic component in CE models. Thus, our findings differed from others in deemphasizing genetics for these two components. Differences in sources of variation would not be surprising for studies of adults (Rushton, Fulker, et al., 1986; Rushton, Littlefield, et al., 1986) versus young children. More interesting is the juxtaposition of our results with those of Zahn-Waxler et al., who studied similarly aged children. At the level of the raw MZ and DZ similarity at comparable age points, our results were actually quite similar to those of Zahn-Waxler et al. (Table 11.3, page 149). Of the 12 pairs of raw MZ and DZ similarity correlations that can be compared across the two studies (our MZ and DZ correlations for helping, concern, and hypothesis testing with Zahn-Waxler et al.'s comparable MZ and DZ correlations at 20 and 24 months), only 2 of the correlational differences were significant at $p < .05$. The differences in conclusions between our study and Zahn-Waxler et al.'s arise from differing approaches to modeling essentially similar raw data.

We fit the ACE model by maximum likelihood (Mx) whereas Zahn-Waxler et al. (2001) used least squares (DF regression). The heritability estimates for concern and helping behavior are very similar across the two studies when examining the comparable ACE model. For instance, our heritability estimate for helping was .22, which is very close to the average of Zahn-Waxler et al.'s average heritability estimate of .24 for 20- and 24-month-olds. Similarly, our heritability estimate of .30 and Zahn-Waxler et al.'s averaged heritability estimate of .245 for 20- and 24-month-olds were again close replicates.

Contrary to previous findings from Davis et al. (1994) and Zahn-Waxler et al. (2001), we noted a large shared environmental influence on prosocial responding, or helping, and concern, an affective component of empathy. Differences in the sources of influence between the two studies may be related to the developmental ages of the children examined. Around 2 years of age, there is a developmental transition as children begin to assert their independence and show aggression. Correspondingly, parental socialization efforts are increasingly directed toward teaching children to behave in caring ways toward others, to refrain from hurting others, and to comply with requests. These socialization practices, as well as parental warmth, are related to greater concern for others in toddler-age children (Zahn-Waxler, Radke-Yarrow, & King, 1979; Robinson, et al., 1994). This heightened variability in observed environmental processes directed toward children this age might make it more difficult to obtain consistently reliable estimates of both environmental and genetic influences. Notably, the most consistent genetic influences on these types of behaviors occur just before and after this age period, at 14 and 36 months (Zahn-Waxler et al., 2001). Our novel bivariate findings were that environmental sources of variation accounted for the covariation between positive affect and helping, whereas genetic factors accounted for the small degree of phenotypic covariation between positive affect and hypothesis testing. Our finding that the modest degree of genetic influence on positive affect was significant in the bivariate, but not the univariate, model is likely a result of the added statistical power of the bivariate approach.

Study Strengths and Limitations

The findings are notable because of the independent measurement of positive affect and empathy, the longitudinal design, and the examination of genetic and environmental sources of variance. The multimethod approach to measuring positive affect should enhance validity because it incorporated two observational and two maternal-report measures. The examination of various specific components of empathy instead of a global empathy rating led to a differentiated pattern of results. An obvious strength of our study was the twin

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design, which allowed for the examination of genetic and environmental contributions to these components.

Limitations of the project include the possibility that findings with twins might not generalize to singletons. Twinship might have an undiscovered impact on the development or expression of empathy. The shared environment relevant to empathy toward caregivers could also conceivably differ between twins and nontwins. Examination of the development of prosocial behavior among singletons revealed that over 50% of the children displayed a prosocial response shortly after their first birthday (Zahn-Waxler, Radke-Yarrow et al., 1992). Among twin samples, these prosocial responses do occur at this early stage of development, yet to a lesser degree than in singletons (Zahn-Waxler, Robinson et al., 1992).

In this study, we examined a single empathy elicitation task at each age of assessment. The use of a single empathy simulation may not capture the full range of children's empathic responses. Additional measures of empathy, either observed or reported, at each assessment age would aid generalizability of the findings. It is noteworthy, however, that many of our findings based on a single task at each age replicate previous research of Zahn-Waxler and colleagues. In addition, we only coded empathy-related behaviors for 30 s, whereas Zahn-Waxler et al. (2001) continued coding an additional 30 s following the pain simulation, allowing twice as much time to capture delayed responses. Finally, our research differed from that of Zahn-Waxler et al. in that they studied only same-sex DZ twins whereas we also included opposite-sex twins.

In summary, our most important findings indicate that the shared environment accounted for a large portion of the variance from 19 to 25 months of age in concern and prosocial helping behavior directed toward the primary caregivers' distress. However, genetic differences were associated with observed differences in empathy-related hypothesis testing. The covariation between positive affect and prosocial helping was mainly accounted for by the shared environment whereas heritability accounted for the covariation between positive affect and empathy-related hypothesis testing.

Future Directions and Implications

In future studies, researchers should examine the impact of other experiential and temperamental factors on empathy development. Eisenberg, Fabes, Shepard, et al. (1998) found teacher-reported dispositional sympathy to positively relate to regulation and low negative emotionality in a sample of 8- to 10-year-old children. Effortful control represents another dimension of temperament that positively relates to children's empathy-related responding (Valiente et al., 2004). Also, a child who is especially attentive to threatening contexts and others' reactions might be prone to greater empathy, provided that these tendencies are coupled with a social orientation. Fear evidenced at 10 months of age positively correlates with empathic concern at 18 months (Spinrad & Stifter, in press) and in toddler-age children (Robinson, et al., 1994; Zahn-Waxler, et al., 1979). That is, moderately shy yet social children might tend to become empathetic, particularly if exposed to empathetic models. Unfortunately, our data do not allow testing of this hypothesis, which incorporates a nonlinear main effect of shyness, an interaction with another aspect of temperament (sociability) and an interaction with experience. However, such complexity might well exist, given the small effect sizes demonstrated in our study.

This study emphasizes the importance of the shared environment for the development of both positive affect and empathy. Parenting, presumably a major component of the shared environment, accounted for 36% of the variance in empathic concern in adults (Koestner, Franz, & Weinberger, 1990). Parents' positive expressivity was marginally associated with children's dispositional sympathy (Valiente et al., 2004). Mothers who held negative attitudes regarding child rearing and tended to be less sensitive to their infants' cues had offspring who responded with more indifference to their mothers' distress as children (Kiang, Moreno, & Robinson, 2004). Responsive mothering is positively related to higher levels of concerned attention and lower levels of personal distress in 18-month-olds (Spinrad & Stifter, in press). In general, a nurturing and warm family environment promotes the development of empathy in children (Eisenberg & Fabes, 1998). Researchers should focus future work on investigating whether these specific parenting and family processes account for the shared environmental variance identified in our analyses.

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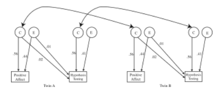

FIGURE 1.

Bivariate biometric model decomposing variance and covariance between positive affect and helping. C = shared environmental influences. E = nonshared environmental influences. Covariance between C for Twin A and C for Twin B are set to 1.0 for both monozygotic and dizygotic twins. Parameter estimates are set equal for Twin A and Twin B. The numbers are standardized squared path coefficients.

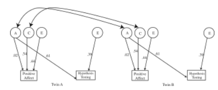

FIGURE 2.
Bivariate biometric model decomposing variance and covariance between positive affect and hypothesis testing. A = additive genetic influences. C = shared environmental influences. E = nonshared environmental influences. Covariance between A for Twin A and A for Twin B are set to 1.0 for monozygotic (MZ) twins, and 0.50 for dizygotic (DZ) twins. Covariance between C for Twin A and C for Twin B are set to 1.0 for both MZ and DZ twins. Parameter estimates are set equal for Twin A and Twin B. The numbers are standardized squared path coefficients.

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TABLE 1

Means and Standard Deviations for Empathy Components of Children Aged 19, 22, and 25 Months

	Pooled sample[a]		**Girls**[b]		**Boys**[c]	
Age (months)	***M***	***SD***	***M***	***SD***	***M***	***SD***
Helping						
19	1.25	0.34	1.23	0.33	1.27	0.35
22	1.26	0.34	1.27	0.34	1.25	0.35
25	1.38	0.44	1.38	0.43	1.38	0.46
Concern						
19	1.53	0.36	1.58	0.35	1.48	0.37
22	1.54	0.35	1.55	0.35	1.53	0.35
	1.57	0.36	1.59	0.35	1.53	0.36
Negative affect						
19	1.25	0.37	1.25	0.38	1.25	0.37
22	1.17	0.30	1.15	0.26	1.19	0.34
25	1.16	0.30	1.14	0.28	1.17	0.33
Hypothesis testing						
19	2.16	0.78	2.10	0.70	2.25	0.88
22	2.25	0.72	2.22	0.68	2.30	0.78
25	2.30	0.66	2.30	0.61	2.32	0.73

Note. Each cell represents subjects with complete data (used in repeated measures analysis of variance).

[a] *ns*: helping = 276, concern = 261, negative affect = 264, hypothesis testing = 274.

[b] *ns*: helping = 157, concern = 149, negative affect = 153, hypothesis testing = 156.

[c] *ns*: helping = 119, concern = 112, negative affect = 111, hypothesis testing = 118.

TABLE 2

Correlations of Empathy Components for Children Aged 19, 22, and 25 months

	1			2			3			4		
	a	**b**	**c**	**a**	**b**	**c**	**a**	**b**	**c**	**a**	**b**	**c**
1. Helping												
a. 19 m	—											
b. 22 m	**.07**	—										
c. 25 m	**.18****	**.20****	—									
2. Concern												
a. 19 m	.00	–.01	–.01	—								
b. 22 m	.00	.12*	.03	**.27****	—							
c. 25 m	–.01	.00	.14**	**.24****	**.24****	—						
3. Negative affect												
a. 19 m	.08	.08	.04	–.03	–.03	.02	—					
b. 22 m	–.10	.05	.07	–.04	–.07	.04	**.07**	—				
c. 25 m	–.04	.07	.15**	.01	–.09	.10*	**–.02**	**.02**	—			
4. Hypothesis testing												
a. 19 m	.07	–.01	–.05	–.02	–.14*	.13*	.01	–.02	–.06	—		
b. 22 m	–.02	.12*	.03	–.07	–.06	–.11	–.01	.00	.00	**.20****	—	
c. 25 m	–.03	–.02	.06	–.08	–.05	–.09	.00	.00	–.05	**.13****	**.24****	—

Note. Bold text indicates cross-age, same component associations.

* $p < .05$.

** $p < .01$.

TABLE 3

Means and Standard Deviations for Children's Empathy Components (Averaged Across 19 to 25 Months)

	Pooled sample[a]		Girls[b]		Boys[c]	
Component	***M***	***SD***	***M***	***SD***	***M***	***SD***
Helping	1.29	0.26	1.27	0.25	1.29	0.27
Concern	1.54	0.27	1.57	0.26	1.50	0.27
Hypothesis testing	2.23	0.54	2.17	0.50	2.31	0.59

[a] $N = 432$.

[b] $n = 234$.

[c] $n = 198$.

TABLE 4

Correlations Between Positive Affect and Empathy Components in Children Aged 19 to 25 Months

	Pooled sample[a]			Girls[b]			Boys[c]		
	Helping	**Concern**	**Hypothesis testing**	**Helping**	**Concern**	**Hypothesis testing**	**Helping**	**Concern**	**Hypothesis testing**
Positive affect	.16**	.09	.12*	.22**	.15*	.06	.10	.05	.16*

Note. Empathy components represent an average from 19 to 25 months of age.

[a] $N = 404$.

[b] $n = 216$.

[c] $n = 188$.

* $p < .05$.

** $p < 0.01$.

TABLE 5

Twin Similarity for Positive Affect and the Empathy Composites

	Intraclass correlations	
Composites[a]	**MZ**	**DZ**
Positive affect[b]	.56	.49
Helping	.18	.20
Concern	.48	.35
Hypothesis testing	.57	.38

Note. MZ = monozygotic (identical) twins; DZ = dizygotic (fraternal) twins. Effects of sex were regressed out.

[a] *N* = 67 MZ pairs and 140 DZ pairs.

[b] *n* = 82 MZ twin pairs and 172 DZ pairs.

TABLE 6

Model Fit and Estimates of Genetic, Shared Environment, and Nonshared Environment Contributions to Positive Affect and Empathy Composites

Composite	Model	−2LL	*df*	$\Delta \chi^2$	*df*	*p*	AIC	h^2	c^2	e^2
Positive affect	ACE	1106.30	485					.22	.42	.36
	AE	1116.37	486	10.07	1	.00	8.07			
	CE	**1107.95**	**486**	**1.65**	**1**	**.20**	**−0.35**		**.56**	**.44**
	E	1192.64	487	86.35	2	.00	82.35			
Helping	ACE	415.48	470					.22	.43	.35
	AE	419.15	471	3.67	1	.06	1.67			
	CE	**416.53**	**471**	**1.05**	**1**	**.31**	**−0.95**		**.57**	**.43**
	E	435.53	472	20.05	2	.00	16.05			
Concern	ACE	47.21	413					.30	.24	.46
	AE	49.26	414	2.04	1	.15	0.04			
	CE	**48.87**	**414**	**1.65**	**1**	**.20**	**−0.35**		**.44**	**.56**
	E	85.85	415	38.64	2	.00	34.64			
Hypothesis testing	ACE	609.83	411					.40	.19	.41
	AE	**611.27**	**412**	**1.44**	**1**	**.23**	**−0.23**	**.62**		**.38**
	CE	613.29	412	3.45	1	.06	1.45			
	E	658.44	413	48.61	2	.00	44.61			

Note. −2LL = the fit statistic − 2 times the log likelihood; *df* = degrees of freedom; $\Delta\chi^2$ = change in chi-squared; AIC = the fit index Akaike's Information Criterion; A = additive genetic; C = shared environmental; E = nonshared environmental influences. The parameter estimates in the rightmost columns are given for the full ACE model, plus the best-fitting reduced model (which is also bolded).