

Maternal Expressed Emotion Predicts Children's Antisocial Behavior Problems: Using Monozygotic-Twin Differences to Identify Environmental Effects on Behavioral Development

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If maternal expressed emotion is an environmental risk factor for children's antisocial behavior problems, it should account for behavioral differences between siblings growing up in the same family even after genetic influences on children's behavior problems are taken into account. This hypothesis was tested in the Environmental Risk Longitudinal Twin Study with a nationally representative 1994–1995 birth cohort of twins. The authors interviewed the mothers of 565 five-year-old monozygotic (MZ) twin pairs and established which twin in each family received more negative emotional expression and which twin received more warmth. Within MZ pairs, the twin receiving more maternal negativity and less warmth had more antisocial behavior problems. Qualitative interviews were used to generate hypotheses about why mothers treat their children differently. The results suggest that maternal emotional attitudes toward children may play a causal role in the development of antisocial behavior and illustrate how genetically informative research can inform tests of socialization hypotheses.

Children who are reared in the same family by the same parents are often remarkably different from each other. In part, siblings differ because they have different genetic makeups, different ages, and sometimes different sex. However, differences can be seen between siblings who are monozygotic (MZ) twins despite the fact that they are identical in genetic makeup, age, and sex. For many psychiatric disorders, MZ twins who are reared in the same family are discordant in over 50% of the cases (suggesting that heritability

is much less than 100%). Behavioral genetics research has exploited these differences between MZ twins to provide evidence that children growing up in the same family are different from each other for environmental reasons. These environmental experiences have been called nonshared (Plomin & Daniels, 1987; Rowe & Plomin, 1981) or child-specific (Kendler, 1993) experiences because they are unique to each sibling growing up in the same family. Historically, most behavioral genetic studies have identified the existence of a nonshared-environment “variance component,” but these studies have not *measured* nonshared experiences. Because it is now known that nonshared environmental experiences are important, psychosocial researchers need to measure experiences that vary among children within families and to ascertain whether these measured experiences can account for behavioral differences between children growing up in the same family. This is one method of testing whether a risk factor having alleged environmental effects on development is indeed environmentally mediated.

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The goal of the present study was to measure child-specific aspects of mothers' parenting styles and to test whether differential maternal attitudes and feelings account for differences between siblings growing up in the same family. Specifically, we focused our attention on mothers' expressed emotion toward their children, and we tested whether differences in maternal expressed emotion account for differences in young children's early-emerging antisocial behavior problems.

We focus on children's early-onset antisocial behavior problems because these are associated with lifelong and pervasive mental (Moffitt, Caspi, Harrington, & Milne, 2002), physical (Farrington & Junger, 1995), economic (Caspi, Wright, Moffitt, & Silva,

1998), and interpersonal (Moffitt et al., 2002) problems, the public-health burden of which is enormous (Potter & Mercy, 1997). Theories about the origins of these early-emerging individual differences implicate parenting (Snyder, Reid, & Patterson, 2003), but whether specific parenting attitudes and behaviors have true *environmental* effects on children’s development is, in fact, contested on empirical grounds (Rowe, 1994; Scarr, 1992). Nevertheless, twin and adoption studies have noted that variation in children’s antisocial behavior problems is influenced by nonshared environmental factors (Rhee & Waldman, 2002). Peers and friends have been emphasized as potential nonshared environments for adolescents (Harris, 1998). However, because our interest is in antisocial behavior problems that emerge in early childhood, we hypothesized that the emotional attitudes directed by mothers toward their offspring represent critical contexts for children’s development, long before experiences outside the home come into play.

The study of emotional attitudes (e.g., criticism, warmth) directed at specific family members has a long history in adult psychiatry (Brown & Rutter, 1966; Rutter & Brown, 1966). Expressed emotion, measured by the Camberwell Family Interview (CFI; Vaughn & Leff, 1976) and the Five-Minute Speech Sample (FMSS; Magana, Goldstein, Karno, Miklowitz, & Falloon, 1986), predicts relapse among schizophrenics and prognosis in several other adult psychiatric disorders (Butzlaff & Hooley, 1998). In more recent years, the study of expressed emotion has been extended downward to focus on childhood disorders, using child-appropriate versions of the CFI and FMSS protocols (Vaughn, 1989). Mothers of children with behavioral disorders have been observed to express more critical comments, fewer positive com-

ments, and less warmth toward their children than have control parents (e.g., Asarnow, Tompson, Hamilton, Goldstein, & Guthrie, 1994; Asarnow, Tompson, Woo, & Cantwell, 2001; Hibbs et al., 1991; Hirshfeld, Biederman, Brody, Faraone, & Rosenbaum, 1997; McCarty & Weisz, 2002; Peris & Baker, 2000; Richman, Stevenson, & Graham, 1982; Schwartz, Dorer, Beardslee, Lavori, & Keller, 1990; Scott & Campbell, 2001; Stubbe, Zahner, Goldstein, & Leckman, 1993; Vostanis & Nicholls, 1995; Vostanis, Nicholls, & Harrington, 1994). In these studies, mother-child pairs from different families have been compared to each other. However, on their own, correlations from such “between-families, 1-child-per-family” research designs do not demonstrate that maternal attitudes are causes of children’s behavior problems, because other risk factors vary across families (e.g., low social class, marital discord, maternal psychopathology). These third variables, which differ across families for both environmental and genetic reasons, may account for the correlation between maternal emotional attitudes and children’s behavior problems.

As shown in Figure 1, socialization researchers have tried to overcome this inferential limitation of “between-families” research designs by increasingly making use of “within-family, 2-children-per-family” designs. The hypothesis is that if maternal treatment is a risk factor for children’s behavior problems, nonshared (or child-specific) maternal treatment should be associated with behavioral differences between siblings growing up within the same family. Typically, these studies examine the relation between nonshared environmental experiences and sibling outcomes using difference-score models or residualized-score models. For example, the difference-score model uses two sibling-difference variables. The first variable reflects differences in the siblings’ expe-

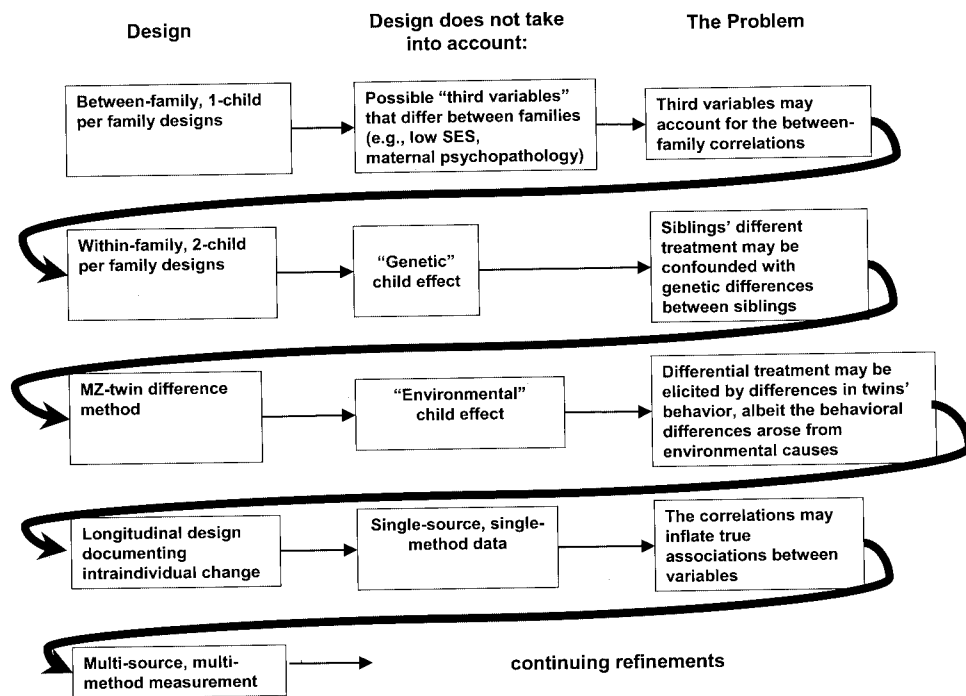


Figure 1. How successive improvements in research design can overcome inferential limitations in nonexperimental studies of the effects of maternal treatment on children’s behavior problems.

riences (e.g., differential maternal negativity). The second variable reflects differences in the siblings' behavioral outcome (e.g., antisocial behavior problems). The correlation between the two difference scores reflects the contribution of nonshared experiences to the creation of sibling outcome differences, independent of factors that differ between families (Rovine, 1994).

However, three additional methodological challenges have impeded progress in identifying whether specific nonshared environmental experiences actually account for behavioral differences between children growing up in the same family. First, many of the "2-children-per-family" studies have not incorporated the inferential leverage afforded by genetically informative designs (Turkheimer & Waldron, 2000). The problem is that to the extent that children's genetically influenced behavior problems evoke different maternal treatment, siblings' different treatment will be confounded with genetic differences between the children (Plomin, 1994). It is thus unknown whether the association between nonshared environmental experiences and behavioral differences between children in the same family reflects an environmental effect or a genetic child effect, which will arise if children's heritable characteristics evoke different treatment (see Figure 1). For this reason, researchers have increasingly made use of, or initiated, genetically informative studies to examine nonshared-environment effects. For example, Rodgers, Rowe, and Li (1994) turned the National Longitudinal Study of Youth into a genetically informative study (using twin, full-sib, half-sib, and cousin pairs) in order to test the hypothesis that differences in parental behavior (e.g., spanking) are related to differences in 5- to 11-year-old children's behavior problems. The Nonshared Environment and Adolescent Development (NEAD) project has studied the differential experiences of MZ and dizygotic (DZ) twins, full siblings, half siblings, and genetically unrelated siblings in order to test hypotheses about whether differences in parental treatment (as well as peer experiences) are related to differences in adolescents' psychological adjustment (Reiss, Neiderhiser, Hetherington, & Plomin, 2000). In the present study, we estimated the contribution of the nonshared environment to young children's antisocial behavior problems by studying differences between MZ twins. The MZ-difference method provides the most direct index of the nonshared environment, because MZ twins are genetically identical (Plomin, DeFries, McClearn, & McGuffin, 2001). As such, correlating MZ-twin differences in experience with MZ-twin differences in outcome is a strong, unambiguous test of environmental experiences independent of genetics; it rules out the two possibilities (a) that a genetically transmitted liability explains both the parenting of the mother and the behavior of the child and (b) that genetically influenced differences between the children evoke different maternal treatments.

A further limitation of research about nonshared environmental effects on children's development is that many studies, including genetically informative ones, are cross-sectional (see Figure 1). Cross-sectional studies have important inferential limitations even when they use the MZ-difference method. For example, a cross-sectional association between child-specific environmental experiences and behavioral outcomes in an MZ-twin difference study suggests, with confidence, that the association between the environmental variable and the child's behavior is not genetically mediated (because MZ twins are genetically identical). However, observing this association does not rule out the possibility of an

environmental child effect, that is, that differential treatment is elicited by differences in the twins' behavior even though these behavioral differences arose from environmental, not genetic, causes. In the present study, we tested whether differences in the expressed emotion that children received at the age of 5 years would predict differences between the children's antisocial behavior problems measured later at the age of 7 years, over and above any continuity in children's antisocial behavior problems from age 5 to age 7. Documenting that maternal expressed emotion is associated with within-individual (and within-pair) increases in antisocial behavior problems is one important (nonexperimental) test of a true environmental risk (Rutter, Pickles, Murray, & Eaves, 2001).

A final limitation of research about nonshared environmental effects is that many studies, including longitudinal ones, rely on the same source (e.g., the mother) to provide information about both the environmental experience and the behavioral outcome of interest. The resulting single-method correlations (see Figure 1) may inflate true associations between variables (Bank, Dishion, Skinner, & Patterson, 1990). With notable exceptions (e.g., Deater-Deckard et al., 2001; Reiss et al., 2000), few studies have examined associations between siblings' differential experiences and differential outcomes by measuring experience and outcome from different sources. Often, studies that have done so have found that correlations between differential experiences and differential behavioral outcomes that are moderate when within-source data are used drop to negligible when across-source data are used (Pike, Reiss, Hetherington, & Plomin, 1996). This drop raises the question of whether the putative differential experience effects are an artifact of single-source measurement (e.g., a mother's negativity toward a child may lead her to exaggerate that child's behavior problems but may not affect the child's actual behavior at all). It is thus important to establish in further research that nonshared family experiences are predictors of independently ascertained behavioral differences between children. In the present study, we measured the twins' behavior problems from teachers' reports as well as mothers'. We reasoned that teachers' independent reports of children's behavior problems were unlikely to be contaminated by the mothers' expressed emotion and would provide a strong test of whether maternal expressed emotion is, in fact, related to children's antisocial behavior problems.

In sum, our goal in the present study was to test whether maternal expressed emotion is an environmental risk factor in the development of children's early-emerging antisocial behavior problems. We tested this hypothesis by using (a) a genetically sensitive MZ-twin design, (b) with longitudinal data, and (c) independent measurements of mothers' expressed emotions and children's antisocial problems. Qualitative interviews were also conducted with a small sample of mothers of very discordant MZ twins to generate hypotheses for future research into the puzzle of why many mothers feel differently toward their twin children despite the fact that the children are genetically identical.

Method

The Environmental Risk Study Sample

Participants are members of the Environmental Risk (E-Risk) Longitudinal Twin Study, which investigates how genetic and environmental

factors shape children's development. The study follows an epidemiological sample of families with young twins who were interviewed in the home when the twins were 5 and 7 years of age. The E-Risk Study sampling frame consisted of two consecutive birth cohorts (1994 and 1995) in a birth register of twins born in England and Wales (Trouton, Spinath, & Plomin, 2002). Of the 15,906 twin pairs born in these 2 years, 71% joined the register. Our sampling frame excluded opposite-sex twin pairs and began with the 73% of families in the register who had same-sex twins.

The E-Risk Study sought a sample size of 1,100 families to allow for attrition in future years of the longitudinal study while retaining statistical power. An initial list of families was drawn from the register to target for home visits, with a 10% oversample to allow for nonparticipation. The probability sample was drawn using a high-risk stratification sampling frame. High-risk families were those in which the mother gave birth for the first time when she was 20 years of age or younger. We used this sampling (a) to replace high-risk families who were selectively lost to the original register via nonresponse and (b) to ensure sufficient base rates of problem behaviors given the low base rates expected for 5-year-old children. Early first childbearing was used as the risk-stratification variable because age of childbearing was recorded for virtually all families in the register, it is relatively free of measurement error, and it is a known risk factor for children's problem behaviors (Maynard, 1997; Moffitt & E-Risk Study Team, 2002). The sampling strategy resulted in a final sample in which two thirds of E-Risk Study mothers accurately represent all mothers in the general population (ages 15–48 years) in England and Wales in 1994–1995 (estimates derived from the General Household Survey; Bennett, Jarvis, Rowlands, Singleton, & Haselden, 1996). The other one third of E-Risk Study mothers (younger only) constitute a 160% oversample of mothers who were at high risk on the basis of their young age at first childbirth (15–20 years). To provide unbiased statistical estimates that can be generalized to the population, we corrected the tests reported in this article with weighting to represent the proportion of young mothers in the United Kingdom (Bennett et al., 1996).

Of the 1,203 families from the initial list who were eligible for inclusion, 1,116 (93%) participated in home-visit assessments when the twins were 5 years old, forming the base sample for the study: 4% of families refused, and 3% were lost to tracing or could not be reached after many attempts. Teachers returned questionnaires on the children's behavior for 94% of the cohort children. Zygosity was determined using a standard zygosity questionnaire that has been shown to have 95% accuracy (Price et al., 2000). Ambiguous cases were zygosity-typed using DNA. The sample included 56% MZ and 44% DZ twin pairs. Sex was evenly distributed within zygosity (49% male).

A follow-up home visit was conducted 18 months after the twins' age 5 assessment when they were 6½ years old on average (range = 6.0 to 7.0 years). Follow-up data were collected for 98% of the 1,116 E-Risk Study families. At this follow-up, teacher questionnaires were obtained for 91% of the 2,232 E-Risk Study twins (93% of those taking part in the follow-up). Hereafter, for simplicity's sake, this follow-up is referred to as the age 7 assessment. In both the age 5 and age 7 assessments, families were given shopping vouchers for their participation, and children were given coloring books and stickers. All research workers had university degrees in behavioral science and experience in psychology, anthropology, or nursing.

The present study reports on MZ-twin pairs; data were obtained from mothers for 622 pairs at age 5 and 606 pairs at age 7 and from teachers for 580 pairs at age 5 and 563 pairs at age 7.

Maternal Expressed Emotion

The measurement of expressed emotion in developmental psychopathology is distinguished by four key features: (a) It focuses on individual-specific expressed emotions (i.e., individual with respect to both the person expressing the emotion and the child receiving it); (b) it refers to emotions observed in the manner in which an adult talks about a child, rather than by

answers to specific closed-ended questions; (c) it uses both verbal and vocal elements in rating emotions (that is, both *what* is said and the *tone* of voice used); and (d) it focuses on emotions about the child as an individual, rather than on emotions concerned with a child's symptoms.

The E-Risk Study uses a novel approach to scoring expressed emotion given concerns that have been raised about the developmental inappropriateness of the standard scoring protocol originally developed for studies of adult psychiatric patients (e.g., Daley, Sonuga-Barke, & Thompson, 2003; McCarty & Weisz, 2002; Sandberg, Rutter, & Jarvi, in press). Specifically, we used a 5-min speech sample to elicit expressed emotion about each child. Trained interviewers asked caregivers to describe each of their children ("For the next 5 minutes, I would like you to describe [child] to me; what is [child] like?"). The mother was encouraged to talk freely with few interruptions. However, if the mother found this difficult, the interviewer could aid the mother with a series of semistructured probes, such as "In what ways would you like [child] to be different?" Interviews about each twin were separated in time by approximately 90 min. All interviews were audiotaped with the mother's consent. Data for expressed emotion were missing for 9% of the sample because some mothers did not wish to be audiotaped or because of technical problems with the tape.

Two trained raters coded the audiotapes according to guidelines adapted from the FMSS scoring manual and modified for use with preschool children (see also Daley et al., 2003; Sandberg et al., in press). The raters underwent 2 weeks of training about coding expressed emotion. Interrater reliability was established by having the raters individually code audiotapes describing 40 children. The same rater coded both twins in the same family. The rater was blind to all other E-Risk Study data. We examined four variables coded from the 5-min speech sample: number of positive comments, number of negative comments, negativity, and warmth. Additional information about the measurement, reliability, and concurrent validity of maternal expressed emotion is reviewed by Sandberg et al. (in press).

Positive comments. Raters counted all positive comments made during the interview about the child. A positive comment was defined primarily by its content. However, because a comment can be given a variety of meanings by its tone, tone of voice was taken into account in determining whether a comment was positive or not. For example, "She's so nice" could be said sarcastically. Tone alone never defined a positive remark but was used to clarify the content of the comment. For example, "He's so forgetful" could be said with warmth and tenderness but would not be considered a positive comment. The majority of positive comments counted were descriptive words indicating the possession of a positive trait (e.g., intelligent, loving, mature, sociable, creative, helpful). However, some mothers with poor vocabulary tended to talk around these issues rather than rely on single descriptors. For example, the statement, "He always wants to wash up and things, to do things for you," was counted as a positive comment. In addition, qualities that the mother clearly valued were counted as positive comments (e.g., "She always listens"). Statements not qualifying as positive included comments phrased in the negative (e.g., "She's not as bad as the other one"), qualified compliments (e.g., "He's quite good"), and statements made in the past tense. The interrater agreement (r) was .63.

Negative comments. Raters counted all negative comments made during the interview about each child (e.g., "She is horrible," "I don't like her," "She is so lazy," "She is so clumsy"). To be counted as a negative comment, both the tone and the content of the comment had to be negative. This criterion was used to ensure that coders did not penalize mothers for their turns of phrase. For example, comments such as "She is a right little madam" or "He's a right little sod" were often said with affection and warmth. These would not have been counted as negative comments unless the tone in which they were said was also negative. Comments such as "She is not a good sleeper" or "He is a fussy eater," although not negative in their own right, were counted as negative comments when the mother repeatedly and disparagingly defined her child, throughout the interview, in

terms of his or her inability to sleep or fussiness over food. The interrater agreement was .90.

Negativity. Negativity was a global measure used to describe the whole speech sample. The 6-point rating scale refers to the negativism expressed in the interview about the child: *No negativity* (0) was coded when the mother made no negative comments about the child. *A little negativity* (1) was coded when the mother made one minor criticism such as “She is lazy.” *Some negativity* (2) was coded when the mother made two criticisms that were stronger in tone than the former rating. The next three codes were considered present when maternal negativity was generalized to the child himself or herself rather than against particular behaviors or attributes. These ratings were used when the tone and content of the interview were primarily negative. *Negative—some dissatisfaction* (3) was coded when the mother repeatedly mentioned one or two particular traits of the child that she did not like and wished to change, for example, “She is not very clever; it would help if she tried more, but she doesn’t; I wish she would try more, like her sister.” This was the general theme of this particular expressed emotion interview with the mother, and it was thus rated a 3. *Negative—makes disparaging remarks and finds fault with the child* (4) was coded when the mother had very little good to say about her child and found fault in almost everything he or she did, for example, “She always does it; I have never met such a clumsy child; we think ‘Oh here we go again, she’s done it again’; it drives me mad; why doesn’t she look where she is going? I’m constantly having to look out for her; she’s constantly breaking things . . . sometimes I think she is stupid, she never learns.” *Resentful and hostile* (5) was coded when the mother gave the impression that she actively disliked the child. The interview would take the form of a stream of negativity against the child, with no positive comments, for example, “I wish I had never had her . . . she’s a cow, I hate her.” The interrater agreement for negativity was .84.

Warmth. Warmth was another global measure of the whole speech sample. The scale refers only to the warmth expressed in the interview about the child. The warmth of the respondent’s personality was not a consideration, nor was warmth shown toward others. Positive comments in themselves were not viewed as evidence of warmth, nor were stereotyped endearments. Warmth was assessed by the tone of voice, spontaneity (e.g., “She is so funny—the other day she made up a song and she was dancing and singing in the garden . . . the song was about everything . . . a butterfly flew by and that ended up in the song . . . it was so sweet.”), sympathy and/or empathy toward the child (e.g., “I feel really sorry for her, it is not her fault . . . I worry for her.”). Warmth was coded on a 6-point scale. *High warmth* (5) and *moderately high warmth* (4) were coded when there was definite and clear-cut tonal warmth, enthusiasm, interest in, and enjoyment of the child. For example, “She is a delight, she is so happy, I love taking her out, she is my ray of sunshine” was coded as a 5. *Moderate warmth* (3) was coded when there was definite understanding, sympathy, and concern but only limited warmth of tone, for example, “I worried about her when she went to school, I thought she may have difficulty in mixing, and I felt sorry for her.” *Some warmth* (2) was coded when the mother showed a detached, rather clinical approach and little or no warmth of tone, but moderate understanding, sympathy, and concern. For example, an interview with comments along the lines of “She’s alright” with little substantiation would have received this rating. *Very little warmth* (1) was rated when there was only a slight amount of understanding, sympathy, concern, enthusiasm about, or interest in the child. *No warmth* (0) was reserved for mothers who showed a complete absence of the qualities of warmth as defined. The interrater agreement for warmth was .90. Table 1 shows the correlations among the four expressed emotion measures.

Children’s Antisocial Behavior Problems

Antisocial behavior problems were assessed at ages 5 and 7 with the Achenbach family of instruments: the Child Behavior Checklist (Achenbach, 1991a) and the Teacher Report Form (Achenbach, 1991b). The

Table 1
Correlations Between Maternal Expressed Emotion When Children Were 5 Years Old

Maternal expressed emotion variables	1	2	3	4
1. No. of negative comments	—	0.83	−0.24	−0.46
2. Negativity		—	−0.45	−0.62
3. No. of positive comments			—	0.63
4. Warmth				—

Note. All correlations are significant at $p < .01$. $N_s = 1,123$ – $1,130$.

externalizing syndrome reported in this article is the sum of items in the Delinquent Behavior and Aggressive Behavior scales; the internal consistency reliabilities of the parent and teacher reports of antisocial behavior problems were $> .90$. The cross-informant (parent–teacher) correlations (see Table 2) for antisocial behavior problems ranged from .31 to .43, which is consistent with published results about the assessment of childhood psychopathology (van der Ende, 1999). The longitudinal correlations (see Table 2) ranged from .54 to .68, a range consistent with published results about the continuity of antisocial behavior problems (Moffitt, Caspi, Rutter, & Silva, 2001).

Results

Results are presented in four parts. First, we tested whether maternal expressed emotion was associated with children’s antisocial behavior problems. Second, we documented that there were similarities and differences within MZ-twin pairs in the emotions expressed toward them by their mothers and in their behavior problems. Third, we tested whether differences between MZ twins in maternal expressed emotion were associated with differences between MZ twins in antisocial behavior problems. Fourth, we present data from the qualitative interviews to generate hypotheses for future research about why many mothers feel differently toward their twin children despite the fact that the children are genetically identical.

Is Maternal Expressed Emotion Associated With Children’s Antisocial Behavior Problems? A Comparison Between Children in Different Families

Table 3 shows the correlations between the maternal expressed emotion variables and children’s antisocial behavior problems. In these analyses, the individual child was the unit of analysis.¹

Maternal expressed emotion was significantly correlated with children’s antisocial behavior problems, both cross-sectionally (when the children were 5 years old) and longitudinally (when the children were 7 years old), when rated by mothers but also when rated by teachers, whose ratings were not confounded with maternal expressed emotion.

¹ Reported significance tests are based on the sandwich, or Huber/White, variance estimator (Gould & Sribney, 1999), a method available in STATA 7.0 (StataCorp, 2001). Application of this technique addresses the assumption of independence of observations. It adjusts estimated standard errors and therefore accounts for the dependence in the data that is due to analyzing sets of twins.

Table 2
Correlations Between Mothers' and Teachers' Reports of Children's Antisocial Behavior Problems at Ages 5 and 7 Years

Rating	1	2	3	4
Age 5				
1. Mothers' ratings	—	<u>0.31</u>	0.68	0.30
2. Teachers' ratings		—	0.36	0.54
Age 7				
3. Mothers' ratings			—	<u>0.43</u>
4. Teachers' ratings				—

Note. Cross-source (cross-sectional) correlations are underlined; longitudinal (within-source) correlations are shown in bold. All correlations are significant at $p < .01$. $N_s = 1,060-1,130$.

Table 3 also shows the results of longitudinal regression analyses predicting intraindividual changes in antisocial behavior problems from ages 5 to 7 as a function of maternal expressed emotion at age 5. At the first step, we entered children's antisocial behavior problems at age 5, and at the second step, we entered maternal expressed emotion assessed when the children were 5 years old. The significant expressed emotion effect documented that maternal expressed emotion at age 5 accounted for variance in children's antisocial behavior problems at age 7 over and above any continuity from age 5 to age 7 antisocial behavior problems, thus ruling out the possibility that the lasting effect of maternal expressed emotion reflected nothing more than a child effect (i.e., prior child behavior evoking maternal expressed emotion). This longitudinal effect was replicated using both mothers' and teachers' reports of children's antisocial behavior problems.

Similarities and Differences in How MZ Twins Are Treated and in Their Behavior Problems

Table 4 shows the correlations between MZ twins in their antisocial behavior problems. MZ twins were very similar in their antisocial behavior problems, whether seen through the eyes of their parents or their teachers. Although genetically identical (MZ)

Table 4
Intrapair Correlations Indexing Similarity Between MZ Twins in Their Antisocial Behavior Problems and in Their Maternal Treatment

Variable	<i>r</i>
Children's antisocial behavior problems	
Mother ratings (age 5)	.66**
Mother ratings (age 7)	.68**
Teacher ratings (age 5)	.76**
Teacher ratings (age 7)	.70**
Maternal expressed emotion (age 5)	
No. of negative comments	.06*
Negativity	.19**
No. of positive comments	.41**
Warmth	.65**

Note. N (pairs) = 565–622.
* $p < .05$. ** $p < .01$.

twins resembled each other behaviorally, they were not phenotypically identical. Approximately one quarter to one third of the variance in the children's antisocial behavior problems could be ascribed to nonshared environmental factors (plus measurement error) ($1 - .66 = .34$ according to mothers' ratings at age 5, and $1 - .68 = .32$ at age 7; $1 - .76 = .24$ according to teachers' ratings at age 5, and $1 - .70 = .30$ at age 7).

Table 4 also shows the correlations between MZ twins in their mother's expressed emotion toward them. On the whole, many E-Risk Study mothers expressed different emotional attitudes toward their MZ twins. This allowed for the possibility that differences in maternal expressed emotion might account, in part, for the behavioral differences observed between children.

Are Differences in Maternal Expressed Emotion Related to Behavioral Differences Between MZ Twins Reared in the Same Family?

Table 5 shows the correlations between MZ-twin differences in maternal expressed emotion and MZ-twin differences in antisocial

Table 3
Cross-Sectional and Longitudinal Associations Between Maternal Expressed Emotion (at Age 5) and Children's Antisocial Behavior Problems (at Ages 5 and 7), According to Mothers' and Teachers' Ratings of Antisocial Behavior Problems

Maternal expressed emotion variables (age 5)	Antisocial behavior problems					
	Mothers' ratings			Teachers' ratings ^c		
	Cross-sectional <i>r</i> (at age 5) ^a	Longitudinal <i>r</i> (at age 7) ^a	β at age 7, controlling for age 5 behavior problems ^b	Cross-sectional <i>r</i> (at age 5) ^a	Longitudinal <i>r</i> (at age 7) ^a	β at age 7, controlling for age 5 behavior problems ^b
No. of negative comments	.46**	.39**	.10**	.18**	.18**	.08*
Negativity	.47**	.39**	.09**	.16**	.14**	.06*
No. of positive comments	-.22**	-.13**	.02	-.06*	-.09**	-.06
Warmth	-.35**	-.27**	-.04	-.14**	-.14**	-.07*

Note. $N_s = 1,025-1,130$, depending on the analysis.

^a This column shows Pearson correlations. ^b This column shows standardized regression coefficients from ordinary least squares hierarchical regression analyses in which children's antisocial behavior problems at age 5 were entered at the first step and maternal expressed emotion at age 5 was entered at the second step. ^c Different teachers rated the children at ages 5 and 7.

* $p < .05$. ** $p < .01$.

Table 5

Cross-Sectional and Longitudinal Associations Between MZ-Twin Differences in Maternal Expressed Emotion (at Age 5) and MZ-Twin Differences in Antisocial Behavior Problems (at Ages 5 and 7), According to Mothers' and Teachers' Ratings of Antisocial Problems

MZ-twin differences in maternal expressed emotion	MZ-twin differences in antisocial behavior problems					
	Mothers' ratings			Teachers' ratings ^c		
	Cross-sectional <i>r</i> (at age 5) ^a	Longitudinal <i>r</i> (at age 7) ^a	β at age 7, controlling for MZ-twin differences at age 5 ^b	Cross-sectional <i>r</i> (at age 5) ^a	Longitudinal <i>r</i> (at age 7) ^a	β at age 7, controlling for MZ-twin differences at age 5 ^b
No. of negative comments	.53**	.35**	.16**	.14**	.18**	.15**
Negativity	.49**	.33**	.16**	.17**	.15**	.10*
No. of positive comments	-.22**	-.20**	-.11**	-.13**	-.15**	-.12**
Warmth	-.28**	-.23**	-.11**	-.10*	-.12**	-.10*

Note. *N* (pairs) = 500–565, depending on the analysis.

^a This column shows Pearson correlations. ^b This column shows standardized regression coefficients from ordinary least squares hierarchical regression analyses in which MZ-twin differences in antisocial behavior problems at age 5 were entered at the first step and MZ-twin differences in maternal expressed emotion at age 5 were entered at the second step. ^c Different teachers rated the children at ages 5 and 7.

* $p < .05$. ** $p < .01$.

behavior problems. In these analyses, the MZ-twin pair is the unit of analysis.

Table 5 shows that differences in mothers' expressed emotion toward their 5-year-old MZ twins were significantly correlated with differences between the MZ twins' behavior problems, both cross-sectionally (when the children were 5 years old) and longitudinally (when the children were 7 years old). The significant associations between differences in maternal expressed emotion and differences in the twins' behavior were observed regardless of whether mothers or teachers rated the children.

To summarize the quantitative findings, Figure 2 shows the mean scores at age 7 for children's antisocial behavior problems as a function of whether a child was the more or the less favored twin in the MZ pair. The less favored twin at age 5 (i.e., the one receiving more maternal negativity and less maternal warmth) had more antisocial behavior problems at age 7 than did the more favored twin.

Table 5 also shows the results of regression analyses predicting behavioral differences between MZ twins at age 7 as a function of differences in their mother's expressed emotion toward them when they were 5 years old, after controlling for age 5 behavioral differences within the twin pair. At the first step, we entered MZ-twin differences in antisocial behavior problems at age 5, and at the second step, we entered MZ-twin differences in maternal expressed emotion at age 5. The significant effect of MZ-twin differences in maternal expressed emotion documented that differences in a mother's expressed emotion toward her identical twins at age 5 predicted that the twins would continue to differ at age 7, over and above any continuity from age 5 to age 7 in behavior problems. This longitudinal effect was replicated when both mothers' and teachers' reports of children's antisocial behavior problems were used.

The analyses in Table 5—based as they are on predicting behavioral differences between genetically identical (MZ) twins—effectively rule out the possibility that genetically influenced differences between the twins contributed to their differential treatment. In addition, the longitudinal analyses—documenting that

differences in maternal expressed emotion are associated with increasing within-pair differences between the twins—suggest that maternal expressed emotion may be causally linked to children's antisocial behavior problems. Still, even these analyses do not entirely rule out the possibility that some earlier, nongenetically influenced difference between the twins produced differences in maternal expressed emotion and in the twins' increasingly diverging antisocial behavior problems. In further analyses, we asked if twin differences in neurological status might account for the association between differential maternal expressed emotion and twin differences in antisocial behavior. Specifically, we used birth weight to index each twin's neurological status (because this difference was most clearly present before both maternal expressed emotion and children's antisocial problems). Within-pair analyses showed that the twin who weighed less at birth received, at age 5, more negative comments ($r = .19, p < .01$), more negativity ($r = .15, p < .01$), fewer positive comments ($r = -.15, p < .01$), and less warmth ($r = -.14, p < .01$). We then repeated all the analyses in Table 5, controlling for twin differences in birth weight. The results were unchanged (an additional table is available from the authors). As an illustration, consider the most conservative test of an environmentally mediated association reported in this article; this appears in the final column of Table 5. When we controlled for MZ-twin differences in birth weight, the regression coefficients in that column changed to the following: $\beta = .16, p < .01$; $\beta = .11, p < .05$; $\beta = -.13, p < .01$; $\beta = -.10, p < .05$.²

Why Do Some Mothers Feel Differently Toward Their Twins? A Qualitative Inquiry

The aforementioned quantitative findings raised the question of why many mothers felt differently toward their twin children

² Following a reviewer's suggestion, we tested whether the association between differential maternal expressed emotion and twin differences in antisocial behavior was nonlinear. None of the quadratic effects that we tested was statistically significant.

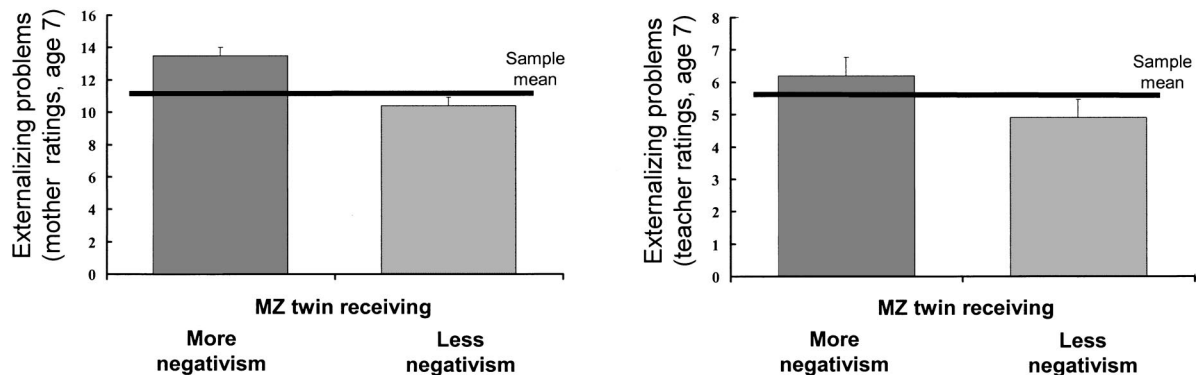


Figure 2. The monozygotic (MZ) twin receiving more maternal negativity at age 5 has more antisocial behavior problems at age 7. A principal-components analysis of the four maternal emotional attitude variables yielded one factor accounting for 72% of the variance. The positive loadings for number of negative comments and negativity, and the negative loadings for number of positive comments and warmth, suggest that the four expressed emotion measures index a mother's orientation toward her child along a continuum from warmth to negativism/hostility. For illustrative purposes in this figure, twins within a pair were designated as receiving more or less negativity depending on a difference score between them. The figure shows means and standard errors among twin pairs for whom the MZ-twin difference in treatment was greater than 0.5 *SD*.

despite the fact that the children were genetically identical. To generate hypotheses for future research, we carried out a qualitative assessment that aimed to uncover possible reasons for differential treatment. Our team of interviewers (who together completed more than 2,000 E-Risk Study home visits) generated an initial list of hypothesized causes for differential treatment of MZ twins. This list of provisional hypotheses was used to guide an open-ended interview protocol we conducted with E-Risk Study mothers of very different MZ twins. We selected seven E-Risk Study families for these qualitative interviews on the basis of MZ zygosity, proximity to London (to reduce travel costs), a twin-pair difference on antisocial behavior problems that was greater than 1 *SD* above the mean difference, and extreme discordance corroborated by the twins' teachers. The mothers were told that the purpose of this visit was to focus on why identical twins can sometimes be so different. The protocol was organized by developmental stages, first discussing differences in the 1st year of life (example probe: "Was one of the twins more difficult to care for as a newborn?"), then the toddler years from ages 1 to 4 (example probe: "Did either twin become closer to one person in your family?"), and finally the current years since starting schooling (example probe: "Can you see similarities between their personalities and other family members' personalities?"). (The interview protocol is available from the authors.) Interviews were audiotaped and converted to transcripts, which the research team read to identify possible causes for differential treatment. Because reasons for differential treatment might be idiosyncratic, we did not look for consensus across the families. However, the following four explanations for differential treatment emerged as major themes. Names have been changed for confidentiality.

One twin has been ill, requiring differential parenting. Case 6300: "Ann had all the blood and Susan didn't get any . . . they took Ann away and put her in special care . . . and when she came out I was terrified of her. I remember the first night I had to change her nappy, I was scared if I pulled her legs they'd fall

off." Case 10735: "When they were born and I saw them, I just felt they had different personalities, I don't know, like Gill was the first one I could hold, 'cos the other one had to have oxygen and stuff and had to be left." Case 13569: "He was in hospital and everyone was all 'poor Jeff, poor Jeff,' and I started thinking, 'Well what about me? I'm the one's just had twins, I'm the one's going through this, he's a seven-week-old baby and doesn't know a thing about it' . . . I suppose, like a mother bonds with a baby? I never did with him . . . because of Jeff being unwell, I sort of detached, and ploughed my emotions into Mike." Case 4959: "Simon was just so much easier to get, you know, used to, 'cos he didn't have so many problems. Simon came out of special care a long time before John." Illness was not systematically related to the direction of favoritism; some mothers were more negative and other mothers were less negative toward the child who had been ill.

The mother holds folk beliefs about twins (e.g., that one twin in a pair must be dominant, or one must be feminine and one masculine) and treats the twins consistently with her beliefs. Case 3462: "Alan will go and play rugby, and watch rugby, but Jimmy'd rather make cakes . . . Jimmy likes being pampered and the cuddles, but Alan's like 'Get off me!' He's a man's man. He's always had to speak for Jimmy." Case 6300: "Susan can be very sweet . . . she loves babies . . . she can be insecure . . . she flutters and dances around . . . there's not much between her ears . . . she's exceptionally vain, more so than Ann. Ann loves any game involving a ball, very sporty, climbs trees, very much a tomboy. One is a serious tomboy and one's a serious girlie girl. Even when they were babies I always dressed one in blue stuff and one in pink stuff." Case 3803: "Amy being more the tomboy, she's the one that'll get dirty, so it's sort of like Sally with the pretty, pretty little things, Amy with the boy things. Sally is the caring one, the shyest of the two, Amy has to be dominant for them both." Case 10735: "I think twins' personalities have to balance each other out, you know, they sort of have to come to some sort of arrangement

between them . . . my younger is more willing to back down and fit in, and my older likes to be in charge.”

The mother has identified one twin as being like herself and feels more strongly about that twin (either positively or negatively). Case 10735: “Cari’s more confident but it’s more of a front with Gill, which is what I was like . . . Gill’s a sweetie, a little madam, she’s very much like me, she’s quite the little bossyboots, like me . . . she’s chatty, like me . . . Gill’s so much like I was, because I had a very troubled childhood I wanna make sure she gets enough emotional support, I feel she needs more than Cari . . . Gill is a bit more brighter than Cari, Cari’s not dim or anything, but Gill’s more, well, like me, she’s like, amazing.” Case 3462: “Jimmy’s got a bad sense of humor, like me, he’s erm very much a Mummy’s boy, it’s nice, very nice.” Case 13569: “The problem with Mike is I think he’s a bit like me, he’s very, very strong-headed . . . yeah, I think he’s always been like me, more sort of abrupt [laughs], I’ll sort of say what I think and then think about the consequences after . . . he’s got to that stage where he just doesn’t really care who he sort of hurts and he doesn’t think about the consequences after, that’s it.” Case 3803: “Sally’s more like me, she thinks about things, they’re both me but she’s, I mean, me.”

The mother, whose relationship with the twins’ father has ended acrimoniously, identifies one twin as representing her ex-partner and directs negative feelings toward that twin. Case 13569: “Jeff and his dad really relate to each other. We all knew Don [her husband] had a connection with Jeff and I had a connection with Mike . . . Jeff would do everything for Don but he wouldn’t for me, and no matter what I did for either of them it wouldn’t be right.” Case 3462: “Oh we’ve had difficulty all the way through, yeah, because when I first woke up he had an affair . . . and then when he went off, the twins were 18 months . . . he took me to court and he’s got my kids at Christmas now . . . he keeps phoning the house and er, I tell him not to and he screams he can phone whoever he wants to phone, and er Jimmy don’t want to go over there, but Alan’s got interests with his dad, Alan’s that close to him.” Case 12623: “I think Jerry is more like me, laid back, and David’s more like his father, more, erm, competitive, shall we say, yeah, he would lash out, that’s how their dad was, and David takes after his dad, he’d be bullying and pushing in.”

Discussion

This study showed that mothers’ emotional attitudes toward their children are associated with children’s antisocial behavior problems. To our knowledge, this study is the first to report three innovative design features that, in combination, support the conclusion that maternal expressed emotion is an environmentally mediated risk factor for—and possibly an environmental cause of—children’s early-emerging antisocial behavior problems.

First, we ruled out the possibility that the empirical association between maternal expressed emotion and children’s behavior problems reflects purely mothers’ bias in talking about and describing their children. This is because the results documented that maternal expressed emotion was associated not only with mothers’ ratings of their children’s behavior problems but also with teachers’ ratings, obtained independently from two different teachers, when each child was 5 years old and 7 years old.

Second, we ruled out the possibility that the association between maternal expressed emotion and children’s antisocial behavior problems reflects purely a child effect, that is, an effect of children’s behavior on parental treatment. This is because longitudinal analyses documented that even after children’s antisocial behavior problems at age 5 were controlled, maternal expressed emotion predicted increases in children’s antisocial behavior problems at age 7.

Third, we ruled out the possibility that the association between maternal expressed emotion and children’s antisocial behavior problems is genetically mediated. This is because the results documented that differences in maternal expressed emotion predicted differences between genetically identical MZ twins. Given that differences in maternal expressed emotion reliably predict differences between the behavior of genetically identical children, it is highly unlikely that the association between maternal treatment and children’s antisocial behavior problems is a function of genetic differences between children. This within-family comparison also ruled out the possibility that the association between maternal expressed emotion and children’s behavior problems reflects unmeasured (genetic or environmental) differences between mothers or between families. This is because the results documented that differences in a mother’s expressed emotion toward her children within the same family predicted behavioral differences between the children.

Against this background, several limitations should be noted. First, it is possible that some other nonshared environmental factor that is correlated with mothers’ child-specific expressed emotion may be accounting for the associations we observed. Such a third variable would have to be a nongenetic factor that causes both (a) mothers to treat their children differently and (b) MZ twins to behave differently. We ruled out the possibility that differences in neurological status (as indexed by birth weight differences) produced the observed association between maternal expressed emotion and children’s antisocial behavior problems, but there may be other, unmeasured factors. If such a factor can be identified, it would raise the possibility that maternal expressed emotion is not a unique cause of children’s behavior problems, but it would not vitiate the fact that maternal expressed emotion is an environmentally mediated risk factor. Passive correlational designs—even longitudinal and genetically sensitive ones—cannot establish causality with certainty. As such, genetically informative intervention studies that seek to change maternal expressed emotion can be used, in future research, to more fully shed light on the causal status of maternal expressed emotion in relation to children’s antisocial behavior problems (Howe, Reiss, & Yuh, 2002).

Second, we did not collect maternal expressed emotion data at the age 7 assessment, which could have been used to strengthen causal analyses. Moreover, such data would have allowed us to test whether initial differences between the twins’ behavior could predict changes in the mother’s expressed emotion over time. Given the utility of our new expressed emotion methodology as applied to this age group of children, future sibling studies may wish to incorporate such measures of maternal emotional attitudes in order to explore this question more fully.

Third, we assume that findings can be generalized from MZ twins to the population of singletons. This assumption is probably defensible because twin-singleton comparisons have found no notable differences in behavior problems or personality (Gjone &

Novik, 1995; Johnson, Krueger, Bouchard, & McGue, 2002; Kendler, Martin, Heath, & Eaves, 1995; Levy, Hay, McLaughlin, Wood, & Waldman, 1996; Moilanen et al., 1999; van den Oord, Koot, Boomsma, Verhulst, & Orleveke, 1995). Moreover, the correlations between maternal emotional attitudes and children's antisocial behavior problems in our twin sample are similar to those reported in the studies of singletons reviewed in the introduction.

Fourth, our data were collected in England and Wales, and more research is necessary to determine whether our findings will be replicated in other populations. However, research with singletons (reviewed in the introduction) suggests that the association between maternal expressed emotion and children's behavior problems is similar in North America and Europe.

Fifth, we have followed the twins in our study only to age 7, and we do not know whether maternal expressed emotion will exert longer term influences on children's development.

A sixth limitation concerns effect sizes, which ranged from large ($r = .5$) to small ($r = .1$) depending on the stringency of the method used. The true effect probably lies somewhere in between. What is remarkable, empirically, about the obtained results is that even if the "true" effect sizes tend toward the small, these effect sizes reflect true environmental associations purged of two factors that have inflated effects in many prior studies: single-source reporting bias and confounding genetic influence. In addition, it must be remembered that the findings are based on limited information about differential parenting (a 5-min speech sample). Aggregated measurements may yield larger effect sizes.

Finally, our measurement of differential expressed emotion was limited to mothers, and the measurement of fathers' expressed emotion may help to account for additional variation in children's differential outcomes. (The E-Risk Study has reported other effects of fathers on children; see Jaffee, Moffitt, Caspi, & Taylor, 2003.)

With these limitations in mind, the results of the present study have implications for socialization theory, in general, and for etiological research about children's early-emerging antisocial problems, more specifically.

Implications for Socialization Theory

In 1987, Plomin and Daniels revolutionized research on child development by asking "Why are children in the same family so different?" In the ensuing 15 years, over 40 studies have tackled this question, but reviewers have concluded that the yield from this research has been disappointing (Turkheimer & Waldron, 2000) for at least two reasons. One conclusion has been that the most important nonshared experiences are outside the family. This conclusion was championed by Harris (1998), who argued that "parents matter a lot less than you think" whereas peer experiences outside the family matter a lot more. According to Harris (1998), psychosocial researchers may need to invest less energy studying nonshared family experiences and more energy documenting how nonshared peer experiences create differences between children growing up in the same family. The present study suggests that such a shift in research priorities may be premature, as the results revealed that maternal expressed emotion is a consequential nonshared environmental experience that accounts for behavioral differences between children.

A second conclusion has been that nonshared experiences are too idiosyncratic and too serendipitous to study systematically. This conclusion was championed by Turkheimer (2000), who offered the "gloomy prospect" that psychosocial researchers may never identify the systematic sources of differences between children growing up in the same family because these differences are most likely created by random developmental processes. The present study suggests a less gloomy prospect because the results revealed that maternal expressed emotion is systematically related to children's antisocial behavior problems.

Implications for Research Into Children's Behavior Problems

Early-onset antisocial behavior problems threaten children's optimal development and have long-term negative consequences for the well-being of the individual child and the community (Potter & Mercy, 1997). Twin studies, including the present one, have shown that genetic factors exert a strong influence on antisocial behavior problems that emerge in early to middle childhood (Arseneault et al., 2003; Taylor, Iacono, & McGue, 2000; van den Oord, Verhulst, & Boomsma, 1996; van der Valk, Verhulst, Stroet, & Boomsma, 1998). But genetic factors cannot be the whole etiological story. This is most clearly evident when studying genetically identical MZ twins. The fact that pairs of MZ twins are discordant for early-onset antisocial behavior problems suggests that each child's unique environmental experiences may play a causal role in the development of these problems. This fact provides a window of opportunity for determining what these unique, nonshared environmental experiences might be.

It has become fashionable, in some circles, to suggest that maternal attitudes and behaviors are little more than genetic epiphenomena. Yet the present study suggests that maternal expressed emotion may play a causal role in the development of antisocial behavior. If this finding withstands the rigors of replication, it should invigorate both basic and applied research into expressed emotion. We suggest three directions for replications and extensions.

First, we encourage researchers to consider adopting and elaborating the expressed emotion methodology as a way to get a handle on differential parenting. Family researchers often note (off the record) that it is difficult to get parents to reveal through direct questioning that they treat their young children differently. Social desirability influences parents to report "fair treatment," perhaps particularly when the children are twins. The expressed emotion methodology, as adapted here for use with families of young children, may offer a suitable, unobtrusive technique for identifying meaningful patterns of differential parenting both between and within families.

Second, more research is needed if we are to understand the cognitive, affective, and possibly physiological mechanisms by which children are influenced by their mothers' expressed emotion toward them. Randomized clinical trials of parenting interventions that focus on enhancing mothers' levels of warmth, positive interaction, and responsiveness toward their children (e.g., Olds et al., 2002; Sanders, Markie-Dadds, Tully, & Bor, 2000; Webster-Stratton, 1998) offer a powerful design for uncovering the mechanisms by which maternal behavior causes antisocial behavior problems.

Third, more research is needed on expressed emotion as an outcome variable. Our quantitative findings naturally prompted a question: Why do many mothers feel differently toward their twin children despite the fact that the children are genetically identical? We conducted a modest qualitative study to address this puzzle, aiming to generate hypotheses for future research into the causes of differential parental treatment of siblings. Four hypotheses suggested themselves. First, illness in one child may require differential parenting and disrupt the parent-child bond. Children's health may influence maternal emotional attitudes and thus represent a source of differential treatment of siblings (e.g., McHale & Pawletok, 1992). It may be that it is not the fact of the illness itself, but the meaning of the child's illness, that is most relevant to mothers. Second, the mother may hold folk beliefs about differences between identical twins and may treat the twins consistently with these beliefs. E-Risk Study mothers reported ample instances of such beliefs, for example, that one twin in a pair must be dominant or that one twin must be feminine and the other masculine. Presumably, these reasons for differential treatment are limited to the special case of twins and would not promote differential treatment of ordinary siblings, although there may be folk beliefs about birth order that affect singletons. Third, the mother may identify one child as being like herself and as a consequence may feel more strongly about that child (either positively or negatively). Fourth, the mother whose relationship with the twins' father is acrimonious may identify one child as representing her ex-partner and then redirect her negative feelings toward that child. More research is needed to uncover reasons why siblings are differentially treated by parents (Asbury, Dunn, Pike, & Plomin, 2003; Jenkins, Rasbash, & O'Connor, 2003). Future quantitative research can be complemented by more detailed qualitative analyses that explore attributional processes and meaning making by mothers in greater depth.

In sum, the present study documents that maternal expressed emotion is a child-specific environmental experience that systematically influences young children's behavioral development. More generally, the study illustrates that genetically sensitive designs can yield valuable evidence about how environmental factors shape development. Many socialization researchers are concerned that the great enthusiasm for genetic research will overshadow the importance of environmental research, both in terms of policy initiatives and in terms of scientific priorities. But this concern is misdirected, because genetically informative research can provide leverage in identifying whether specific environmental risks represent environmental causation via "nurture" (Rutter, 2000).

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