Behavioral Inhibition as a Function of Relationship in Preschool Twins and Siblings

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Monozygotic (MZ) twins spend more time with each other and are more genetically alike than are dizygotic (DZ) twins or nontwin siblings and therefore probably experience less diversity in their playmates than DZ twins, who in turn may experience less diversity than other-age siblings. Thus MZ twins may be more inhibited than DZ twins, who may in turn be more inhibited than nontwin siblings. To test this, 205 children (42 MZ twins, 94 DZ twins, and 69 nontwin siblings) were assessed in a playroom laboratory during free play with an unfamiliar peer. Children's inhibition was rated based on latency to touch a toy for the first time and amount of time spent interacting with the other child. Additionally, the Child Behavior Checklist (CBCL) withdrawn scale was used to assess inhibition according to parent report. Behavioral ratings showed that MZ and DZ twins did not significantly differ on the inhibition or withdrawn ratings. DZ twins were significantly more inhibited than were nontwin siblings, according to laboratory ratings. Greater inhibition of twins during the free peer play situation can be explained by their relative lack of experience in playing with children who are less genetically and phenotypically like themselves. Parental ratings showed exactly the opposite pattern, suggesting a rater bias effect.

Monozygotic (MZ) twins, who spend a lot of time with each other and are very much alike, may spend more time playing with each other than with other friends, and they may do this to a greater extent than do dizygotic (DZ) co-twins because MZ twins are more similar to each other genetically and therefore may have more similar interests and play behaviors. In one study of preteen twins, MZ twins reported each other as being one of their best friends more often than did DZ twins (Rose, 2002), suggesting that they play together more often than do DZ twins. Therefore, MZ twins probably experience less diversity in their playmates than do DZ twins. This lack of diverse experiences with other children may negatively impact MZ twins' behaviors with other children, leading them to be more inhibited than DZ twins or nontwins. Similarly, DZ twins, being the same age as each other, are likely to play together more often than do nontwin siblings, and therefore they may experience less diversity in their friendships than do nontwin siblings. Thus, in line with developmental social genetics theory (Scott, 1977), we would predict that MZ twins will be more socially withdrawn than DZ twins, who will be more withdrawn than nontwin siblings.

This idea, based on the developmental social genetics theory that children's social interactions rely in part on the genotypes of each of the children (Segal, 1997), suggests that the degree to which two children share genotypes will influence the way in which they play together. Studies on cooperation among twin children have found that MZ twins are more cooperative with each other than are DZ twins (Segal, 1988; Segal & Hershberger, 1999). It may be the case that children who spend most of their play time with another child who is genetically very similar to them may have a more difficult time when they are in a situation where they must interact with a child who is genetically different from them. Thus, children with the least experience playing with genetically diverse playmates may show higher levels of behavioral inhibition when they are in peer play situations with unfamiliar peers. If this is so, then MZ children should be more inhibited than DZ children, who should be more inhibited than nontwin children.

An inhibited child, when encountering unfamiliar people or situations, consistently displays behaviors that include becoming quiet, ceasing activity, and withdrawal or retreat (Kagan et al., 1989). DiLalla et al. (1994) found that 2-year-old MZ twins during a peer play situation with another set of 2-year-old twins

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were more often rated as extremely inhibited than were DZ twins. Further analysis of the data showed that on a continuous measure of inhibition (rather than examining extreme scores), MZ twins were significantly more inhibited than were DZ twins. Earlier research has yielded similar findings. For instance, Koch (1966) noted that 5- to 6-year-old MZ male twins were more passive than were DZ twins. Young MZ twins have also been rated as less behaviorally deviant (Stevenson & Fielding, 1985) and less aggressive (Ghodsian-Carpey & Baker, 1987). DiLalla et al. (1994) suggested that if one DZ twin is shy, it is less likely that the other DZ twin will also be shy than it is for MZ twins, given that the trait is heritable. Therefore, shy DZ twins are more likely to have experiences with a less-shy twin than are MZ twins. These experiences should lead DZ twins to be better able to interact with unfamiliar children, whereas MZ twins' inhibition may be reinforced by their co-twins and thus may become an even stronger behavior.

Comparisons of twins and nontwins have yielded some differences as well. For instance, several studies have documented increased externalizing behaviors among twins as compared to singletons (Gau et al., 1992; Levy et al., 1996; Simonoff, 1992). The children in these studies have ranged from 5 to 16 years. However, there are fewer studies on inhibited behaviors. Gjone and Novik (1995) found that twins aged 12–13 years showed slightly lower levels of internalizing behavior problems than did nontwins, although this did not hold for younger twins. Also, Pulkkinen et al. (2003) found an increase in depressive symptoms among 12-year-old male singletons as compared to male twins, but there was no difference for the females. Interestingly, they also found that twins received higher scores on adaptive behaviors, especially socially active behaviors, than did nontwins, suggesting in fact that twins might be more socially competent than singletons. It may be that by the age of 12, twins have been able to use their own experiences of having a same-age sibling to augment their experiences outside of the home, thus increasing their social competence.

Studies of behaviors such as inhibition and aggression in twins may help us to understand children's social development (Segal et al., 1996). Greater social closeness and cooperation was found between MZ twins for 11- to 83-year-old twins than DZ twins (Segal & Hershberger, 1999), perhaps as a function of their increased interactions with similar peers (their co-twins). However, 8- to 12-year-old MZ twins were not more cooperative than DZ twins when paired with an unfamiliar twin rather than with their co-twin (Segal et al., 1996). The greater level of cooperation shown by MZ twins with their co-twins is probably specific to the intratwin interaction rather than a behavior that is expressed when the twins are paired with unfamiliar people. Thus, more genetically similar individuals are more cooperative among themselves, but not necessarily when they are paired with others with whom they do not share genotype. Following from developmental social genetics theory (Segal, 1977), it can be inferred that children who spend more time with genetically similar children will be less prepared to interact with children who are different from them. Therefore, we might expect that MZ twins will be more inhibited when interacting with children other than their co-twin.

Specifically, we expected that 5-year-old MZ twins would be more socially withdrawn than DZ twins, who would be more withdrawn than nontwin siblings. We also explored whether this effect differed depending on whether inhibition was measured by parent ratings or by behavioral observations of the children during an unfamiliar peer play situation. We expected that the behavioral observations would provide the strongest support for our hypothesis because the unfamiliarity of the situation would serve to enhance inhibition in the children. We also expected parent ratings to be less indicative of inhibited behavior in twins because parents of twins see their children play together frequently, more so than do parents of nontwin siblings, and therefore parents of twins might focus more on the positive interaction behaviors of their children and less on inhibited behaviors shown when their children are in less familiar situations.

Methods

Participants

Children in this study were part of a larger project, the Southern Illinois Twins and Siblings Study (SITSS; DiLalla, 2002). For the present project, twin and sibling pairs who had been tested thus far at the age of 5 years were included. All children were tested within two months of their fifth birthday. Siblings were recruited by contacting siblings of children who had already been tested in the Play Lab and inviting them to participate. Included in the present sample were 207 children: 44 MZ twins (24 girls, 20 boys), 94 DZ twins (36 girls, 58 boys; 66 same-sex, 28 opposite-sex), and 69 nontwin siblings (40 girls, 29 boys; 39 same-sex, 30 opposite-sex). Five children were missing parent questionnaires, so parent variable analyses were based on 202 children.

Procedure

Prior to coming to the laboratory, parents completed a series of questionnaires about their children, including a zygosity rating, family demographics, and questionnaires about child behaviors. At the time of testing, children were brought to a laboratory playroom and were given approximately 5–10 minutes to become comfortable with the general setting. Then one child from a twin pair was paired with a same-age, same-sex, unfamiliar singleton child. One twin and one singleton were allowed to enter the playroom and play freely by themselves for 20 minutes. The room was equipped with puppets, a toy tool set,

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Table 1

Descriptive Statistics by Degree of Relationship

	MZ twins		DZ twins		Nontwin siblings	
	Mean (*SD*)	Range	Mean (*SD*)	Range	Mean (*SD*)	Range
Latency to touch toy (sec)	127.95 (351.69)	1.07–1200	101.94 (304.92)	0.54–1200	17.15 (61.75)	1–513.83
Peer play interaction score	2.79 (1.27)	1.05–5	2.73 (1.41)	1–5	2.42 (1.12)	1–5
CBCL Withdrawn raw score	1.10 (1.27)	0–5	1.36 (1.54)	0–7	2.06 (2.17)	0–9
CBCL Withdrawn *T* score	51.79 (3.47)	50–64	52.58 (4.39)	50–70	54.47 (6.31)	50–75

kitchen toys, checkers, and posters. There were 2 one-way mirrors: one through which to videotape and the other for parents to watch through if they chose. Children's play was videotaped for later behavioral coding. When the 20 minutes passed, the two children left the playroom and the other twin and another matched singleton entered the playroom and were allowed to play freely for 20 minutes. Again, play was videotaped for later behavioral coding. Siblings were tested when each was 5 years old, so only one child (sibling) and a matched unfamiliar peer came to the laboratory. The other sibling was tested later when he or she was 5 years old.

Measures

Zygosity was assessed by having parents rate the twin similarity of eight physical attributes taken from the Nichols & Bilbro (1966) zygosity questionnaire (reported accuracy 95%). The research assistant who spent the most time with the twins also completed this questionnaire. Parent and tester ratings were averaged to assess zygosity (as done in the Twin Infant Project [TIP], DiLalla et al., 1990, and the MacArthur Longitudinal Twin Study [MLTS], Emde, et al., 1992).

The Child Behavior Checklist (CBCL; Achenbach, 1991) was used to assess parental ratings of child inhibition. This measure was completed by the parents directly prior to coming to the laboratory for the peer play testing. Scores for the Withdrawn Behaviors subscale were used to assess parent-rated inhibition of the children. Raw scores were used rather than *T* scores due to the nonclinical nature of the sample, as suggested by Achenbach & Rescorla (2001).[1]

Laboratory ratings of inhibition were obtained from behavioral ratings of the children during the 20 minutes of peer play interaction. Although raters knew whether they were coding a twin or a nontwin, they did not know the zygosity status of the children they coded. Additionally, raters only coded one member of a sibling or twin pair. Raters were 'blind' to the hypotheses for this project.

For inhibition, three behaviors were initially coded. The first 2 were chosen because they were two of the measures used successfully by DiLalla et al. (1994) to assess inhibition in 2-year-old twins, and are standard inhibition peer play measures used by Reznick et al. (1986). These were 'latency to vocalize' (how many seconds it took a child to say something out loud for the first time) and 'latency to touch toy' (how many seconds it took a child to touch a toy for the first time). However, because of tape quality on a number of the videotapes, verbalizations were difficult to rate, and therefore the latency to vocalize was not used for this study. Interrater reliability for latency to touch toy was assessed using Cohen's Kappa and was very high, alpha = .99. The final measure was based on the amount of time a child spent interacting with the other child. This was measured by rating each child at the end of every minute on a 5-point, Likert-type scale assessing amount of time spent interacting with the other child. The 20 scores that were obtained (1 per minute for 20 minutes) were then averaged to obtain a general rating of 'amount of interaction'. Interrater reliability for this measure was assessed using weighted Kappa (Fleiss et al., 1969) and was acceptable, Kappa = .79.

Results

Sex differences were assessed for each of the inhibition variables to determine whether boys and girls differed. A multivariate analysis of variance (MANOVA) showed that there were no significant sex differences on the behavioral measures of inhibition during the peer play, $F(2, 199) = 2.85$, p = n.s. Same-sex and opposite-sex DZ twin pairs then were compared, and again there were no significant differences between the groups on inhibition, $F(2, 86) = 0.03$, p = n.s. Finally, same-sex and opposite-sex sibling pairs were compared, and no significant differences were found between these two groups on behavioral inhibition, $F(2, 66) = 0.75$, p = n.s. Therefore, boys and girls were combined for the following analyses.

Twins Versus Siblings

First, all twins were combined into a single group, and twins were compared to singletons to determine whether twins were more inhibited than singletons. A MANOVA showed a significant group effect overall, $F(3, 193) = 5.86$, $p < .001$. Univariate tests showed that the significant group differences were for latency to touch toy, $F(1, 197) = 6.13$, $p < .05$, and CBCL Withdrawn, $F(1, 197) = 8.06$, $p < .01$. Twins took significantly longer than singletons to touch a toy upon

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entering the playroom. However, contrary to initial hypotheses, parents of twins rated their children as less withdrawn than did parents of singletons.

These analyses included all twins and siblings in the study. Therefore, the assumption of independence of sample is violated. Because of the size of this sample, splitting the sample and rerunning the analyses using only one child from each twin or sibling set results in low power to detect meaningful differences. Nonetheless, this was done in order to determine whether the differences noted with the full sample were also found with a purer sample of only one child from each family.

A MANOVA comparing twins to singletons on the peer play inhibition measures and CBCL Withdrawn showed, as with the full sample, that there was a significant group difference, $F(3, 95) = 3.86$, $p < .05$. Univariate tests showed that there was a significant group difference for latency to touch a toy, $F(1, 99) = 4.53$, $p < .05$ and CBCL withdrawn, $F(1, 99) = 4.43$, $p < .05$. Twins had a significantly higher latency time, and parents of singletons rated their children as more withdrawn than did parents of twins. Thus, the subsample results paralleled those of the full sample.

MZ Twins Versus DZ Twins

Analyses were repeated, comparing MZ twins to DZ twins, with the expectation that MZ twins would be more behaviorally inhibited than DZ twins. MANOVA analysis showed that there was no significant group difference, $F(3, 125) = 0.20$, p = n.s., on the inhibition variables as measured in the playroom or the CBCL Withdrawn measure.

These analyses were repeated using the subsample consisting of only one child from each twin pair. Again, there was no significant group difference, $F(3, 61) = 0.55$, p = n.s., on the playroom inhibition measures or parent ratings of Withdrawn behavior.

MZ Versus DZ Versus Sibling Comparisons

To test our hypothesis regarding behavior differences between MZ twins, DZ twins, and nontwin siblings simultaneously during the peer play situation, MANOVA was used on the entire sample to determine whether there were group differences (MZ vs. DZ vs. nontwin siblings) on the behavioral measures of inhibition rated from the peer play behaviors and the withdrawn score from the CBCL (see Table 2). The group difference overall was significant, $F(6, 386) = 3.16$, $p < .01$. The univariate tests showed that there was a significant difference for latency to toy touch, $F(2, 197) = 3.18$, $p < .05$, and for CBCL withdrawn, $F(2, 197) = 4.82$, $p < .01$. As expected, on the behavioral measures, MZ twins were rated as the shyest group, DZ twins were intermediate, and nontwin siblings were rated as least shy. Levene's test of variance homogeneity was significant for all measures ($p < .01$). Duncan C post-hoc tests showed that there was a significant difference between DZ twins and nontwin siblings on latency to touch toy ($p < .05$). For CBCL withdrawn, the significant difference occurred between MZ twins and nontwin siblings ($p < .05$). Again, contrary to initial hypotheses, on the CBCL withdrawn measure, MZ twins were rated as the least withdrawn group, DZ twins were rated as more withdrawn, and nontwin siblings were rated as the most withdrawn.

These analyses were repeated using only the subsample consisting of a single member from each sibling pair. Results were in the same direction as with the full sample, but analyses were not all significant, possibly as a result of the smaller sample size. The overall MANOVA was significant, $F(6, 190) = 2.35$, $p < .05$. Univariate analyses showed a marginally significant result for CBCL Withdrawn scores, $F(2, 99) = 2.87$, $p < .06$, but not for the behavioral inhibition measures (see Table 2).

Finally, because of the concern that twins might be different from nontwins as a function of birth complications typical of twins, such as low birthweight and early birth, these two variables were assessed in a subgroup of the total sample. These data were available for 114 children (57 twin pairs). The number of weeks early that the twins were born ranged from 0 to 9, with a mean of 3.1. The birthweight of the twins ranged from 45 to 128 ounces, with a mean of 90.0 ounces. Infants are considered premature if they weigh less than 88 ounces at birth, and they are considered to be very low birthweight (VLB) if they weigh less than 52.95 ounces. In this sample of twins, there were 6 VLB children, 44 premature children, and 64 normal birthweight children. Thus, this sample is primarily a normal sample. Correlation analysis was run to determine whether there was a relation between the birth variables (birthweight and early birth) and the three inhibition variables. No correlations were significant either for the total sample or for the subsample comprised of a single child from each twin pair.

Discussion

We had hypothesized that monozygotic twins would be more inhibited than dizygotic twins, who in turn would be more inhibited than nontwin siblings. Because MZ twins are more genetically and phenotypically similar to each other than DZ twins or nontwin siblings, they may spend more of their time together and therefore be exposed to fewer differences in playmates than are DZ twins or nontwin siblings. This has been supported in research by Rose (2002), showing that MZ twins report their co-twin as their best friend more often than do DZ twins. Similarly, DZ twins, being the same age as each other and genetically similar, were assumed to spend more time with each other during their preschool years and were expected to have less experience with other children. Therefore, MZ twins might generally be more inhibited around others who are different from them than are DZ twins

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Table 2

MANOVA Results for Inhibition and Withdrawn Scores Across Groups

	F	MZ–DZ	MZ-siblings	DZ-siblings	Levene's test
Full sample					
Latency to touch toy	$F(2, 197) = 3.18$, $p < .05$	*ns*	*ns*	$p < .05$	$p < .01$
Peer play interaction	$F(2, 197) = 1.41$, $p =$ ns	*ns*	*ns*	*ns*	$p < .01$
CBCL withdrawn	$F(2, 197) = 4.82$, $p < .01$	*ns*	$p < .05$	*ns*	$p < .01$
Subsample with one child from each sibling pair					
Latency to touch toy	$F(2, 99) = 2.24$, $p =$ ns	*ns*	*ns*	*ns*	$p < .01$
Peer play interaction	$F(2, 99) = 0.58$, $p =$ ns	*ns*	*ns*	*ns*	*ns*
CBCL withdrawn	$F(2, 99) = 2.87$, $p < .06$	*ns*	$p < .06$	*ns*	*ns*

Note: *ns* = not significant

or nontwins, and DZ twins might be more inhibited than nontwin singletons. This was partially supported in this study using the behavioral measures assessed during a peer play situation in the laboratory. DZ twins were significantly slower than nontwin singletons to touch a toy, a measure of inhibition, upon entering a strange playroom. MZ twins had the longest latency to first touch a toy after entering the strange playroom, although this was not significantly different from DZ twins and nontwins.

We initially hypothesized that parent ratings would reflect similar behaviors although not as strongly, but parent ratings showed exactly the opposite effect. Parents of MZ twins rated their children as less withdrawn or inhibited than did parents of nontwin siblings, and DZ twins were rated midway between the two. Although this runs counter to our initial hypothesis, it can in fact be explained quite logically. It is likely that mothers of MZ twins rated them as less withdrawn or shy because they see them interacting with each other so frequently that this biased their judgments of shyness. They might think of their twins as very outgoing and social because they play so well together. Alternatively, mothers of nontwin siblings do not watch them play together as much and therefore do not see them playing at home as much, and their ratings appear to reflect that. This fits with concerns about maternal versus teacher ratings of children (Scourfield et al., 2004). Mother and teacher ratings typically have very low correlations, and this is probably a result of mothers rating child behaviors in the home and teachers rating behaviors in the classroom. Thus, if mothers are rating the home behaviors of their children, they should think of their MZ twins as the most social and least withdrawn, as they are so frequently playing together, and mothers of singletons should think of their children as relatively less social and more withdrawn, as they do not watch them play with other children as often.

The laboratory results support the developmental social genetics theory (Segal, 1997) that experience with dissimilar peers may be important for reducing withdrawn behaviors. MZ twins' behaviors of greater inhibition during the free peer play situation can be explained by their relative lack of experience in playing with children who are less genetically and phenotypically like themselves. However, parent ratings provide a different picture, suggesting that twins are less withdrawn than are singletons. This is similar to results reported by Pulkkinen et al. (2003), who found that 12-year-old twins were more socially adaptable than nontwins, although they found no differences in levels of social anxiety. It may be the case that in a stressful situation such as the peer play paradigm, young children's behaviors are more reflective of inhibition than ratings made by parents or peers on their behaviors in more normative settings.

One strength of this study was the inclusion of nontwin siblings who were tested at the same ages (5 years old), although they were tested in different years. By ensuring that all children were tested at the same age, any differences in behavior that may have been a function of development were eliminated. This can be a concern with studies that examine siblings within a family as the children are often assessed at the same point in time even though they are different ages. Another strength of this study is the use of both parent and trained rater reports, which allowed exploration of whether there is a difference between the two on ratings of inhibition. Results were different for the different raters, suggesting the need for further exploration into exactly what is measured in the laboratory and by parents.

Although MZ and DZ scores were in the expected directions on the behavioral inhibition measures, they were not significantly different from each other. MZ twins were more behaviorally inhibited during the peer play situation than were DZ twins, but the significant difference was between DZ twins and nontwin siblings. Koeppen-Schomerus et al. (2003) similarly found significant twin–nontwin differences for an overall measure of behavior problems in 2-year-olds and significant DZ-nontwin differences in 3-year-olds, although they also found MZ–DZ differences. Based on parent ratings, they found that nontwin siblings scored lowest on a measure of behavioral problems and DZ twins scored the highest.

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However, they do not state whether the behavior problems are primarily internalizing or externalizing, and therefore it is difficult to align their results with the current study's findings.

Inclusion of nontwin siblings in this study not only allowed the comparison of twins with other-age siblings in order to test the proposed developmental social genetic theory, but it also provided an opportunity to determine whether twins are different from nontwins for the purpose of generalizing results. Without information about nontwins, we cannot know if data gleaned from twin studies is useful for the more general population (Eaves et al., 1989). This study suggests that 5-year-old twins may indeed be more inhibited than nontwins in strange situations, but perhaps not in more typical situations, such as those in which parents typically observe them. Behavioral observations of 2-year-old twins (DiLalla et al., 1994) similarly showed that MZ twins appeared to be extremely more inhibited than DZ twins in a strange playroom situation, but nontwin siblings were not included in that study for comparison. If it is true that something special about the early twin environment contributes to increased inhibition, then current estimates of the heritability of inhibition for the general population may need to be adjusted.

One limitation of this study was a failure to ask parents about the frequency with which their children play with other children. The current hypothesis states that MZ twins interact more with each other than with other friends, resulting in their increased inhibition around others who are not similar to themselves. It would have been valuable to have parents provide an estimate of the amount of time twins and siblings actually play together as opposed to with other children, to more directly assess this, although these reports would have to be carefully monitored to evaluate the likelihood of parental subjectivity bias.

Another limitation is the fact that twins were separated during the peer play testing, which was necessary for assessing their behaviors independently, but which may have put a strain on them if they were not used to being separated. If it was harder for MZ twins to be separated than for DZ twins, and harder for twins than for singleton (nontwin) children, then this might have increased the inhibition scores accordingly. Perhaps if the twins were not separated from each other, their peer play behaviors would have been less inhibited. There has been discussion (Segal & Russell, 1992) about separating twins when they begin school because it may provide them with a chance to become more independent, although there is a counterargument that it may be too stressful for twins to be separated. However, there is no conclusive evidence that one way is better than the other. It seems to depend largely on the twins' personality and other experiences. Thus, separating twins for the present project may have had an inhibiting effect for some of the twins, but not for all.

In sum, we have demonstrated that unbiased raters' scores of inhibited behaviors during free play with an unfamiliar child show that MZ and DZ twins are similar in the degree to which they show inhibited behaviors. This is important for the basic assumptions underlying twin research. Results also showed that DZ twins tend to be more inhibited than nontwin siblings. Parent ratings showed the opposite trend. Clearly, differences exist between parent ratings and trained observers' scores. Further work examining this difference is necessary to understand both environmental and genetic influences on inhibition in young children.

Endnote

1 Analyses were repeated using *T* scores in order to ascertain whether using normalized scores that were corrected for sex changed the results. This did not affect the outcome; exactly the same results were obtained.

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