

Interactive Links Between Theory of Mind, Peer Victimization, and Reactive and Proactive Aggression

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Abstract

This study investigated the relation between theory of mind and reactive and proactive aggression, respectively, as well as the moderating role of peer victimization in this context. The 574 participants were drawn from a longitudinal study of twins. Theory of mind was assessed before school entry, when participants were 5 years old. Reactive and proactive aggression as well as peer victimization were assessed a year later in kindergarten. Results from multilevel regression

analyses revealed that low theory of mind was related to a high level of reactive aggression, but only in children who experienced average to high levels of peer victimization. In contrast, a high theory of mind was related to a high level of proactive aggression. Again, this relation was especially pronounced in children who experienced high levels of peer victimization. These findings challenge the social skills deficit view of aggression and provide support for a multidimensional perspective of aggressive behavior.

Keywords

Theory of mind; Reactive and proactive aggression; Peer victimization

In the study of aggressive behavior a fundamental distinction is made between reactive aggression and proactive aggression, which refer to two different underlying functions of aggression (Day, Bream and Paul 1992; Dodge and Coie 1987; Schwartz et al. 1998). Reactive aggression is defined as a retaliatory response to a real or perceived threat or provocation. It is associated with the frustration theory of aggression (Berkowitz 1989) and is accompanied by an activation of the autonomous system (Hubbard et al. 2002). In contrast, proactive aggression is considered a non-provoked behavior that is motivated by the desire for personal gains or the domination of others (Vitaro and Brendgen 2005). As an organized and planned behavior, proactive aggression is related to the anticipation of a positive outcome of the aggressive behavior (Dodge et al. 1997). Although studies usually report a high correlation between reactive and proactive aggression (mean $r=0.68$; Card and Little 2006), factor analyses and meta-analyses provide clear evidence for the validity of the distinction between the two functions of aggression (Card and Little 2006; Crick and Dodge 1996; McAuliffe et al. 2007; Poulin and Boivin 2000; Vitaro et al. 1998). As will be discussed in more detail below, evidence also suggests that these two functions of aggressive behavior are differentially related to social cognitive skills, particularly with respect to the decoding of social stimuli (Crick and Dodge 1996; Dodge et al. 1997; Dodge and Coie 1987; Hubbard et al. 2001; Schippel et al. 2003). The present study examines a specific and as yet unstudied aspect of decoding-related social cognitive skills, namely theory of mind, in relation to proactive and reactive aggression.

The Role of Theory of Mind in Social Behavior

Theory of mind implies the capacity to attribute mental states to the self and to others in order to explain and predict behaviors (Astington 2001). Classical theory of mind measures indicate that, at the end of the preschool period, most children are able to attribute false beliefs to themselves and to others, and can distinguish between appearance and reality (Gopnik and Astington 1988; Wellman et al. 2001). This is possible because they can simultaneously take into account their own and others' mental representation, realizing that mental representations can vary within and between individuals, over time, or when new information is received. Theory of mind is thus considered a crucial element in the capacity to decode and understand social cues and hence in the development of adaptive social behavior (Astington 2001; Hughes and Leekam 2004). In line with this notion, individual differences in theory of mind among preschoolers have been found to predict individual

differences in social behavior at school entry. For instance, theory of mind skills in young children are positively associated with teacher ratings of social competence (Cassidy et al. 2003; Lalonde and Chandler 1995) and the coordination of story characters' actions and thoughts (Pelletier and Astington 2004).

Theory of mind skills — or rather a lack thereof — are also considered an important predictor of aggressive behavior (Crick and Dodge 1994; Harvey et al. 2001). In line with this notion, aggressive-defiant behavior has been negatively associated with theory of mind skills in preschoolers and kindergarten children (Capage and Watson 2001). However, in studies examining general conduct disorder symptoms, no relation with theory of mind was observed (Happé and Frith 1996; Sutton et al. 2000), and at least two studies found a positive association with bullying behavior in elementary school-aged children (Caravita et al. 2010; Sutton et al. 1999). The apparently mixed findings with respect to the relation between theory of mind and aggression may stem from the diversity of behavioral outcomes studied, ranging from aggressive-defiant behavior to conduct disorder and bullying. Notably, a closer inspection of these behaviors suggests that they may reflect different underlying functions. Specifically, whereas aggression-defiance incorporates behaviors that are rather reactive in nature, bullying is a purposeful attack aimed at humiliating others or to obtain desired objects from them. Conduct disorder, which includes symptoms such as physical fights, weapon use, cruelty to animals, and vandalism, covers both reactively and proactively aggressive behaviors. The relation between theory of mind skills and aggressive behavior may thus vary depending on the underlying function of the aggressive behavior.

Differential Links Between Socio-Cognitive Skills and Reactive and Proactive Aggression: Implications for a Potentially Differential Link with Theory of Mind

In line with the view of reactive aggression as an angry response to real or perceived provocation and of proactive aggression as a planned behavior driven by the anticipated rewards, several studies have shown significant differences in the underlying social cognitive processes of reactive and proactive aggression. Of particular importance to the present study is the finding that reactively aggressive children seem to focus more on the personal valence of the observable outcome of a social situation to understand what happened than on other persons' perspectives of the situation. Specifically, reactively aggressive children show a hostile attribution bias (i.e., a tendency to suspect hostile intentions in others) when an ambiguous situation leads to a negative outcome for themselves (Crick and Dodge 1996; Dodge and Coie 1987; Schwartz et al. 1998). It has been suggested that this hostile attribution bias may be attributable to a lack of theory of mind skills, particularly in young children (Katsurada and Sugawara 1998; Orobio de Castro et al. 2002; Runions and Keating 2007). Specifically, children who have difficulties taking into account another person's perspective may be prone to react aggressively during social interactions involving real or perceived provocations or threats, based solely on their own negative outcome of the situation instead of the other person's intention (Pettit et al. 1988). Thus, a lack of theory of mind skills, measured before school entry, could be positively related to the frequency of reactive aggressive behavior in the first year of school.

In contrast to reactive aggression, proactive aggression is positively associated with socio-cognitive skills like leadership and a sense of humor (Dodge and Coie 1987; Poulin and Boivin 2000). Moreover, proactive aggression is usually not associated with a hostile attribution bias in ambiguous situations with a negative outcome (Dodge et al. 1997; Schwartz et al. 1998). This suggests that proactively aggressive children can understand another person's possibly benign intentions during social interactions, even in situations that involve a negative outcome for themselves. Instead, proactively aggressive children have been found to select aggressive strategies in social situations because they anticipate that such behavior will lead to personal gains (Crick and Dodge 1996; Dodge et al. 1997). In contrast to their expected negative link with reactive aggression, theory of mind skills may thus be positively related to proactive aggression. Children with high theory of mind skills may deliberately choose aggressive behavior in some social situations because they expect it to be effective for achieving personal gains. Some, albeit indirect evidence in support of this notion comes from findings that theory of mind is positively related to bullying behavior (Caravita et al. 2010; Sutton et al. 1999) and to children's ability to lie in a consistent fashion (Talwar et al. 2007). To date, however, no study has directly examined the possibility of a differential relation of theory of mind with reactive and proactive aggression, respectively.

Peer Victimization Experiences as a Potential Moderator of the Link Between Theory of Mind and Reactive Versus Proactive Aggression

Not all children with low theory of mind may resort to the frequent use of reactive aggression. Indeed, evidence suggests that the relation between cognitive skills and social behavior may not be a linear one and is often moderated by social context (Crick and Dodge 1994; Dodge et al. 2003; Gibb and Coles 2005). Young children who have difficulties inferring another person's perspective may thus rely on their own perception of reality that is based on previous experiences to interpret the situation (Runions and Keating 2007). If these previous experiences are negative, the child may interpret the situation as threatening and react aggressively. In fact, the anterior social context of reactively aggressive children is often characterized by physical abuse and a coercive discipline style of the parents (Dodge et al. 1997; Vitaro and Brendgen 2005). Similarly, in their relations with peers, reactively aggressive children are often exposed to rejection and victimization (Lamarche et al. 2007; Poulin and Boivin 2000; Salmivalli and Nieminen 2002; Schwartz et al. 1998). These negative peer experiences are, in turn, related to a further increase in children's reactively aggressive behavior (Camodeca et al. 2002; Salmivalli and Helteenvuori 2007). Low theory of mind skills should thus be a risk factor of reactive aggression particularly in children who are exposed to negative experiences with the social environment, such as a negative treatment from parents or peers. Some evidence in support of this notion comes from studies showing that harsh treatment from parents interacts with theory of mind to predict regulatory behavior problems such as temper tantrums, hyperactivity and defiant behavior — behaviors that are closely related to reactive aggression (Vitaro et al. 2002; Waschbusch et al. 1998). Specifically, children with lower theory of mind skills and who experience harsh parenting are more susceptible to displaying regulatory problem behaviors than those with higher theory of mind skills (Hughes and Ensor 2006, 2007). It is unclear, however, whether a

similar moderating effect of harsh treatment by peers (i.e., peer victimization) can be found in the link between theory of mind and reactive aggression.

In addition, the question arises whether peer victimization experiences may also moderate the hypothesized positive link between theory of mind and proactive aggression. It has been suggested that peer victimization experiences may eventually push some children to become bullies themselves, i.e., to purposefully use aggressive behavior in order to dominate others (Pellegrini 1998). Empirical evidence so far has found no support for a direct link between peer victimization experiences and increased proactive aggression (Lamarche et al. 2007; Poulin and Boivin 2000; Salmivalli and Helteenvuori 2007; Schwartz et al. 1998). Nonetheless, it is possible that children with high theory of mind skills may be less prone to deliberately use aggressive behavior to dominate or humiliate others if they have experienced themselves the anguish such behavior can cause for the victim. In line with this notion, children's expectation that their aggression would cause pain and suffering in the victim was related to a decrease in the use of bullying behavior in early adolescent boys who were themselves victimized by their peers (Egan et al. 1998). It remains to be seen whether peer victimization moderates the putative positive link between theory of mind and proactive aggression in young children.

Gender Effects

In examining these issues, potential gender differences need to be considered. For example, although some studies found no gender differences in reactive or proactive aggression (Connor et al. 2003; Polman et al. 2007), others found higher rates of reactive and proactive aggression in boys than in girls (Baker et al. 2008; Little et al. 2003; Salmivalli and Helteenvuori 2007; Salmivalli and Nieminen 2002). Boys also are more often the targets of peer victimization (Rose and Rudolph 2006) and show a slight delay in the development of theory of mind skills compared to girls (Sabbagh et al. 2006). Apart from these main effects of gender, the previously cited literature provides only little indication that hypothesized associations between theory of mind, peer victimization, and reactive and proactive aggression should significantly differ for girls and boys. The sole exception might be the putative link between theory of mind and proactive aggression, which might be stronger for boys than for girls. This expectation was based on the fact that theory of mind was positively related to bullying behavior only in boys but not girls in one study (Caravita et al. 2010), although gender-specific correlations were not reported in another study (Sutton et al. 1999).

The Present Study

In summary, the first objective of the present study was to investigate the relation between theory of mind skills before school entry and reactive and proactive aggression in kindergarten. The principal expectation was that theory of mind would be differently related to the two functions of aggression. Specifically, theory of mind skills should be negatively related to reactive aggression but positively related to proactive aggression. Secondly, we aimed to examine the moderating role of peer victimization in the relation between theory of mind and the different functions of aggressive behaviors. We expected that theory of mind should be negatively related to reactive aggression especially in children who are frequently

victimized by their peers. In contrast, the putative positive link between theory of mind and proactive aggression was thought to be mitigated in highly victimized children. Finally, we expected that the association between theory of mind and proactive aggression might be stronger for boys than for girls. These hypotheses were examined while including a measure of language skills as a control variable in all analyses. The positive relation between language development and theory of mind is firmly established (Astington 2001; Milligan et al. 2007). It is thus essential to control for language to eliminate the possibility that the contribution of theory of mind to reactive or proactive aggression could be better explained by a child's language skills — or lack thereof. The overlap with the respective other type of aggression was also controlled in all analyses due to the relatively strong inter-correlation between reactive aggression and proactive aggression (Card and Little 2006).

The questions addressed in the present study were investigated using a convenience sample of twins. Twin samples have been used in previous research on the predictors of child adjustment even when genetic effects were not the focus of the research question (e.g., Arseneault et al. 2006). Importantly, empirical evidence suggests that twins' psychosocial development is comparable to that of children from single births (so-called singletons). Thus, compared to singletons, twins do not show more externalizing behavior problems (including aggression) than singletons (Laffey-Ardley and Thorpe 2006; Pulkkinen et al. 2003). Moreover, twins and singletons are comparable with respect to the quality of their peer relations such as the number of friends, friendship features, or the level of victimization by peers (Laffey-Ardley and Thorpe; Lamarche et al. 2007; Thorpe 2003). Twins also do not seem to differ from singletons in regard to theory of mind (Cassidy et al. 2005), but twins are known to show a 2 to 4 month delay in early language development compared to singletons (Dale et al. 1998; Thorpe 2003). Specific comparisons of identical (monozygotic) and nonidentical (dizygotic) twins suggest no zygosity differences in regard to socio-cognitive and language development, aggressive behavior and children's peer relationships (Lemelin et al. 2007; Lamarche et al. 2007; Thorpe 2003). However, there is some evidence that mixed-gender siblings slightly outperform same-gender siblings in regard to language and cognitive development (Cassidy et al. 2005; Dale et al. 1998; Pulkkinen et al. 2003).

The twins were assessed when they were 5 years of age (before school entry), and again when they were 6 years of age (kindergarten). This developmental period was selected because individual differences in theory of mind in preschool children have been found to predict individual differences in social behavior at the beginning of schooling (Cutting and Dunn 2002; Dunn 1995; Runions and Keating 2007; Renouf et al. 2010). Moreover, evidence suggests that a substantial amount of kindergarteners are already exposed to peer victimization (Barker et al. 2008; Kochenderfer and Ladd 1996).

Method

Sample

Participants of the present study were drawn from an ongoing longitudinal study, the Quebec Newborn Twin Study, a population-based sample of twins from the greater Montreal area in the Province of Quebec, Canada. Families were recruited right after the twins' birth between November 1995 and July 1998 ($N=648$ twin pairs). Eighty percent of the families spoke

French, whereas the remaining families spoke English. Eighty-four percent of the families were of European descent, 3% were of African descent, 2% were of Asian descent, and 2% were Native North Americans. The remaining families (9%) did not provide ethnicity information. The demographic characteristics of the twin families were compared to those of a sample of singletons that is representative of the large urban centers in the province of Quebec (SantéQuébec et al. 1998) when the children were 5 months of age. The results showed that the same percentage (95%) of parents in both samples lived together at the time of birth of their child(ren); 44% of the twins compared to 45% of the singletons were the first born children in the family; 66% of the mothers and 60% of the fathers of the twins were between 25 and 34 years old compared to 66% mothers and 63% fathers of the singletons; 17% of the mothers and 14% of the fathers of the twins had not finished high school compared to 12% and 14% of the parents of the singletons; the same proportion of mothers (28%) and fathers (27%) in both samples held a university degree; 83% of the twin families and 79% of singleton families held an employment; 10% of the twin families and 9% of the singleton families received social welfare or unemployment insurance; finally 30% of the twin families and 29% of the singleton families had an annual total income of less than \$30,000, 44% (42%) had an annual total income between \$30,000 and \$59,999, and 27% (29%) had an annual total income of more than \$60,000. These results indicate extremely similar socio-demographic profiles in the twin sample and the representative sample of singletons.

The sample was followed longitudinally at 5, 18, 30, and 48 months focusing on a variety of child-related and family-related characteristics. Zygosity was assessed at 18 months based on physical resemblance via the Zygosity Questionnaire for Young Twins (Goldsmith 1991). For a subsample of these twin pairs ($n=123$ twin pairs), a DNA sample was evaluated with respect to 8–10 highly polymorphous genetic markers (Forget-Dubois et al. 2003). The comparison of zygosity based on the similarity of these genetic markers with zygosity based on physical resemblance revealed a 94% correspondence rate, which is similar to rates obtained in older twin samples. At age 60 months ($M=5.3$ years, $SD=0.3$), data were collected regarding children's cognitive development and school-readiness, including theory of mind and language skills. At 72 months ($M=6.0$ years, $SD=0.3$), children's social adaptation in kindergarten was assessed. The present paper describes findings from the 60 month and 72 month data collection. Parts of these data were also used in previous studies that addressed different research questions from the ones examined here (Brendgen et al. 2006; Lamarche et al. 2007; Renouf et al. 2010). Yearly attrition in the sample varied between 1% and 9%. Of note, due to time constraints and budget limitations, data collection at 60 months was restricted to a randomly chosen subsample (50% of the total available sample). As a result, the final sample for the present study consisted of 574 individual children for whom data were available at both 60 and 72 months. These children were part of 120 monozygotic (MZ) twin pairs and 167 dizygotic (DZ) twin pairs (i.e., 57 male MZ pairs, 63 female MZ pairs; 35 male DZ pairs, 40 female DZ pairs; 92 mixed gender DZ pairs). The twin pairs who were part of the present study sample did not differ from those for whom data were not available in regard to socio-demographic variables such as parental education or employment status, but there were fewer single-mother families in the study sample than would be expected based on an independence model. Moreover, a comparison

in regard to mother-rated general aggressive-disruptive behavior in prior annual waves assessed at ages 18 to 48 months revealed no significant differences between those who were included in the present study and those who were excluded.

Measures and Procedure

At 60 months, the twins and their parents were invited to the lab, where each child was individually tested on a variety of cognitive tasks, including a theory of mind task, and a receptive vocabulary task. At 72 months, teachers responded to a mailed questionnaire that included a set of behavioral items, including items regarding reactive and proactive aggression as well as peer victimization. All instruments were administered in either English or French, depending on the language spoken by the children and the teachers (see descriptions of measures below). Prior to data collection, active written consent from the parents and verbal assent from the children was obtained. Data collection took place in the spring of the kindergarten school year to ensure that the teachers had got to know the children. Parents were compensated for travel costs to the lab. Teachers were paid 50\$Can for completing the questionnaires. The research questions and instruments were approved by the IRB and by the school board administrators.

Theory of Mind—When the children were 60 months of age, a standard “Unexpected Identity” task adapted from Flavell et al. (1983) was used to measure theory of mind skills. This task is representative of the major change in theory of mind capacities that start emerging in children at around 4 years of age (Wellman et al. 2001). Similar tasks have been used in other studies and are part of commonly used theory of mind test batteries (Cassidy et al. 2005; Milligan et al. 2007). The stimulus was a sponge covered with granite gray paint to make it look like a rock. Typically, children first thought that the object looked like a “rock” when the interviewer first showed the “rock” but realized it really was a “sponge” when the interviewer squeezed the “rock”. The stimulus was then placed on a table in plain view and three test questions were asked, each one assessing a different indicator of theory of mind: *appearance-reality distinction* “When you look at this right now what does it look like, a rock or a sponge?”, *representational change* “When you saw this the first time what did you think it was, a rock or a sponge?”, and *false belief* “It’s the first time Molo [a puppet] sees this, what does he think it is, a rock or a sponge?”. Notably, puppets have been used in previous theory of mind assessments, particularly in false beliefs assessments, and they have been found to be as reliable as when real persons are used as references (Wellman et al. 2001). Following or preceding each of the three test questions, a control ‘reality’ question about the real identity of the object was asked in order to control for the child’s memory “What is it truly and really, a rock or a sponge?”. The scoring procedure is based on a method proposed by Zelazo and colleagues (Zelazo et al. 2002), and has been used previously with English-speaking and French-speaking children (Renouf et al. 2010). A correct answer to both a given test question and its associated control ‘reality’ question resulted in a score of two points; a correct answer only to the control ‘reality’ question resulted in a score of one point. Moreover, a child who only gave a correct answer to the appearance-reality distinction test question but not to any of the other two test questions also received a score of 0. The reason for this latter scoring decision was that it is relatively more difficult for a child to remember the real identity of the object (i.e., sponge), when what is in

plain view is a false appearance (i.e., rock). Finally, children who answered “rock” to all of the six questions (phenomenism error) or children who answered “sponge” to all of the six questions (reality error) were also given a score of 0, the latter two indicating a lack of theory of mind skills (Flavell et al. 1983). Hence, after summing individual scores, the total theory of mind score varied between 0 and 6 ($\alpha=0.77$, $M=3.05$, $SD=2.13$).

Language Skills—Also at age 60 months, children’s receptive language skills were assessed using the Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn and Dunn 1981). For French speakers, the validated French version of the Peabody was administered (Dunn et al. 1993). The PPVT receptive vocabulary subset was chosen because it has been found to be a good indicator of language skills (Dunn and Dunn 1981) and has been used extensively in previous research on theory of mind (e.g., Cutting and Dunn 2002; Ruffman et al. 2003). Children had to point to the one of four black and white drawings that corresponded to the word stated by the research assistant. Raw scores varied between 7 and 101 ($M=55.49$, $SD=18.71$).

Aggression and Peer Victimization—When the children were 72 months of age, proactive and reactive aggressions as well as peer victimization were assessed through teacher ratings. Seven items inspired by Dodge and Coie (1987) were used to assess *proactive* and *reactive aggression*, respectively. Items assessing proactive aggression were: “scared other children to get what he or she wants”, “used physical force to dominate other children”; “encouraged others to pick on a particular child”. Items assessing reactive aggression were: “when someone accidentally hurt him or her, he or she reacted with anger and fighting”; “reacted in an aggressive manner when teased or threatened”; “reacted in an aggressive manner when something was taken away from him or her”. Another reactive aggression item “reacted in an aggressive manner when contradicted” was added to assess the extent to which children behave reactively aggressively even in a rather benign, less provocative context. In previous research, these teacher-rated measures of proactive and reactive aggression have shown a clear two-factor structure (Vitaro et al. 2006) and very good external validity, as indicated by distinct relations with early reactive temperament and harsh parenting (Vitaro et al. 2006), and with peer-related difficulties (Lamarche et al. 2007). Both English and French versions of these and the original Dodge and Coie proactive and reactive scales have been used extensively in English speaking and French-speaking populations (e.g., Brendgen et al. 2006; Lamarche et al. 2007; Poulin and Boivin 2000; Schwartz et al. 1998; Vitaro et al. 2002, 2006). The *peer victimization* scale consisted of three items that evaluated a broad range of victimization by peers: “was called names by other children”, “was hit or pushed by other children”, and “was made fun of by other children”. Teachers were asked to indicate how frequently each type of behavior had occurred for the child during the past three months. Equivalent teacher ratings of peer victimization at school entry have been related to child self-ratings as well as to mother ratings of peer victimization in a normative population-based sample of English-speaking and French speaking children (Barker et al. 2008). For each item, the response scale ranged from 0(never), 1(sometimes), to 2 (often). Separately for each function of aggression and for peer victimization, the respective items were averaged to form a global scale. Proactive aggression scores varied between 0 and 6 ($\alpha=0.65$, $M=0.65$, $SD=1.04$), reactive aggression

scores varied between 0 and 8 ($\alpha=0.86$, $M=1.21$, $SD=1.78$), and peer victimization scores varied between 0 and 6 ($\alpha=0.60$, $M=0.73$, $SD=0.99$).

Results

Preliminary Analyses

To account for interdependency in the twin data, bivariate phenotypic correlations between the main study variables were estimated based on an intra-class correlation matrix that included the correlations between all study variables both within each twin and across both twins (Carey 2005). As can be seen in Table 1, proactive aggression and reactive aggression were positively related. Both were positively related to peer victimization. Theory of mind was positively related to receptive language and proactive aggression but unrelated to reactive aggression, and peer victimization. Nested comparisons of the multivariate means matrix across five groups (male and female MZ pairs, male and female same-sex DZ pairs, and mixed-sex DZ pairs) were performed to examine mean differences in the study variables by zygosity, gender composition of the dyad (i.e., same-gender or mixed-gender), and child gender. All study variables were unrelated to zygosity. With regard to the gender composition of the dyad, mixed-gender dyads showed significantly higher receptive vocabulary skills, $p < 0.05$, and higher theory of mind, $p < 0.05$, than same-gender DZ and MZ dyads, but no differences in regard to proactive or reactive aggression or any other variables emerged. With respect to child gender differences, results showed that, compared to girls, boys were more reactively aggressive, $p < 0.01$, and more victimized by peers, $p < 0.01$. No other gender differences emerged.

Main Analyses: Analytical Strategy

Multilevel regression analyses were performed to test our main hypotheses. In a two-level model, a hierarchy consists of lower-level observations (i.e., level 1 unit of analysis) nested within higher-level observations (i.e., level 2 unit of analysis). In the context of the present study, each individual child is nested within a twin pair. It is assumed that observations across twin pairs are independent from one another. However, observations within a given pair are interdependent, thus violating the assumption of independent observations in traditional linear models. Multilevel models allow for the estimation of within-pair and between-pair effects while simultaneously adjusting for the amount of data interdependency. In the present study, the level 1 unit of analysis represents each individual child, whereas the level 2 unit of analysis represents each individual twin pair. The level 1 variance estimates describe the degree to which twins within a pair differ from each other (i.e., within-pair variance), whereas the level 2 variance indicates the degree to which twin pairs differ from one another (i.e., between-pair variance) with respect to the dependent variables (i.e., proactive and reactive aggression). Notably, because aggressive behavior shows considerable heritability (Rhee and Waldman 2002), members of monozygotic (MZ) twin pairs can be expected to be more similar to each other than members of dizygotic (DZ) twin pairs with respect to the dependent variables. Therefore, especially the within-pair or level 1 variance may differ between MZ and DZ twins, even though the preliminary analyses had shown no mean differences in proactive or reactive aggression between MZ and DZ twins. Therefore, separate estimates of level 1 and level 2 variances were included in the multilevel model for

MZ twins and DZ twins. Since separate variances were estimated for MZ and for DZ twins, and because the gender-composition of the dyad was not significantly related to the aggression variables, no level 2 predictors were entered in the model. Indeed, all predictors of interest (i.e., child gender, the respective other type of aggression, receptive vocabulary, theory of mind, peer victimization) were child-specific and were thus included in the multi-level analyses as level 1 predictors. These level 1 predictors were estimated as fixed — rather than random — coefficients, since their effects were not expected to vary from one twin pair to the next and since there were no level 2 (pair-level) predictors to explain such variation. The fixed coefficient estimates provide information about the unique link between each child-specific predictor and the dependent variable and can be interpreted in a similar way as regression coefficients in a multiple regression.

Multilevel modeling was executed using the Mplus software package (Muthén and Muthén 1998–2004). Specifically, two series of consecutive models of increasing complexity were estimated — one model series to predict proactive aggression and another model series to predict reactive aggression. In each of the two model series, each subsequent model was compared to the preceding one to evaluate whether the inclusion of additional predictors provided a better fit to the data. In each model series, an unconditional model was estimated first, i.e., without including any predictors. The unconditional model provided preliminary information about the total within-pair (i.e., level 1) and between-pair (i.e., level 2) variance of the dependent variable. In the first predictive model, three level 1 (i.e., child-specific) predictors were included: child gender, the respective other type of aggression, and receptive vocabulary. In the second predictive model, the main level 1 predictors of interest (i.e., theory of mind and peer victimization) were added to evaluate their unique role in the prediction of the dependent variable while controlling for the variables entered in the previous model step. In the third predictive model, three two-way interaction terms were added: ‘Theory of Mind x Peer Victimization’, ‘Theory of Mind x Gender’, and ‘Peer Victimization x Gender’. Finally, in the fourth predictive model, a three-way interaction term ‘Theory of Mind x Peer Victimization x Gender’ was added. The $-2\log$ likelihood and the likelihood ratio test, which is equivalent to a χ^2 difference test, were used to evaluate whether a significant proportion of variance was explained by the newly entered variables at each step. For ease of interpretability, the child-level predictors were centered around the grand mean via *z*-standardization prior to statistical analysis (Kreft et al. 1995).

Main Analyses: Predictions to Reactive Aggression

Table 2 presents the results from the multilevel analyses with reactive aggression as the dependent variable. The first model, which included child gender, reactive aggression, and receptive vocabulary as predictors, explained a significant portion of the variance of reactive aggression, as shown by the improvement in model fit compared to the unconditional model, $-2LL(3)=311.6, p<0.001$. Proactive aggression was the strongest predictor, with a higher level of proactive aggression being associated with a higher level of reactive aggression, $\beta=0.60, p<0.001$. Boys displayed more reactive aggression than girls, $\beta=-0.26, p<0.001$. Moreover, lower receptive vocabulary was associated with a higher level of reactive aggression, $\beta=-0.10, p<0.01$.

The second model, where theory of mind and peer victimization were added to the equation, showed a further improvement in model fit compared to the previous model, $-2LL(2)=36.6, p<0.001$. However, only peer victimization explained unique variance of reactive aggression, with a higher level of peer victimization being associated with a higher level of reactive aggression, $\beta=0.18, p<0.001$. In contrast, no main effect of theory of mind on reactive aggression was found, $\beta=-0.05, ns$.

The three two-way interaction terms added in the third model ('Theory of Mind x Peer Victimization', 'Theory of Mind x Gender', and 'Peer Victimization x Gender') provided a further significant improvement in model fit compared to the second model, $-2LL(3)=13.1, p<0.01$. However, only the interaction of theory of mind and peer victimization was significant, $\beta=-0.07, p<0.05$. To probe the nature of this interaction, the relation between theory of mind and reactive aggression was examined at three different levels of peer victimization (Aiken and West 1991; Hox 2002). For children who experienced a high level of peer victimization (i.e., one standard deviation above the mean), a low level of theory of mind was significantly related to a higher level of reactive aggression, $\beta=-0.16, p<0.01$. For children who experienced an average level of peer victimization (i.e., at the mean), a low level of theory of mind was also significantly related to a higher level of reactive aggression, albeit to a lesser extent, $\beta=-0.09, p<0.05$. In contrast, for children who experienced a low level of peer victimization (i.e., one standard deviation below the mean), theory of mind was unrelated to reactive aggression, $\beta=-0.02, ns$.

In the fourth model, a triple interaction between gender, theory of mind, and peer victimization was added to examine whether the moderating effect of peer victimization in the relation between theory of mind and reactive aggression differed for boys and girls. This triple interaction was not significant, $\beta=0.11, ns$.

Main Analyses: Predictions to Proactive Aggression

Table 3 presents the results from the multilevel analyses with proactive aggression as the dependent variable. The first model, which included child gender, reactive aggression, and receptive vocabulary as predictors, significantly improved the model fit compared to the unconditional model, $-2LL(3)=294.1, p<0.001$. Reactive aggression had the strongest effect, with a higher level of reactive aggression being associated with a higher level of proactive aggression, $\beta=0.67, p<0.001$. A small but significant effect was also found for receptive vocabulary, indicating that a higher receptive vocabulary was associated with a higher level of proactive aggression, $\beta=0.08, p<0.05$. No unique effect of child gender on proactive aggression was found, $\beta=0.06, ns$.

The addition of theory of mind and of peer victimization in the second model significantly improved model fit compared to the first model, $-2LL(2)=8.4, p<0.05$. However, only theory of mind made a significant unique contribution, indicating that a higher level of theory of mind skills was related to a higher level of proactive aggression, $\beta=0.07, p<0.05$.

The third model, in which the three two-way interaction terms 'Theory of Mind x Peer Victimization', 'Theory of Mind x Gender', and 'Peer Victimization x Gender' were added, further improved the model fit compared to the previous model, $-2LL(3)=11.7, p<0.01$.

Only the interaction between theory of mind and peer victimization showed a significant effect, however, $\beta=0.10$, $p<0.01$. The break-down of the interaction revealed that, for children who experienced low levels of peer victimization (i.e., one standard deviation below the mean), as well as for moderately victimized children (i.e., at the mean), theory of mind was unrelated to proactive aggression, $\beta=-0.04$, *ns*, and $\beta=0.05$, *ns*, respectively. However, for children experiencing high levels of peer victimization (i.e., one standard deviation above the mean), theory of mind was positively related to proactive aggression, $\beta=0.16$, $p<0.01$.

The fourth model did not significantly improve the model fit, revealing a non significant triple interaction between gender, theory of mind and peer victimization, $\beta= -0.01$, *ns*.

Discussion

The present study investigated the relation between theory of mind skills before school entry and reactive and proactive aggression in kindergarten, as well as the potential moderating effect of peer victimization in this context. In the following sections, we will first discuss the findings with respect to each of the two functions of aggression. Then, the unique contribution of the results to our understanding of aggression will be discussed.

Theory of Mind and Reactive Aggression

Previous research has revealed a significant relation between low social cognitive skills and reactive aggression (Day et al. 1992; McAuliffe et al. 2007). What seems to be particularly characteristic of reactively aggressive children is their tendency to suspect hostile intentions in others when a social situation leads to a negative outcome for themselves, even when the other person's intention is ambiguous (Crick and Dodge 1996; Dodge and Coie 1987; Schwartz et al. 1998). Some scholars have suggested that this hostile attribution bias may be due to an underlying lack of theory of mind skills (Katsurada and Sugawara 1998; Orobio de Castro et al. 2002; Runions and Keating 2007). In support of this notion, our findings showed that low theory of mind skills are indeed related to higher levels of reactive aggression. However, our findings also reveal that the negative relation between theory of mind skills and reactive aggression is not systematic, but is only evident in children who are frequently victimized by their peers. Children who lack the skills to consider another person's perspective for decoding social cues must rely on their own perception of reality, which is based on previous experiences (Runions and Keating 2007). If previous experiences with others are predominantly negative, these children may be especially prone to interpret the situation as threatening and react aggressively. Previous research has shown that harsh treatment by parents may be one such negative experience that fosters reactive behavior in children with low theory of mind skills (Hughes and Ensor 2006, 2007). Our study suggests that negative treatment by peers may be a similar contributing factor in the link between low theory of mind and reactive aggression and that these associations are the same for girls and boys. Together, these findings may thus help explain the hostile attribution bias found in reactively aggressive children. The development of a tenacious hostile attribution bias, stemming from the combined effect of a lack of theory of mind and negative social experiences, may explain why low theory of mind at age 5 predicted reactive aggression even 1 year later. Future studies should examine whether the negative relation between

theory of mind and reactive aggression in victimized children is indeed mediated by a negatively biased interpretation of social events. If so, theory of mind skills may be an important primary factor to consider in evaluating problem areas in the social information processing of reactively aggressive children.

The moderating effect of peer victimization in the relation between theory of mind and reactive aggression emphasizes the important role of the social environment in determining whether a lack of theory of mind leads to future behavior problems (Fonagy et al. 2002). By the same token, theory of mind development is itself influenced by social interaction with others in general and with peers in particular (Dunn 2000; Hughes and Leekam 2004). Reactive aggression has been shown to lead to further rejection and victimization by peers (Card and Little 2006; Crick and Dodge 1996; Dodge et al. 1997; Lamarche et al. 2007; Little et al. 2003; Salmivalli and Helteenvuori 2007). As a result, these children may be deprived of opportunities for positive social interactions, which, in turn, might further delay the acquisition of theory of mind skills. Delayed acquisition of theory of mind skills may thus also explain, at least for some children, why a lack of theory of mind skills at age 5 still predicted high levels of reactive aggression 1 year later.

Theory of Mind and Proactive Aggression

In contrast to its negative link with reactive aggression, theory of mind was positively related to proactive aggression. As an organized and planned behavior, proactive aggression has been related to the anticipation of a positive outcome of the aggressive behavior (Crick and Dodge 1996; Dodge et al. 1997). Theory of mind skills may be helpful to such planned and organized behavior by helping in the calculation of the potential risks and benefits of using aggression in a given social situation as well as in anticipating how others will react. As expected, this positive relation between theory of mind and proactive aggression was moderated by children's level of peer victimization. Contrary to expectations, however, the positive relation between theory of mind and proactive aggression was only evident in children who were frequently — not rarely — victimized by their peers. Children with theory of mind skills who are victimized by peers might eventually try to use proactive aggression to regain power and social status in the peer group and to thus counteract the social damage of peer victimization (Day et al. 1992; Hawley et al. 2007; Pellegrini 1998). This seems to work at least for some children, as longitudinal research has shown a decrease in peer victimization over time in proactively aggressive children (Salmivalli and Helteenvuori 2007). Especially at the beginning of schooling, peers may confound a child's proactive aggression with affirmative and dominant behavior. In line with this notion, Dodge and colleagues found that not only leadership and persuasive behavior (i.e., directing the behavior of another through verbal requests, demands, or vague and implied threats), but also the use of proactive aggression (unprovoked bullying) were positively related to popularity in first graders, but not in third graders (Dodge, Coie, Pettit, and Price 1990). The potential benefits of high levels of proactive aggression for the maintenance or improvement of social status might be rather shortlived, however. Indeed, the findings reported by Dodge et al. (1990) suggest that peers increasingly discriminate between proactive aggression and affirmative behavior as they grow older. As a consequence, victimized children with high theory of mind skills may also eventually re-evaluate their behavior strategies and use

proactive aggression less frequently. The present findings of a positive link between theory of mind and proactive aggression may thus pertain mainly to younger, but not necessarily to older children. Moreover, it is possible that this increased variability in the use of proactive aggression in older children with high theory of mind skills may occur sooner in girls than in boys. Indeed, although no gender moderation effects were found in our young sample, theory of mind was positively related to bullying behavior in boys but not girls in one study with older children (Caravita et al. 2010). These potential emerging gender differences need to be examined in future studies covering a larger developmental period.

Contributions of the Findings to Our Understanding of Aggression

The present findings of differential links between theory of mind and reactive and proactive aggression are in line with numerous other studies that have reported different correlates, predictors, and outcomes of these two *functions* of aggression (for an overview, see Vitaro and Brendgen 2005). The present findings also complement a previous study with this sample, which examined the links of theory of mind with different *forms* of aggression, namely physical aggression (e.g., hitting, kicking) and indirect aggression (rumor spreading, social exclusion) (Renouf et al. 2010). The results from that study showed that, whereas theory of mind was unrelated to physical aggression, it was positively related to indirect aggression. Together, the findings from the two studies support the notion of the multi-dimensional nature of aggressive behavior, which can take different forms and serve different functions. This multi-dimensional nature needs to be taken into account if we are to understand the socio-cognitive basis of aggressive behavior. Unfortunately, research on the different functions and on the different forms of aggression has so far largely evolved in parallel. For example, as noted by several scholars (e.g., Card and Little 2006; Little et al. 2003), traditional measures of the two functions of aggression — including the teacher-reported measure used here — rely on items that refer to a common underlying form (i.e. mostly physical aggression). While a self-report measure has been developed to disentangle form from function in the aggressive behavior of adolescents (Little et al. 2003), a comparable multi-axial measure of aggression in young children is lacking. Nevertheless, the joint consideration of forms and functions could help refine our understanding of the relation between theory of mind and aggressive behavior. For instance, it is possible that physical-reactive aggression is negatively associated with theory of mind, but that physical-proactive aggression is positively associated with theory of mind. In contrast, indirect aggression, which requires the skilled manipulation of others while concealing one's true intention, may be positively related to theory of mind regardless of the function it serves.

Although they may still provide a somewhat incomplete picture, the present findings concerning proactive and reactive aggression as well as those from our previous study concerning physical and indirect aggression (Renouf et al. 2010) challenge the “social skills deficit” hypothesis of aggression. Instead, our results add to those from a growing number of studies suggesting that many aggressive children possess at least average, if not superior theory of mind skills (Caravita et al. 2010; Sutton et al. 1999). In this context, our findings also highlight the fact that aggression may not only reflect pathology but sometimes also socially adaptive behavior (Hawley et al. 2007). Indeed, studies examining the developmental trajectories of the different forms and the different functions of aggressive

behavior show that only a small proportion of children exhibit chronically high levels of aggressive behavior, which may be associated with subsequent adjustment problems (e.g., Barker et al. 2010; Côté et al. 2007). However, because our proactive and reactive aggression measures were only assessed once when the children were in kindergarten and are based on a population sample, our findings cannot discriminate between children who exhibit chronically high and perhaps pathological levels of aggression and those whose use of aggression is more variable and decreases over time. Because children with high theory of mind skills likely adapt their behavior to the specific situation at hand, it is possible that especially our finding of a positive link between theory of mind and planned, purposeful aggressive behavior reflects a more normative rather than a pathological type of aggression. Chronically high levels of either type of aggression in a high-risk or clinical sample might thus show a relation with theory of mind that is perhaps more consistently in line with the “social skills deficits” view of aggression than the associations found in our sample.

Strengths, Limitations, and Conclusions

The present study is the first to examine the differential association of theory of mind with proactive and reactive aggression. In this context, the study possesses several strengths, including the use of a prospective longitudinal design and the examination of negative treatment by peers as a potential moderator of the link between theory of mind and the two different functions of aggression. A further strength is the rigorous control of possible confounding factors, specifically in regard to the overlap between proactive and reactive aggression and in regard to a possible effect of children’s personal characteristics such as gender and receptive vocabulary. In addition, the use of different evaluation sources, such as a laboratory task to evaluate theory of mind skills and teacher ratings to evaluate social behaviors, minimized the problem of shared source variance.

Despite these strengths, the study also presents several limitations, which need to be considered in the interpretation of the findings. Thus, despite the longitudinal study design covering two consecutive years, the failure to measure theory of mind and aggressive behavior at both times made it impossible to examine the directionality of effects. As mentioned, especially the frequent use of reactive aggression may lead to further peer difficulties, thus depriving children of opportunities for positive social interactions that may promote the development of theory of mind skills. Future research thus needs to test a transactional model to uncover such potential bi-directional effects between theory of mind and reactive aggression. A further limitation is the use of a single informant (i.e., teachers) for aggressive behaviors and peer victimization. Although teachers are considered a valid and reliable source of information for measuring school-based behavior such as aggression and peer victimization (Dodge and Coie 1987; Barker et al. 2008), they could be less privy than classmates to evaluate proactive aggression and peer victimization, which might not always take place in front of the teacher (Salmivalli and Nieminen 2002). The reliance on teacher ratings could also explain the low internal consistency observed for the proactive aggression and the peer victimization scales, which may have led to an underestimation of effect sizes. A multi-informant approach, including peer reports, self-reports, and observational measures might improve the validity of these measures (Card and Little 2006) and also yield somewhat higher effects than those reported here.

In addition to these methodological limitations, a conceptual limitation is also important to consider with respect to our measure of theory of mind. Specifically, the single theory of mind task used in our study only allowed us to assess children's understanding of their own versus others' beliefs. However, the use of a complete battery of theory of mind measures would be important in future studies to capture all aspects of theory of mind, including children's understanding of intention and emotion. Moreover, although the laboratory task used in the present study offers a fairly objective evaluation of theory of mind, its ecological validity is limited. Even children who possess theory of mind may not always use this skill, depending on the social context. Thus, it is possible that some children use their theory of mind skills when they want something but not when they feel threatened, teased or provoked. In addition, as mentioned, our findings may only apply to normative samples and be specific to the young age of the children in our sample. High theory of mind skills may translate into a more selective, and perhaps less frequent use of proactive aggression as children grow older. Moreover, with increasing age, it may well not be the lack of theory of mind per se that increases reactive aggression but the way children use these skills in the face of perceived provocation (Crick and Dodge 1999). Evaluation of theory of mind adapted to different developmental periods in longitudinal studies would increase the comprehension of theory of mind in relation to the different subtypes of aggressive behavior.

These limitations notwithstanding, we believe the present study offers important new insights into the differential relation of theory of mind with proactive and reactive aggression. It adds to the existing evidence that individual differences in theory of mind before school entry are a significant predictor of individual differences in social behavior at the beginning of schooling (Dunn 1995; Runions and Keating 2007). The study also underscores the important role of environmental experiences in the cognition-behavior link. If replicated, the present findings have important implications for prevention efforts aimed at reducing aggressive behavior in children. Specifically, although some frequently employed strategies such as improving theory of mind skills may be effective in reducing reactive aggression, they may at the same time increase the use of proactive aggression. This outcome may be especially likely in children who are exposed to negative treatment from their peer group. As such, particular efforts may need to be directed towards preventing these children from resorting to violent and hurtful behavior themselves.

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Table 1Phenotypic Correlations Between the Main Study Variables ($n=287$ Twin Pairs)

Variables	1	2	3	4
1. Receptive vocabulary	–			
2. Theory of mind	0.28**	–		
3. Peer victimization	-0.14**	-0.04	–	
4. Proactive aggression	0.06	0.09*	0.30**	–
5. Reactive aggression	-0.04	-0.02	0.40**	0.65**

*
 $p < 0.05$;**
 $p < 0.01$ (two-tailed test).

These correlations are based on a multivariate 2- group intra-class correlation matrix that includes the phenotypic correlations (i.e., the correlations between variables within twin 1 and within twin 2, respectively, which are constrained to be equal for twin 1 and twin 2 and for MZ and DZ twins) as well as the correlations across twin 1 and twin 2 (i.e., the intraclass correlations indicating similarity between two twins of a pair). For the purposes of the present study, only the phenotypic correlations are presented.

Table 2

Multilevel Analyses Predicting Reactive Aggression ($n=574$ Individuals)

Model	Predictor	Fixed effect (se)	Level 1 variance (se)	Level 2 variance (se)	-2log likelihood (np)	Likelihood ratio (df)
Unconditional	Constant	-0.04(0.05)	MZ=-0.43(0.06)*** DZ=-0.75(0.08)***	MZ=0.32(0.07)*** DZ=0.29(0.08)***	1533.9 (5)	
1	Gender	-0.26(0.06)***	MZ=-0.34(0.05)*** DZ=-0.40(0.04)***	MZ=0.14(0.05)** DZ=0.14(0.04)**	1222.3 (8)	311.6*** (3)
	Proactive Aggression	0.60(0.03)***				
	Receptive Vocabulary	-0.10(0.03)**				
2	Peer Victimization	0.18(0.03)***	MZ=-0.31(0.04)*** DZ=-0.40(0.04)***	MZ=0.13(0.04)** DZ=0.11(0.04)**	1186.7 (10)	36.6*** (2)
	Theory of Mind	-0.05(0.03)				
3	Theory of Mind * Peer Victimization	-0.07(0.03)*	MZ=-0.31(0.04)*** DZ=-0.39(0.04)***	MZ=0.13(0.05)** DZ=0.10(0.04)**	1173.6 (13)	13.1** (3)
	Theory of Mind * Gender	0.06(0.06)				
	Peer Victimization * Gender	-0.11(0.06)				
4	Theory of Mind * Peer Victimization * Gender	0.11(0.06)	MZ=-0.31(0.04)*** DZ=-0.38(0.04)***	MZ=0.12(0.04)** DZ=0.10(0.04)**	1170.6 (14)	3.0 (1)

Gender is coded 0 = boys, and 1 = girls. Np = number of parameters; df = degrees of freedom

* $p < 0.05$;** $p < 0.01$;*** $p < 0.001$.

Table 3

Multilevel Analyses Predicting Proactive Aggression ($n=574$ Individuals)

Model	Predictor	Fixed effect (se)	Level 1 variance (se)	Level 2 variance (se)	-2log likelihood (np)	Likelihood ratio (df)
Unconditional	Constant	-0.01(0.06)	MZ=0.52(0.07)***	MZ=0.29(0.08)***	1575.1	
1	Gender	0.06(0.06)	DZ=0.68(0.08)***	DZ=0.44(.10)***	(5)	
	Reactive Aggression	0.67(0.03)***	MZ=0.41(0.05)***	MZ=0.15(0.05)**	1281.0	294.1***
	Receptive Vocabulary	0.08(0.03)*	DZ=0.39(0.04)***	DZ=0.19(0.05)***	(8)	(3)
2	Peer Victimization	0.06(0.03)	MZ=0.40(0.05)***	MZ=0.15(0.05)**	1272.6	8.4*
	Theory of Mind	0.07(0.03)*	DZ=0.39(0.04)***	DZ=0.18(0.05)***	(10)	(2)
3	Theory of Mind * Peer Victimization	0.10(0.03)**	MZ=0.39(0.05)***	MZ=0.17(0.05)**	1260.9	11.7**
	Theory of Mind * Gender	0.05(0.06)	DZ=0.38(0.04)***	DZ=0.17(0.05)***	(13)	(3)
	Peer Victimization * Gender	0.03(0.06)	MZ=0.39(0.05)***	MZ=0.17(0.05)**	1260.9	0.0
4	Theory of Mind * Peer Victimization * Gender	-0.01(0.07)	DZ=0.38(0.04)***	DZ=0.17(0.05)***	(14)	(1)

Gender is coded 0 = boys, and 1 = girls. Np = number of parameters; df = degrees of freedom

* $p < 0.05$;** $p < 0.01$;*** $p < 0.001$.