Is the association between childhood maltreatment and aggressive behavior mediated by hostile attribution bias in women? A discordant twin study

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Abstract:
It is important to understand the mechanisms behind aggressive behavior in order to develop effective prevention and intervention strategies. It has been hypothesized that maltreated children are prone to social information processing biases, such as hostile attribution bias (HAB) which, in turn, may increase the likelihood of aggressive behavior. The first aim of the present study was to replicate previous findings regarding the associations between childhood maltreatment, HAB, and aggressive behavior in a large population-based sample of Finnish female twins and their sisters ($N = 2167$). Specifically, the aim was to analyze whether part of the association between childhood maltreatment and aggressive behavior would be mediated by HAB. The second aim was to test whether the associations decrease or disappear, when potential confounding by shared genetic and common environmental effects are controlled for through the use of a discordant twin method. Discordant twin analyses were conducted, first for all twin pairs together (n pairs = 239) and then for dizygotic (n pairs = 100) and monozygotic twin pairs (n pairs = 131) separately. Consistent with previous studies, there was a significant association between all the variables when familial confounding was uncontrolled. Further, HAB mediated the association between childhood maltreatment and aggressive behavior. The discordant twin analyses revealed that the strength of all of the associations were smaller, and no longer significant, in comparison to the uncontrolled effect sizes, indicating confounding by shared genetic or common environmental factors. Furthermore, the association between HAB and aggressive behavior was not only influenced by common environmental effects, but also by genetic effects shared between the variables. The present study indicates a mediation between childhood maltreatment and aggressive behavior through HAB, however suggests that the associations between these variables are at least partially confounded by shared familial (genetic or common environmental) factors.

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Abstrakt:

Det är viktigt att förstå orsaken bakom aggressivt beteende med tanke på förebyggande åtgärder och behandling. Det har gjorts hypoteser om att barn som blivit utsatts för misshandel gör olika slags sociala informationsprocesseringsbiaser, såsom fientlig attributionsbias (HAB). HAB kan i sin tur öka sannolikheten för aggressivt beteende. Första syftet med denna studie var att analysera sambanden mellan barnmisshandel, HAB och aggressivt beteende i ett stort populationsbaserat sampel bestående av finländska kvinnliga tvillingar och deras systrar ($N = 2167$). Specifikt var syftet att studera ifall HAB medierade associationen mellan barnmisshandel och aggressivt beteende. Andra syftet med denna studie var att undersöka ifall sambandet mellan variablerna minskade eller försvann när man kontrollerade för gemensamma gen- och omgivningseffekter med hjälp av en disharmonisk tvillingmetod. De disharmoniska tvillinganalyserna utfördes först för alla tvillingar (n par = 239) tillsammans, sedan skilt för tvåäggstvillingar (n par = 100) och enäggstvillingar (n par = 131). Resultaten stämde överens med resultat från tidigare liknande studier; det fanns en signifikant association mellan alla variablerna när man inte kontrollerade för familjära förväxlingsfaktorer. Resultaten visade även att HAB medierade associationen mellan barnmisshandel och aggressivt beteende. Analyserna gjorda med den disharmoniska tvillingmetoden visade att sambanden var åtminstone delvis påverkade av gemensamma gen- och omgivningseffekter. Analyserna visade också att sambandet mellan HAB och aggressivt beteende påverkades utöver gemensamma omgivningseffekter även av gemensamma genetiska effekter. Ingen av de disharmoniska tvillinganalyserna var signifikanta. Denna studie stöder hypotesen om att variablerna är associerade med varandra samt att sambanden åtminstone delvis är påverkade av gemensamma gen- och omgivningseffekter.

Nyckelord: Barnmisshandel, fientlig attributionsbias, aggressivt beteende, disharmonisk tvillingstudie	
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Introduction

Aggression is a phenomenon that has existed for a long time and it can be seen as a social problem that is worth the attention of the society (Anderson & Bushman, 2002). Aggression is defined as any behavior that is meant to injure or harm others who want to avoid to be treated that way (Baron & Richardson, 2004). Aggression can be categorized both by its form, overt aggression or relational aggression, and function, proactive aggression or reactive aggression (Little, Henrich, Jones, & Hawley, 2003; Vitaro, Brendgen, & Barker, 2006). Overt aggression is verbal and physical behaviors towards others with the intent to hurt them, while relational aggression is when one wants to significantly damage someone's friendships or feeling of inclusion in the peer group (Buss & Perry, 1992; Coie & Dodge, 1998, Crick & Grotpeter, 1995). Proactive aggression is controlled and goal-oriented, while reactive aggression is an impulsive emotional response to provocation (Cornell et al., 1996). Aggressive behavior can be a purposeful and adaptive reaction (such as in the case of self-defense or when defending family members), which can help individuals and species to survive, but it can be destructive if it is used in the wrong way (Lorenz, 2005). Being a victim of violence can lead to various injuries, other health problems (e.g. different psychological and behavioral problems) and in the worst case death (Krug, Mercy, Dahlberg, & Zwi, 2002). Understanding the development of aggressive behavior is important so that evidence-based preventative interventions can be developed (Dodge, 2006; Richey, Brown, Fite, & Bortolato, 2016).

Several models have been proposed in order to explain the emergence of aggressive behavior from a developmental point of view. One widely used model is the social information processing model (SIP) (Crick & Dodge, 1994; Dodge, Pettit, McClaskey, Brown, & Gottman, 1986). This model aims at explaining the cognitive and emotional processes that lead to aggressive behavior in social situations. According to the model, people experience six mental steps when facing social situational cues. These steps are 1) encoding of social cues, 2) interpretation and mental representation of the meaning of those cues, 3) formulation of goals, 4) accessing one or more potential responses from memory, 5) evaluation and selection of a response, 6) enactment to that response. These processes have been identified in both children/adolescents (Dodge & Crick, 1990; Lösel, Bliesener, & Bender, 2007) and adults (Bailey & Ostrov, 2008; Basquill, Nezu, Nezu, & Klein, 2004; Matthews

& Norris, 2002; Miller & Lynam, 2006). If a bias occurs in any of these six mental steps (e.g. a person misinterprets a situation), it could enhance the likelihood of aggressive behavior (Crick & Dodge, 1994; De Castro, Veerman, Koops, Bosch, & Monshouwer, 2002; Dodge et al., 1986). One example of a well-known bias which is associated with increased likelihood for aggressive behavior is the hostile attribution bias (HAB) (Crick & Dodge, 1994; De Castro et al., 2002; Dodge et al., 1986)

HAB can occur when the information from social cues is interpreted erroneously (Dodge et al., 1986; Dodge & Coie, 1987). It is the tendency to misinterpret others' actions, and underlying motives, as hostile (Epps & Kendall, 1995; Matthews & Norris, 2002; Milich & Dodge, 1984). Furthermore, people with high HAB tend to put the blame of a negative outcome on others (Adams & John, 1997; Matthews & Norris, 2002). In line with SIP theory, individuals who tend to see others' actions as hostile have a higher risk for aggressive behavior (Bushman, 2016; De Castro et al., 2002). Studies show that HAB has been positively associated with aggressive behavior both in children (Crick, Grotpeter, & Bigbee, 2002; see meta-analysis De Castro et al., 2002) and adults (Bailey & Ostrov, 2008; Chen, Coccaro, Lee, & Jacobson, 2012; Richey et al., 2016). In addition, HAB has been positively associated with a history of aggressive behavior, as measured retrospectively in adults (Coccaro, Fanning, Keedy, & Lee, 2016). Based on studies such as these, treatments have been developed for aggressive behavior that focus on changing biases in SIP, such as HAB (Coccaro et al., 2016).

Childhood maltreatment can be defined as emotional abuse, physical abuse, sexual abuse, emotional neglect or physical neglect (Finkelhor, Turner, Shattuck, & Hamby, 2013; Hussey, Chang, & Kotch, 2006). Dodge, Bates, and Pettit (1990) hypothesized that maltreated children are at risk for displaying HAB, because they tend to develop biased and inadequate patterns in the processing of social information, and they are therefore in the risk zone for behaving aggressively in ambiguous social situations both in childhood and later in life. Childhood maltreatment has been associated with both short and long- term negative effects on the mental and physical health of individuals with a history of childhood maltreatment (see the following reviews Brown, Fang, & Florence, 2011; Norman et al., 2012; Twardosz & Lutzker, 2010). A history of childhood maltreatment is also a risk factor for aggressive behavior in childhood (Cullerton-Sen et al., 2008) as well as later in life (Allen, 2011; Berzenski & Yates, 2010; Chen et al., 2012; Cowie,

2015; Fitton, Yu, & Fazel, 2018; Frazzetto et al., 2007; Richey et al., 2016; Taft, Schumm, Marshall, Panuzio, & Holtzworth-Munroe, 2008). Also in line with the social information processing theory are results from previous studies showing that childhood maltreatment is positively associated with HAB both in children (e.g., Price & Glad, 2003) and in adults (Richey et al., 2016).

Dodge, Pettit, Bates, and Valente (1995) hypothesized that maltreated children would develop more externalizing behavior problems, and the association would be mediated through biases made in SIP. They hypothesized that maltreated children would show biases in the encoding of cues (i.e., they would miss relevant social cues because they are more sensitive to notice hostile cues) and in the interpretation of the intentions of others (i.e., they would be prone to misinterpreting others' intentions as hostile). Furthermore, according to the hypotheses of Dodge et al. (1995), maltreated children would bear in mind more examples of aggressive ways to respond (and fewer examples of neutral or proactive ways to react), and they would be prone to thinking that aggressive behavior would lead to positive outcomes (Dodge et al., 1995). All of these biases in SIP would, in turn, increase the likelihood for an aggressive response to a socially ambiguous situation (Dodge et al., 1995). A number of studies have specifically tested whether the association between childhood maltreatment and aggressive behavior is mediated through SIP, finding support for partial mediation in children (Dodge et al., 1990; Dodge et al., 1995), in adolescents (Calvete & Orue, 2011), and in adults (Taft et al., 2008). Especially HAB seems to mediate the association between childhood maltreatment and aggressive behavior both in children (Dodge et al., 1990), in adolescents (Calvete & Orue, 2011) and in adults (Coccaro, Noblett, & McCloskey, 2009). In addition, a study by Richey et al. (2016) showed an indirect effect of childhood maltreatment through instrumental HAB (defined by the authors as a belief that someone is acting hostile toward someone else's belongings) on reactive aggression. In contrast, a study with a sample of 42 men failed to identify HAB as a mediator between emotional childhood maltreatment and aggression (Cowie, 2015). A study by Chen et al. (2012) showed that childhood maltreatment was associated with higher levels of adult aggression even when controlling for social information processing. The study also found that childhood maltreatment moderated the relationship between social information processing (HAB) and aggression, so that the association between

HAB and aggression was stronger when the participants showed less of physical neglect and emotional abuse.

As it seems, there are only a few studies that have analyzed the indirect effect of childhood maltreatment mediated by HAB on aggressive behavior. All of these studies have used relatively low samples ($n < 1000$; Calvete & Orue, 2011; Coccaro et al., 2009; Cowie, 2015; Dodge et al., 1990; Richey et al., 2016) indicating a need for replication in additional large population-based samples for women. Even though previous studies have shown associations between childhood maltreatment, HAB and aggressive behavior, the associations are not necessarily causal. Instead, the associations could be confounded by underlying familial (genetic or common environmental) factors shared between some, or all of, the variables.

By comparing the resemblance between monozygotic (MZ) twins with that of dizygotic (DZ) twins, the influence of genes and common environmental factors can be disentangled. Polderman et al. (2015) conducted a meta-analysis with twin studies from the last 50 years, with data on 17,804 traits from more than 14 million twin pairs, and the results indicated that all human traits analyzed to date are genetically influenced to some degree. In line with this, twin and adoption studies have shown that aggressive behavior is affected by genetic variation (Vassos, Collier & Fazel, 2014). A meta-analysis by Miles and Carey (1997) showed that genes can affect the variation in aggressive behavior between individuals up to 50%, while a recent meta-analysis by Beatty, Heisel, Hall, Levine, and La France (2002) showed that aggressiveness was 58% genetic. A meta-analysis by Burt (2009) showed that genes affect 65% of the variance in aggressive forms of antisocial behavior. Further, a meta-analysis by Rhee and Waldman (2002) showed that antisocial behavior was influenced by genes to 41%. The effect of common environmental effects on antisocial behavior (i.e. those environmental influences that make two twins more alike), has shown to be 5% and 16% respectively according to meta-analyses (Burt, 2009; Rhee & Waldman, 2002). Childhood maltreatment is also influenced by genes, as shown by a large population-based twin study, partly based on the same sample as the current study (Pezzoli, Antfolk, Hatoum, & Santtila, 2018). Findings have also shown that parenting behavior, among other measures on environment, can be influenced by genetic factors (Harlaar et al., 2008; Kendler & Baker, 2007). In other words, an individual's genetic makeup can influence his or her likelihood of being maltreated (a form of gene-environment correlation, rGE), either in the form of

evocative rGE or passive rGE (Plomin, DeFries, & Loehlin, 1977). The former occurs if a child's inherited traits evoke a reaction from the parents, and the latter if there is an association between the genes inherited by a child from his or her parents, and the environment provided by the parents. A parent who is prone to aggressive behavior (a genetically influenced trait) might be more prone to also maltreat or neglect their children. Furthermore, a child who has inherited a predisposition to behave aggressively, might be more prone to evoke maltreatment by his or her parents, especially since they share part of the genetic predisposition to aggression. The same could be hypothesized for HAB. This way, the associations between childhood maltreatment, HAB, and aggressive behavior might not be truly causal, but instead at least partly, confounded by underlying genetic and environmental effects that are shared between the variables.

The discordant twin method is used to investigate the strength of the possible causal relationship between environmental variables and developmental outcomes, when experimental manipulation is not possible (Vitaro, Brendgren & Arseneault, 2009). The method is also known as co-twin control method (Goldberg & Fischer, 2005). Using twins, the method enables researchers to control for important confounders, mainly effects of genetic influences and environmental influences (that are shared between the twins) that might be shared between the outcome variable and the assumed causal factor, and could not otherwise be controlled for (McGue, Osler, & Christensen, 2010; Vitaro et al., 2009). The rationale for the method lies on the fact that monozygotic (MZ) twins share 100% of their segregating genes while dizygotic (DZ) twins share, on average, 50% of their genes (Capusan et al., 2016; Yirmiya, Segal, Bloch, & Knafo-Noam, 2018). In addition, twins reared together also share a large part of their environment, referred to as common environmental influences (Vitaro et al., 2009). Therefore, twins in a pair can be seen as each other's controls, matched for effects of common environmental influences, and genetic influences (fully controlled for within MZ twin pairs, but only partly in DZ twin pairs). If the effect of a factor, such as HAB or childhood maltreatment, is causal, one would except that the twin with higher levels of HAB or childhood maltreatment would also show higher levels of aggressive behavior, in comparison to his/her twin. If the magnitude of the association to aggression is smaller when measured within twin pairs (discordant for childhood maltreatment and HAB), in comparison to between twins or unrelated individuals, this would indicate that part

of the association is accounted for by underlying shared genetic or common environmental influences. In addition, if no effect is seen within MZ twin pairs, all of the association between the assumed causal factor (childhood maltreatment and HAB) and the outcome (aggressive behavior) is, in fact, due to such underlying confounding effects.

Previous studies have used this method, or other similar methods, to investigate possible causal relationships between different variables. One of them is a large population-based twin study which showed that genes and common environment confounded the association between childhood maltreatment and adult violent offending (Forsman & Långstöm, 2012). Another twin study found that the association between childhood maltreatment and ADHD symptoms in adults was partly causal but also partly confounded by genes and environment (Capusan et al., 2016). The relationship between childhood maltreatment and sexual coercion, on the other hand seemed to be mostly causal (Forsman, Johansson, Santtila, Sandnabba, & Långström, 2015). A study with male twins showed that regarding the association between childhood maltreatment and alcoholism, common environmental factors partly accounted for the association (Young-Wolff, Kendler, Ericson, & Prescott, 2011). To the best of our knowledge, the present study is the first to investigate the indirect effect of childhood maltreatment on aggressive behavior mediated by HAB, while controlling for possible familial confounders with the discordant twin method.

The aim of this study was twofold. The first aim was to replicate the previous findings with regards to the associations between childhood maltreatment, HAB, and aggressive behavior in a large population-based sample of Finnish female twins and their sisters. Specifically, the aim was to analyze whether part of the association between childhood maltreatment and aggressive behavior would be mediated through HAB. The second aim, was to test whether the associations between childhood maltreatment, HAB and aggressive behavior, as well as the indirect effect of childhood maltreatment through HAB on aggressive behavior decrease or disappear, when controlling for potential confounding by shared genetic and common environmental effects.
Based on previous studies, the following hypotheses were formulated:

1) Childhood maltreatment is positively associated with HAB and aggressive behavior.

2) HAB is positively associated with aggressive behavior

3) There is an indirect effect of childhood maltreatment on aggressive behavior mediated through HAB.

4) Part of the associations between childhood maltreatment, HAB, and aggressive behavior are confounded by shared underlying genetic or common environmental effects, which means that the effect size of the associations is smaller within twin pairs compared to between individuals when controlling for familial clustering in the data.

5) Furthermore, since analyses within MZ twin pairs control for shared common environmental effects and shared genetic effects, whereas within DZ twin pair analyses only control for the former and part of the latter, the effect sizes are expected to be smaller within MZ twin pairs compared to within DZ twin pairs.

Method

Participants

The final sample consisted of female twins and sisters to twins ($N = 2167$, from altogether 1729 families) from the Finnish population-based Genetics of Sexuality and Aggression (GSA) project. Only women who participated both in the GSA data collection conducted in 2006 (mean age at the time of data collection was 25.52 years, $SD = 4.97$) and a follow-up conducted in 2013 (mean age at the time of data collection 33.11 years, $SD = 5.00$) were included.

The data collection conducted in 2006 targeted all Finnish-speaking twins aged 18-33 years and their siblings of at least 18 years of age, residing in Finland at the time of data collection (for a detailed description of the sample, see Johansson et al., 2013). Overall, 23,577 adults met the criteria described above, of which 11,663 were women. Of these women, 6200 responded to the survey, yielding a participation rate of 53.2%. All participants were recruited through the Central Population Registry of Finland. The participants were requested to fill in a questionnaire by mail or online. Women who indicated their willingness to be contacted again in the future for additional data collections were contacted again in 2013 for a follow up ($n = 5197$). This time, the participants were requested to fill in an online questionnaire. The final response rate for this follow-up data collection was 41.8% ($n = 2173$). The research plans for all GSA data collections were accepted by The Ethics Committee of Åbo

Akademi University, in accordance with the Helsinki Declaration. At both data collections, written informed consents were received from the participants.

The sample used in the current study consisted of women who participated in the data collection in 2006 and the follow-up in 2013, and had data available on at least one of the variables of interest. The final sample included 544 monozygotic (MZ) twin individuals, 497 dizygotic (DZ) same-sex twins, 462 DZ opposite sex twins, 37 twins with undefined zygosity, and 627 sisters to twins. The discordant twin analyses were based on data from 131 MZ and 100 DZ twin pairs. In addition, data from eight twin pairs with undefined zygosity were included when both zygosity groups were analysed together.

Zygosity determination. Zygosity was determined for the majority of twins by comparing responses on two items measuring physical resemblance, a questionnaire constructed by Sarna, Kaprio, Sistonen, and Koskenvuo (1978). The two items were "*Were you and your twin partner so similar in appearance at school age that people had difficulty in telling you apart?*" and "*During childhood, were you and your twin partner as like as 'two peas in a pod' or were you not more alike than siblings in general?*" (for more information about these items, see Sarna et al., 1978). The twin pairs who answered "*Yes*" to the first question and "*Like two peas in a pod*" to the second question were labeled as MZ. The twins who answered "*No*" and "*Of ordinary family likeness*" were labeled as DZ. For those complete twin pairs in the GSA sample for whom genotypic data were also available, this questionnaire-based zygosity measure was compared against a genetically derived zygosity measure. In case of discrepancies, the gene-based zygosity measure was used (for more information, the reader is kindly referred to Johansson et al., 2013). In the GSA sample, 91% of the twins provided correct information about their zygosity based on the zygosity questionnaire. Questionnaire-based zygosity determination is widely used in twin research and has shown good validity (Christiansen et al., 2003; Jackson, Snieder, Davis, & Treiber, 2001; Ooki, Yamada, Asaka, & Hayakawa, 1990; Sarna et al., 1978). It has been compared with DNA and has shown good agreement, both when completed by twins and parents of twins (Christiansen et al., 2003, Jackson et al., 2001; Ooki & Asaka, 2004; Rietveld et al., 2000; Sarna et al., 1978).

Measures

Childhood Maltreatment. The Childhood Trauma Questionnaire Short Form (CTQ-SF; Bernstein et al., 2003) was used to measure childhood maltreatment. The questionnaire contains 25 items, and three items that are used to check validity. The CTQ-SF is divided into five scales: physical abuse (e.g. "*I got hit so hard by someone in my family that I had to see a doctor or go the hospital*"), emotional abuse (e.g. "*People in my family said hurtful or insulting things to me*"), sexual abuse (e.g. "*Someone tried to touch me in a sexual way or tried to make me touch them*"), physical neglect (e.g. "*I didn't have enough to eat*") and emotional neglect (e.g. "*I thought that my parents wished that I had never been born*"). Some of the questions are reverse-scored (e.g. "*I felt loved*"). Each scale contains five items which are scored through a 5-point Likert-type scale, from 1 = "*never true*" to 5 = "*very often true*". The questions reveal information about maltreatment during childhood, but they do not specify the age of the participant when it occurred. In this study, childhood maltreatment was measured in the 2006 data collection. A mean score was calculated based on all items except the three items measuring validity. The internal consistency was high in the current sample (α = .903). The CTQ-SF has shown good measurement invariance and good criterion validity (Bernstein et al., 2003). Translated versions of the CTQ-SF has also shown good internal consistency, good test–retest reliability and validity (Gerdner & Allgulander, 2009; Kim, Bae, Han, Oh, & MacDonald, 2013; Thombs, Bernstein, Lobbestael, & Arntz, 2009).

Aggressive Behavior. Aggressive behavior in adulthood was measured using the physical and the verbal aggression scales of the widely used Buss and Perry Aggression Questionnaire (AQ; Buss & Perry, 1992). These scales contain in total 14 items, scored on a 5-point Likert-type scale with the end points of 1 meaning "*Not at all typical*" and 5 meaning "*Very typical*". Questions like "*At times, I can't control the urge to hit someone*" assess physical aggression while questions like "*I can't help getting into arguments when people disagree with me*" assess verbal aggression. In sum, the scales consist of nine questions about physical aggression and five questions about verbal aggression. The questionnaire also contains reverse-scored questions (e.g. "*I cannot imagine myself hitting anyone for any reason*"). In the current study, data on aggressive behavior were used from the 2013 follow-up data collection. A mean score was calculated based on all 14 items. The

questionnaire has shown good reliability and validity (Buss & Perry, 1992; Harris, 1997), and similar results have also been seen in translated versions of the AQ (Collani & Werner, 2005; Meesters, Muris, Bosma, Schouten, & Beuving, 1996). The physical aggression scale has shown high internal consistency and the verbal aggression scale has shown moderate internal consistency (Gerevich, Bácskai, & Czobor, 2007). The internal consistency for the current sample was acceptable (α = .778).

Hostile Attribution Bias. Hostile attribution bias (HAB) was assessed using the Social Information Processing–Attribution and Emotional Response Questionnaire (SIP–AEQ; Coccaro et al., 2009). The questionnaire contains eight vignettes depicting socially ambiguous situations towards the participant, which are either classified as direct aggression (*e.g. someone hits you*) or relational aggression (*e.g., someone rejects you*). Each vignette (e.g. Why do you think s/he bumped your arm making you spill your coffee?) has four different statements that describe possible motives behind the action: hostile intent (e.g. Because s/he wanted to burn me with the hot coffee), indirect hostile intent (e.g. This person wanted to make me look bad to the customer), instrumental non-hostile intent (e.g. This person was focused on the meeting) and neutral or benign intent (e.g. This person did this by accident). Each statement is rated on a scale from 1 to 4 (1 meaning "*not likely at all*" and 4 meaning "*very likely*"). Information about HAB was collected in 2013. A mean score was calculated based on ratings of the response options measuring hostile intent and the response options measuring indirect hostile intent (measures of HAB), and used in the analyses. The correlation between the response options was strong (r = .76, p <.001). The internal consistency for the current sample was acceptable (α = .876). The questionnaire has shown both good discriminant and convergent validity, and good internal reliability (Coccaro et al., 2009).

Statistical Analyses

Descriptive statistics and the correlation analyses were conducted using IBM SPSS Statistics version 24.0 for Windows (IBM Corp., 2016). Descriptive statistics and Pearson correlations were conducted for the raw variable scores based on the entire sample. The significance level was set at 0.05. No data were missing for the HAB

and aggressive behavior items, however, the childhood maltreatment items included some missing data (1.4% or less per item). Missing values were not imputed.

For the main analyses, structural equation modeling (SEM) was used, more specifically path analysis, with Mplus version 7.4 (Muthén & Muthén, 2015) to estimate regressive paths between childhood maltreatment, HAB and aggressive behavior. More specifically, as depicted in the schematic model shown in Figure 1, aggressive behavior was regressed on childhood maltreatment (path c') and HAB (path b), and HAB on childhood maltreatment (path a). The indirect effect of childhood maltreatment on aggressive behavior through HAB (path ab) was also estimated using the "MODEL INDIRECT" command in Mplus. Maximum likelihood estimation was used with robust standard errors which enables inclusion of missing values (Yuan & Bentler, 2000). The main analyses were conducted in three steps. First, the paths were estimated using the entire sample comprising both twins and sisters to twins ($N = 2167$). Interdependency between members of the same family was taken into account using the "CLUSTER" option. Second, paths were estimated within all twin pairs (regardless of zygosity; n pairs = 239). Third, paths were estimated within twin pairs, for MZ and DZ twin pairs (131 MZ pairs and 100 DZ pairs) using a multigroup approach. Results from standardized two-tailed tests were reported including 95% confidence intervals for the regression coefficients. Age was used as a covariate in all analyses.

Steps two and three are forms of the discordant twin method, in which confounding effects of familial (genetic or common environmental influences) can be controlled for by comparing twins within a pair. For this aim, the difference score strategy was used (Vitaro et al., 2009) in which the associations between the differences in the environmental experience of interest between the twins in a twin pair, and the difference in the outcome variable between the twins in a twin pair, are examined. Relative within-pair difference scores were computed by randomly categorizing one of the twins in a pair as twin 1 and the other as twin 2, and then subtracting the score of twin 1 with the score of twin 2, for childhood maltreatment, HAB, and aggressive behavior, respectively (for more information about the difference score strategy, see Vitaro et al., 2009). Thereafter, as described above, SEM was used to estimate associations between the difference scores of the variables (in a similar manner, as depicted in Figure 1). All variables where measured continuously.

A.

B.
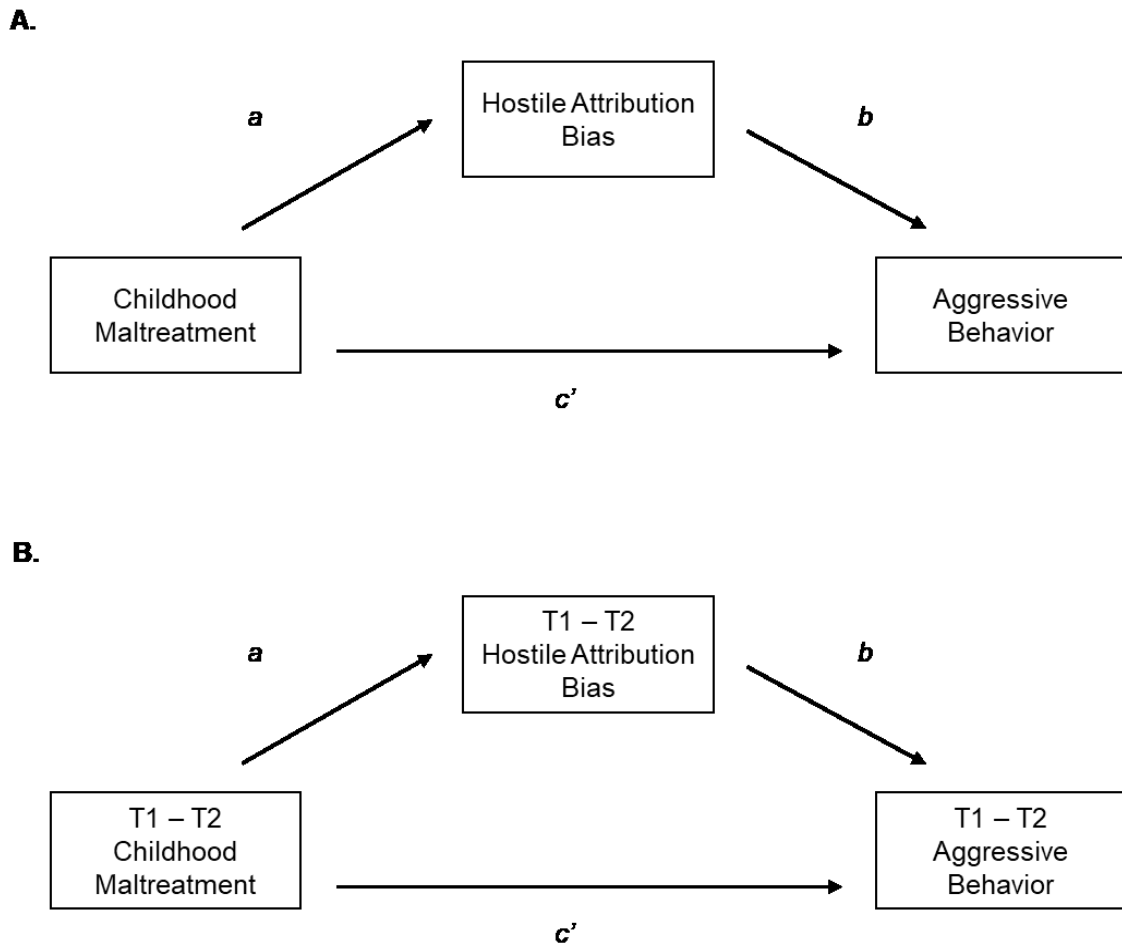
Figure 1. A schematic representation of the hypothesized model in which hostile attribution bias (HAB) mediates the association between childhood maltreatment and aggressive behavior, both between individuals for the entire sample (A) and for the within twin pair analyses (B). (T1 – T2) stands for the difference in the variable between twin 1 (T1) and twin 2 (T2) in a pair. The model disentangles the direct effect of childhood maltreatment on aggressive behavior (path *c'*) while controlling for the effect of HAB, and the indirect effect of childhood maltreatment on aggressive behavior through increased HAB (path *ab*). Single-headed arrows represent regression paths.

Results

Descriptive statistics and correlations

Descriptive statistics and Pearson correlations were conducted for the entire sample using the raw mean scores (see Table 1). As expected, the variables childhood maltreatment, HAB and aggressive behavior correlated positively with each other, although the magnitudes of the correlations were relatively low. The mean score for the questionnaire measuring childhood maltreatment was between "never true" and "rarely true". The mean score for the questionnaire measuring HAB was between "not likely at all" and "unlikely". The mean score for the aggression questionnaire was between "not at all typical" and "not that typical". The mean scores indicated relatively low levels of childhood maltreatment, HAB and aggressive behavior in the entire sample.

Based on visual inspection, childhood maltreatment was non-normally distributed, with a skewness of 2.04 (SE = .05) and a kurtosis of 5.26 (SE = .11). Aggressive behavior was also non-normally distributed, with a skewness of 1.51 (SE = .05) and a kurtosis of 4.15 (SE = .11). Because childhood maltreatment and aggressive behavior were skewed, these variables were log transformed for the remaining analyses. The HAB variable was normally distributed and therefore not log transformed.

Table 1

Means (SD), ranges and intercorrelations for childhood maltreatment, hostile attribution bias, and aggressive behavior based on raw mean scores

Variable	*M*	*SD*	Range		Pearson Correlations		
			Min.	Max.	<u>1.</u>	<u>2.</u>	<u>3.</u>
1. Childhood maltreatment	1.42	.44	1.00	3.92			
2. Hostile attribution bias	1.86	.41	1.00	3.94	.14**		
3. Aggressive behavior	1.82	.43	1.00	4.57	.22**	.22**	

Note. Childhood maltreatment was measured with Childhood trauma questionnaire short form (on a scale from 1 to 5). Hostile attribution bias (HAB) was measured with Social information processing–attribution and emotional response questionnaire (on a scale from 1 to 4). Aggressive behavior was measured with Aggression questionnaire (from a scale from 1 to 5). Higher values indicated higher levels of childhood maltreatment, HAB, and aggressive behavior, respectively. **.Correlation is significant at the 0.01 level (2-tailed).

**Main analyses with SEM using the entire sample**

First, the associations between the three variables of interest were examined with SEM in an attempt to replicate previous studies (hypotheses 1-3). Results are presented in Table 2 and Figure 2 (included for illustrative purposes to ease comparison between effect sizes of the different paths between the different groups). As in previous studies, childhood maltreatment was significantly and positively associated with both aggressive behavior and HAB (confirming hypothesis 1). HAB was also positively associated with aggressive behavior, in line with previous studies (confirming hypothesis 2). The results also showed that there was a significant indirect effect of childhood maltreatment on aggressive behavior mediated through HAB (confirming hypothesis 3).

Table 2

Structural equation modeling of the different paths between childhood maltreatment, aggressive behavior and hostile attribution bias separately for the whole sample, as well as within all twin pairs, within dizygotic twin pairs and within monozygotic twin pairs.

	All (N = 2167)			All twins[a] (n pairs = 239)			DZ[a] (n pairs = 100)			MZ[a] (n pairs= 131)		
	B [95% CI]	SE	p	B [95% CI]	SE	p	B [95% CI]	SE	p	B [95% CI]	SE	p
Path c'	0.19 [0.15, 0.23]	.02	<.001	.04 [-0.06, 0.14]	.06	.513	.12 [-0.03, 0.26]	.09	.183	-.07 [-0.20, 0.06]	.08	.352
Path a	0.15 [0.11, 0.18]	.02	<.001	-.01 [-0.13, 0.11]	.07	.899	-.05 [-0.24, 0.15]	.12	.071	.05 [-0.09, 0.19]	.09	.563
Path b	0.18 [0.15, 0.22]	.02	<.001	.11 [0.01, 0.22]	.06	.077	.17 [-0.00, 0.34]	.10	.105	.07 [-0.05, 0.20]	.08	.340
Path ab	.03 [0.02, 0.04]	.01	<.001	.00 [-0.02, 0.01]	.01	.899	-.01 [-0.04, 0.03]	.02	.710	.00 [-0.01, 0.02]	.01	.638

Note. Age was included in the models as a covariate. Path c' = The direct effect of childhood maltreatment on aggressive behavior while controlling for the effect of HAB. Path a = The effect of childhood maltreatment on hostile attribution bias (HAB). Path b = The effect of HAB on aggressive behavior. Path ab = The indirect effect of childhood maltreatment on aggressive behavior through increased HAB. MZ = Monozygotic twins. DZ = Dizygotic twins. [a] = based on within twin pair analyses, i.e. the difference between the twins in one variable is regressed onto the twin difference in another variable.
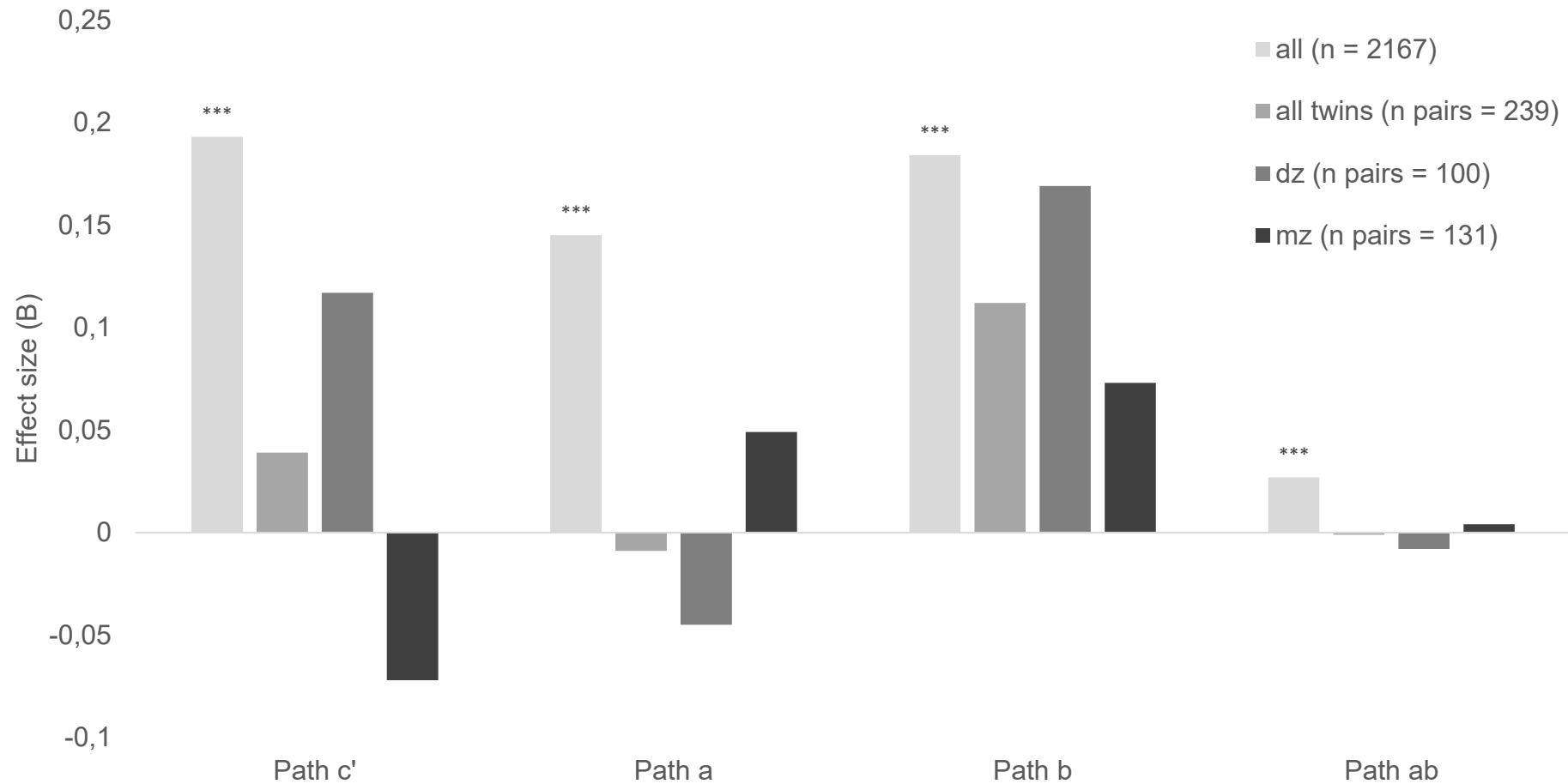
Figure 2. A visual representation to ease comparison between effect sizes of path c' = The direct effect of childhood maltreatment on aggressive behavior while controlling for the effect of hostile attribution bias (HAB), path a = The effect of childhood maltreatment on HAB, path b = The effect of HAB on aggressive behavior and path ab = The indirect effect of childhood maltreatment on aggressive behavior through increased HAB between all participants, all twin pairs, DZ twin pairs and MZ twin pairs. *** Association is significant at the $p < .001$ level.

Discordant twin analyses

Next, discordant twin analyses were conducted to control for genetic and environmental effects shared between the twins. Results from the discordant twin analyses are also shown in Table 2. The effect sizes from the different groups (all participants, all twins, DZ twins, MZ twins) were visually compared to each other (Figure 2). First, regression paths (see Figure 1 for an illustration) were estimated within all twin pairs (not separating between MZ and DZ twins). The effect sizes for the associations between childhood maltreatment and aggressive behavior, as well as HAB and aggressive behavior, were smaller when analyzed within twin pairs using the difference score strategy, compared to the between individual analyses using the entire sample (Table 2, Figure 2). The indirect effect of childhood maltreatment on aggressive behavior through HAB showed similar results; the effect was smaller when analyzed within twin pairs using the difference score strategy, compared to the between individual analyses using the entire sample (Table 2, Figure 2). Furthermore, the paths were no longer significant. The smaller effect sizes imply that the associations between the variables might be at least partly confounded by underlying genetic or common environmental effects shared between the variables. The pattern of the effect size of the association between childhood maltreatment and HAB was unclear, because it turned out to be negative. However, when it comes to the 95% confidence interval of this association, it overlapped zero.

Lastly, DZ twins and MZ twins were examined separately using a multigroup approach. In line with the within all twin pair results, none of the paths (see Figure 1) were significant for either within DZ twin pairs or within MZ twin pairs and, overall, the effect sizes for the associations between childhood maltreatment, HAB and aggressive behavior were again lower than for the between individual analyses using the entire sample.

The within twin pair analyses for DZ twins, as well as for all twins not taking into account zygosity, control for confounding due to shared common environmental effects between the variables, but only account for part of the potential genetic confounding. Comparing MZ twins in a pair to each other controls, however, for both types of confounding. Therefore, analyzing the associations between childhood maltreatment, HAB and aggressive behavior within MZ twin pairs is the most stringent control of confounding by shared common environmental and genetic influences. The effect sizes for the associations between childhood maltreatment and

aggressive behavior, between childhood maltreatment and HAB, HAB and aggressive behavior, and the indirect effect of childhood maltreatment mediated by HAB on aggressive behavior, were all smaller for the MZ twins compared to the entire sample and non-significant. The direction of the effect size for the association between childhood maltreatment and aggressive behavior was negative, however, the 95% confidence interval overlapped zero. These results support the assumption that at least part of the associations between childhood maltreatment, HAB and aggressive behavior are due to underlying influences of shared genetic or common environmental factors. Since none of the associations were significant when analyzed within MZ twin pairs (or within all twin pairs), it is unclear whether robust associations between the variables exist when familial confounding has been accounted for.

Because within MZ twin pair analyses control for both common environmental and shared genetic effects, whereas within DZ twin pair analyses only control for the former and part of the latter, the effect size is expected to be smaller within MZ twin pairs than within DZ twin pairs if there would be a genetic confounding. Visual comparisons between within DZ twin pair analyses and within MZ twin pair analyses suggested that the confounding would not only be due to shared common environmental factors, but also due to shared genetic effects, for the association between HAB and aggressive behavior. The indirect effect of childhood maltreatment on aggressive behavior through HAB was estimated close to zero in all analyzes except for the entire sample not accounting for any confounding. For the remaining paths (path a and path c´), the pattern of effect sizes was somewhat unclear between the dz and mz groups, and should thus be interpreted caution with regards to whether the familial confounding is due to shared genes or common environmental factors. One should bear in mind, when interpreting the effect sizes, that all associations were non-significant for the within twin pair analyses.

In summary, as said before, none of the discordant twin analyses were significant. Regarding hypothesis 4, the effect sizes were smaller for all the discordant twin analyses than for the entire sample analyses, indicating that the associations between childhood maltreatment, HAB and aggressive behavior are at least partly confounded by shared underlying genetic or common environmental effects. Further, regarding hypothesis 5, the results indicate that the association

between HAB and aggressive behavior is not only confounded by common environmental effects, but also by shared genetic effects.

Discussion

Several theoretical models have tried to explain the development of aggressive behavior. One of them is the social information processing (SIP) model which is based on the assumption that people go through six different steps in their mind when facing social situational cues (Crick & Dodge, 1994; Dodge et al., 1986). According to Dodge et al. (1995) maltreated children tend to make different biases in this SIP model, such as hostile attribution bias (HAB) which, in turn, may increase the likelihood of aggressive behavior. A few studies have specifically analyzed whether the effect of childhood maltreatment on aggressive behavior is mediated by HAB, with the majority of them finding results indicative of mediation (Calvete & Orue, 2011; Coccaro et al., 2009; Dodge et al., 1990; Richey et al., 2016). It is, however, possible that these associations are not causal, but instead at least partly due to the same familial (genetic or common environmental) factors influencing childhood maltreatment, HAB and aggressive behavior. To the author's knowledge, this is the first study to analyze whether the indirect effect of childhood maltreatment on aggressive behavior mediated by HAB exists while controlling for genetic and common environmental confounders. Familial confounding was investigated, and controlled for, using the discordant twin design (e.g. Vitaro et al., 2009) in a population-based sample of Finnish female twins and their sisters.

Consistent with previous findings (Allen, 2011; Berzenski & Yates, 2010; Chen et al., 2012; Cowie, 2015; Cullerton-Sen et al., 2008; Frazzetto et al., 2007; Richey et al., 2016; Taft et al., 2008) childhood maltreatment and aggressive behavior were positively associated. Childhood maltreatment was also positively associated with HAB, in line with findings from previous studies (Price & Glad, 2003; Richey et al., 2016), confirming the first hypothesis that childhood maltreatment is positively associated with both HAB and aggressive behavior. Furthermore, also consistent with previous findings (Bailey & Ostrov, 2008; Crick et al., 2002; for a meta-analysis, see De Castro et al., 2002; Richey et al., 2016; Walters, 2007), HAB and aggressive behavior were positively associated, confirming the second hypothesis. One way to look at these findings is that maltreated children are more likely to interpret others' actions as hostile, and that they are also more

likely to develop aggressive behavior. It also seems that people who interpret others' actions as hostile are more likely to behave aggressively.

Further, the results indicated a positive significant indirect effect of childhood maltreatment on aggressive behavior mediated through HAB, in line with the third hypothesis. These results are consistent with previous findings indicating that biases in SIP works as a mediating variable between childhood maltreatment and aggressive behavior (Calvete & Orue, 2011; Dodge et al., 1990; Dodge et al., 1995; Taft et al., 2008), and also with findings indicating that especially HAB works as that mediator (Calvete & Orue, 2011; Coccaro et al., 2009; Dodge et al., 1990). An explanation to this could be that maltreatment has psychological effects on individuals' ways to interpret others' actions and motives. Individuals who have been maltreated are more likely to view others' actions as hostile and that, in turn, increases the likelihood of aggressive behavior.

The results were also in line with findings by Richey et al. (2016) who found in their study (n = 339 college students) that instrumental HAB (defined by the authors as a belief that someone is acting hostile toward someone else's belongings) partially mediated the association between childhood maltreatment and reactive aggression (response to provocation). However, the same study indicated that relational HAB (defined by the authors as a belief that someone is acting hostile toward someone's interpersonal relationship) did not act as a mediator between childhood maltreatment and reactive aggression. The authors thus hypothesized, that some forms of HAB might be more pronounced than others in explaining aggressive behavior in maltreated individuals (Richey et al., 2016). The present study, however, did not analyze the different parts of HAB separately, and the results by Richey et al. (2016) have yet to be replicated. In addition, a study by Cowie (2015) failed to identify HAB as a mediator between emotional childhood maltreatment and aggressive behavior, however, this study was likely underpowered due to a small sample size (n = 42). Findings from Chen et al. (2012) showed that childhood maltreatment moderated the relationship between social information processing (HAB) and aggression, so that the association between HAB and aggression was stronger when the participants showed less of physical neglect and emotional abuse. These findings should be viewed carefully; other aspects of SIP showed different results which could indicate that the results could have been biased (Chen et al., 2012). The study by Chen et al. (2012) also found that childhood maltreatment and

aggression were associated even when controlling for HAB. In line with this, the results of the present study revealed a direct effect of childhood maltreatment on aggressive behavior, in addition to the indirect effect mediated through HAB, thus indicating that childhood maltreatment also has a unique contribution to aggressive behavior, over and above the indirect path through HAB. The association between childhood maltreatment and aggressive behavior can also be mediated by problems with emotion regulation or other aspects of SIP like; having access to aggressive responses, encoding errors and positive evaluation of aggression (Dodge et al., 1995; Lee & Hoaken, 2007).

It is important to understand the mechanism behind aggressive behavior; which factors may lead to it or work as mediators, so that we have the knowledge to focus on the right aspects in the intervention and prevention of aggressive behavior. The social information processing theory has been used in intervention programs to reduce aggressive behavior, and it has shown positive outcomes (Li, 2013; Terzian, 2015; Wilson, Lipsey, & Wilson, 2006). Previous intervention programs have focused on all aspects of SIP, but Richey et al. (2016) suggested that it would save some time and resources to only concentrate on HAB (especially instrumental HAB) in the intervention. If HAB works as a *causal* mediator between childhood maltreatment and aggressive behavior, it might be possible to prevent maltreated children from becoming aggressive later in life by focusing on their social information processing skills, especially HAB. However, if the associations are not causal in nature, but more or less confounded by underlying familial factors shared between the variables, this might decrease expectations of treatment efficacy of such interventions.

Thus, the second aim was to test whether shared underlying familial (genetic or common environmental) factors could account for part of the associations between childhood maltreatment, HAB and aggressive behavior, as well as the indirect effect of maltreatment on aggressive behavior through HAB, by using a discordant twin method. If an effect is truly causal, the twin with higher values on the independent variable (e.g. childhood maltreatment), should also show higher values on the dependent variable (e.g. aggressive behavior), that is, a difference within the twin pairs in one variable should be associated with differences within the twin pairs in the second variable. If the effect between variables is attenuated when analyzed within twin pairs in comparison to in an unrelated sample (or in this case a

sample in which interdependence due to family membership is controlled for), it indicates that part of the association is confounded by genetic or common environmental influences, shared between the variables. As hypothesized, the effect sizes for all associations were smaller for the within twin pair analyses than for the between individual analyses using the entire sample (not controlling for confounding by shared genes or common environmental factors), indicating that the associations were at least partly confounded by such familial factors (confirming the fourth hypothesis). Together with the fact that the associations from the within twin pairs were not significant, this indicates that it is unclear whether, or to what degree, robust associations remain when controlling for familial confounding. Common environmental effects shared between the variables could for instance be the family environment or the neighborhood environment. In addition, confounding could occur, for example, if parents who are genetically predisposed to behave aggressively, may also act aggressively and maltreat their own children at the same time as the child inherits part of his/her parents genetic predisposition for aggressive behavior. This way, a correlation between childhood maltreatment and aggressive behavior of the child might arise, even though the effect between maltreatment and aggressive behavior might not be causal. Similarly, a child might inherit both a predisposition for HAB and for aggressive behavior, and something in the family environment, might influence both HAB and aggressive behavior. Inferences regarding the nature of the confounding (genetic or common environmental in origin) cannot, however, be drawn when all twins regardless of zygosity are grouped together.

Regarding the fifth hypothesis, that part of the confounding would be genetic in origin, was indicated only for the association between HAB and aggressive behavior. This means that people who tend to interpret others' actions and motives as hostile are more likely to behave aggressively, and that association is partly influenced by genetic influences shared between HAB and aggressive behavior. For example, the genetic set of an individual who tends to interpret others' actions as hostile, can affect his or her likelihood to behave aggressively. The results were somewhat unclear for the other associations.

Overall, the association between HAB and aggressive behavior seemed most robust of the tested associations after controlling for confounding, even though it did not reach significance. Previous research indicates that negatively biased social

cognitive factors (e.g. social information processing) partially mediated the association between social-environmental risk factors (social rejection and community violence exposure) and aggressive behavior (Bradshaw, 2004). The study found that social information processing was more related to violent exposure than to social rejection. Previous studies have also shown that social information processing partially mediate the association between social rejection and aggression in children (Dodge, 2003). In other words, the relationship between HAB and aggressive behavior could be influenced also by social-environmental risk factors outside the family environment (i.e. likely not shared between twins) and such factors would, thus, not be taken into account in the discordant twin analyses.

The finding that at least part of the associations between childhood maltreatment, HAB and aggressive behavior are confounded by familial factors shared between the variables, is in line with previous studies which have found genetic or environmental confounding in the associations between childhood maltreatment and other variables. Forsman and Långström (2012) found genetic and environmental confounding in the association between childhood maltreatment and adult violent offending. Similar findings were also shown in a study by Capusan et al. (2016), where the association between childhood maltreatment and ADHD symptoms was partly causal but also partly confounded by genes and environment. Common environmental factors were also discovered in members of twin pairs in a study regarding the association between childhood maltreatment and alcoholism (Young-Wolff et al., 2011).

The reason why the discordant twin analyses were conducted both separately for DZ and MZ twin pairs, as well as for all twin pairs together, is the sample size. Even if the best way to control for genetic and environmental confounding is to only use MZ twin pairs, both zygosity groups had quite small sample sizes. Small sample sizes can easily lead to biases. To obtain a greater sample size, and thereby more statistical power, all the twin pairs were gathered into one group. That way a more robust estimate was gained, even though it only discovered familial confounding without saying anything about environment or genes.

Strengths and Limitations

There were both some strengths and some limitations with the study, and these must be taken into consideration when interpreting the results. A strength with the current

study was that a large population-based female sample ($N = 2167$) was used, which allows the results to be generalized to the female population. Compared to men, less is known about aggressive behavior and its development in women. A strength was also that this is the first study to control for potential genetic and common environmental confounding for the associations between childhood maltreatment, HAB and aggressive behavior by using the discordant twin method. The discordant twin method has shown strong internal validity (Vitaro et al., 2009) and has been used to investigate the possible causal nature of several different associations when experimental manipulation is not possible (Baur et al., 2016; Vitaro et al., 2009). Childhood maltreatment, HAB and aggressive behavior were measured with questionnaires showing good validity and reliability (Bernstein et al., 2003; Buss & Perry, 1992; Coccaro et al., 2009; Collani & Werner, 2005; Gerdner & Allgulander, 2009; Harris, 1997; Kim et al., 2013; Meesters et al., 1996; Thombs et al., 2009). The data were collected on two occasions, the first one in 2006 (childhood maltreatment) and the follow-up in 2013 (aggressive behavior and HAB), however data for all variables were not collected on both time points. When it comes to testing causality, the best scenario would be that all variables would have been collected at all time points (Kenny, 1975). Thus, although the data can be informative in rejecting causality through the discordant twin analyses, it cannot be used to prove causality. The present study used twins (and sisters to twins) as sample; therefore, it is important to discuss the generalizability to non-twins. Studies have shown that twins only differ from non-twins in some single aspects (such as language development and weight), but most aspects do not differ, and therefore results from twin studies can be generalized to the non-twin population (Andrew et al., 2001; Johnson, Krueger, Bouchard, & McGue, 2002; Pulkkinen, Vaalamo, Hietala, Kaprio, & Rose, 2003).

A limitation in the present study was that because the sample included only women, it is unclear whether the results are generalizable to men. A meta-analytic review showed gender differences in aggression, indicating that boys showed more direct aggression than girls (Card, Stucky, Sawalani, & Little, 2008). A study by Mathieson et al. (2011) showed that the association between HAB and relational aggression was moderated by relational risk factors (e.g. emotional sensitivity) in girls, but not in boys. Another study indicated that girls showed more HAB in relational situations compared to boys (Godleski & Ostrov, 2010). Further, childhood

sexual abuse has shown to be more common among women than men (Pereda, 2009a, 2009b; Stoltenborgh, Van Ijzendoorn, Euser, & Bakermans-Kranenburg, 2011). Because of these gender differences, it is possible that the associations could look different for men than for women. Although the entire sample was large, the sample sizes were small for the discordant twin analyses for the group with all twins (*n* pairs = 239), for the DZ group (*n* pairs = 100) and for the MZ group (*n* pairs = 131). That none of the effects were significant for the discordant twin analyses may depend on the fact that the statistical power to find effects is weaker due to the small sample size for these groups. The response rates for the data collections were 53% and 42% respectively. The sample was, however, at first wave comparable to other population-based samples on different characteristics (Johansson et al., 2013). A limitation to remember regarding the discordant twin method, is that even if twins share many environmental factors, they do not share all environmental experiences (e.g. being bullied in school) (Vitaro et al., 2009) and cannot, thus, control for confounding of such factors. Also, importantly, the method does not guarantee that the association is causal, because there is no assurance that the method controls for all possible confounders (Forsman & Långström, 2012). Another thing to keep in mind is that it is possible that the associations were influenced by other factors, which were not measured in the present study (e.g. anxiety, impulsiveness etc.). In self-reports such as questionnaires, there is always a risk that some individuals answer dishonestly (e.g. they want to protect their privacy or provide a better picture of themselves) (Van de Mortel, 2008). Another bias that can occur with questionnaires is that some people tend to answer with only the extremes of the response options (Baur et al., 2016). Another limitation was that childhood maltreatment was measured in retrospect. Retrospective self-reports might not be entirely reliable, because there is a chance that people forget things or make other reporting biases when they fill in the self-reports (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008). A review by Hardt and Rutter (2004), where they looked at the retrospective reports of adults on their negative events in childhood (abuse/neglect/family conflicts), indicated, however, that the reports can be seen as valid, even if they involve some false negatives and measurement error. They found that people tend to underestimate the occurrence of abuse/neglect more likely than overestimate (Hardt & Rutter, 2004).

Conclusions

The present study replicated findings regarding the associations between childhood maltreatment, HAB and aggressive behavior, in a large population-based sample of Finnish female twins and their sisters. A positive significant association was found between all the variables. Findings showed that HAB worked as a mediator between childhood maltreatment and aggressive behavior. An explanation for this would be that maltreatment has psychological negative effects on the way people look at others' actions and motives, and if they interpret others' actions as hostile, they are more likely to behave aggressively towards them, than if they would interpret others' actions and motives as neutral, in line with social information processing theories. However, when looking at the overall picture of the discordant twin analyses, the results indicated that the associations between all the variables were confounded to some degree by familial (genes or common environment) factors shared between the variables. Additionally, the association between HAB and aggressive behavior was not only influenced by common environmental effects, but also by genetic effects shared between the variables. For the development of future prevention of aggressive behavior, it is important to understand the mechanisms behind it, and these findings suggest that part of the relationships between childhood maltreatment, HAB and aggressive behavior are confounded by familial factors. More research is needed, preferably using larger samples including all genders, to investigate whether there is evidence to support causal associations after controlling for familial confounding.

Swedish Summary

Medieras associationen mellan barnmisshandel och aggressivt beteende av fientlig attributionsbias hos kvinnor? En disharmonisk tvillingstudie

Inledning

Aggression är ett socialt problem som vårt samhälle borde uppmärksamma (Anderson & Bushman, 2002). Aggression kan definieras som ett beteende där man vill skada andra som inte vill bli skadade (Baron & Richardson, 2004). Aggression är en instinkt som är till nytta för vår överlevnad men som kan vara till skada om det används på fel sätt (Lorenz, 2005) och kan i värsta fall leda till svåra skador för den utsatta eller till och med dödsfall (Krug, Mercy, Dahlberg, & Zwi, 2002). För att kunna förebygga samt utveckla den bästa behandlingen för aggressivt beteende är det viktigt att förstå dess uppkomst (Dodge, 2006; Richey, Brown, Fite, & Bortolato, 2016).

Den sociala informationsprocesseringsteorin (SIP) är en av flera teorier som förklarar uppkomsten av aggressivt beteende (Crick & Dodge, 1994; Dodge, Pettit, McClaskey, Brown, & Gottman, 1986). Teorin presenterar de emotionella och kognitiva processerna som leder till aggressivt beteende i sociala situationer. En bias i någon av dessa processer kan leda till aggressivt beteende (Crick & Dodge, 1994; De Castro, Veerman, Koops, Bosch, & Monshouwer, 2002; Dodge m.fl., 1986). Fientlig attributionsbias (HAB) är ett exempel av en sådan bias (Crick & Dodge, 1994; De Castro m.fl., 2002; Dodge m.fl., 1986). HAB innebär att man tenderar att tolka andras icke-fientliga avsikter som fientliga (Epps & Kendall, 1995; Matthews & Norris, 2002; Milich & Dodge, 1984). HAB har visat sig vara associerad med aggressivt beteende hos både barn (Crick, Grotpeter, & Bigbee, 2002; se meta-analys De Castro m.fl., 2002) och vuxna (Bailey & Ostrov, 2008; Chen, Coccaro, Lee, & Jacobson, 2012; Richey m.fl., 2016). HAB har även visat sig vara positivt associerad med en historik av tidigare aggressivt beteende (Coccaro, Fanning, Keedy, & Lee, 2016).

Barnmisshandel kan definieras som emotionell misshandel, fysisk misshandel, sexuell misshandel, emotionell försummelse och fysisk försummelse. (Finkelhor, Turner, Shattuck, & Hamby, 2013; Hussey, Chang, & Kotch, 2006). Studier har visat att barnmisshandel är associerad med aggressivt beteende både hos barn (Cullerton-

Sen m.fl., 2008) och vuxna (Allen, 2011; Berzenski & Yates, 2010; Chen m.fl., 2012; Cowie, 2015; Frazzetto m.fl., 2007; Richey m.fl., 2016; Taft, Schumm, Marshall, Panuzio, & Holtzworth-Munroe, 2008). Barnmisshandel har också visat sig vara associerad med HAB både i studier med barn (t.ex., Price & Glad, 2003) och vuxna (Richey m.fl., 2016).

Dodge, Pettit, Bates, and Valente (1995) gjorde antagandet att barn som blivit utsatta för misshandel skulle utveckla mera externaliserade beteendeproblem och att denna association skulle medieras av biaser gjorda i SIP, speciellt av HAB. De antog också att alla biaser i SIP skulle leda till aggressivt beteende i socialt tvetydiga situationer. Tidigare studier tyder på att associationen mellan barnmisshandel och aggressivt beteende är partiellt medierad av SIP hos barn (Dodge m.fl., 1990; Dodge m.fl., 1995), ungdomar (Calvete & Orue, 2011) och vuxna (Taft m.fl., 2008). Framför allt har det visat sig att HAB medierar associationen mellan dessa variabler hos barn (Dodge m.fl., 1990), ungdomar (Calvete & Orue, 2011) och vuxna (Coccaro, Noblett, & McCloskey, 2009). En studie fann en indirekt effekt av barnmisshandel via instrumentell HAB på reaktiv aggression (Richey m.fl., 2016). En annan studie med 42 deltagare kunde dock inte identifiera att HAB medierade associationen mellan emotionell barnmisshandel och aggression (Cowie, 2015). En studie av Chen m.fl. (2012) fann att barnmisshandel var associerad med högre nivåer av aggression i vuxenlivet, även när man kontrollerade för SIP. Studien visade också att associationen mellan HAB och aggression var starkare när individerna rapporterat mindre fysisk vanvård och emotionell misshandel.

Även om tidigare studier tyder på att det finns en association mellan barnmisshandel och aggressivt beteende som medieras av HAB, kan man inte med säkerhet veta om associationen är kausal. Det kan hända att associationerna de facto uppstår på grund av att familjära faktorer (gener eller omgivning) delas mellan några, eller mellan alla, variabler. Problemet med gemensamma familjära faktorer kan lösas med en studiedesign där man jämför enäggstvillingar (MZ) med tvåäggstvillingar (DZ). Tidigare studier har visat att bland annat aggressivt beteende och barnmisshandel har en genetisk bakgrund (Beatty, Heisel, Hall, Levine, & La France, 2002; Miles & Carey, 1997; Pezzoli, Antfolk, Hatoum, & Santtila, 2018; Vassos, Collier & Fazel, 2014). Den disharmoniska tvillingmetoden är en metod som används för att analysera styrkan av den möjliga kausala associationen mellan en oberoende variabel och en beroende variabel när experimentell manipulation inte är

möjligt (Vitaro, Brendgren & Arseneault, 2009). På grund av att metoden använder sig av tvillingar kan man kontrollera för familjära förväxlingsfaktorer som kan vara delade mellan beroende variabeln och den förväntade kausala faktorn (McGue, Osler, & Christensen, 2010; Vitaro m.fl., 2009). Om effekten av en faktor (ex. HAB eller barnmisshandel) är kausal, så skulle man kunna förvänta sig att tvillingen med högre nivåer av HAB eller barnmisshandel också skulle visa högre nivåer av aggressivt beteende i jämförelse till sin tvilling. Om effekterna i associationerna är mindre i analyserna gjorda inom tvillingparen (disharmoniska för barnmisshandel och HAB) i jämförelse med analyserna utförda mellan tvillingarna eller individerna som inte är släkt, så betyder det att en del av associationerna är påverkade av delade gen- och omgivningseffekter. För att studera möjliga kausala associationer mellan olika variabler så har tidigare studier även använt sig av den disharmoniska tvillingmetoden eller andra liknande metoder (Capusan m.fl., 2016; Forsman, Johansson, Santtila, Sandnabba, & Långström, 2015; Forsman & Långstöm, 2012; Young-Wolff, Kendler, Ericson, & Prescott, 2011). Såvitt skribenten vet, så är denna studie den första som analyserar den indirekta effekten av barnmisshandel på aggressivt beteende genom HAB, samtidigt som man kontrollerar för möjliga familjära förväxlingsfaktorer med den disharmoniska tvillingmetoden.

Studien hade två olika syften. Första syftet var att replikera tidigare studier angående associationerna mellan barnmisshandel, HAB och aggressivt beteende. Detta i ett stort populationsbaserat sampel bestående av finländska kvinnliga tvillingar och deras systrar. Specifikt var syftet att studera ifall associationen mellan barnmisshandel och aggressivt beteende medierades av HAB. Andra syftet i denna studie var att analysera ifall associationerna mellan barnmisshandel, HAB och aggressivt beteende, samt den indirekta effekten av barnmisshandel på aggressivt beteende medierad av HAB skulle minska eller försvinna när man kontrollerade för potentiella förväxlingsfaktorer (delade gener och omgivning). Hypoteserna för studien var: 1) Barnmisshandel är positivt associerad med HAB och aggressivt beteende, 2) HAB är positivt associerad med aggressivt beteende, 3) Det finns en indirekt effekt mellan barnmisshandel och aggressivt beteende som är medierad av HAB, 4) En del av associationen mellan barnmisshandel, HAB och aggressivt beteende är påverkad av delade underliggande genetiska effekter eller gemensamma omgivningseffekter, vilket betyder att effektstorlekarna är mindre i analyserna utförda inom tvillingparen jämfört med analyserna utförda mellan individerna när

man kontrollerar för familjära kluster, 5) Analyser med MZ tvillingpar kontrollerar både för delade genetiska effekter och gemensamma omgivningseffekter. Analyser med DZ tvillingpar i sin tur, kontrollerar för gemensamma omgivningseffekter men endast delvis för de delade genetiska effekterna. På grund av detta så förväntas effektstorlekarna vara mindre i analyserna med MZ tvillingpar jämfört med analyserna med DZ tvillingpar.

Metod

Samplet i denna studie bestod av kvinnliga tvillingar och deras systrar ($N =$ 2167, från 1729 familjer) från Finnish population-based Genetics of Sexuality and Aggression (GSA) projektet. Alla deltagare rekryterades från finska befolkningsregistercentralen och var över 18 år gamla. År 2006 ombads deltagarna i GSA projektet att fylla i ett frågeformulär manuellt eller via nätet. År 2013 ombads de igen att fylla i ett frågeformulär som uppföljning. Forskningsplanerna för alla GSA datainsamlingarna accepterades av etiska nämnden vid Åbo Akademi, i enlighet med Helsingfors deklarationen. Det slutliga samplet bestod av kvinnor som hade svarat på båda frågeformulären (2006 och 2013) och som hade information tillgänglig minst i en av de variablerna som vi studerade. Det slutliga samplet bestod av 544 MZ tvillingar, 497 DZ tvillingar av samma kön, 462 DZ tvillingar av olika kön, 37 tvillingar med odefinierad zygositet och 627 systrar till tvillingar. De disharmoniska tvillinganalyserna baserades på data från 131 MZ och 100 DZ tvillingpar. Data från åtta tvillingpar med odefinierad zygositet inkluderades när båda zygositet grupperna analyserades tillsammans. Tvillingarnas zygositet bestämdes för de flesta tvillingar genom att jämföra svaren i ett frågeformulär som mäter fysisk likhet, skapad av Sarna, Kaprio, Sistonen, and Koskenvuo (1978). Barnmisshandel mättes år 2006 med The Childhood Trauma Questionnaire Short Form (CTQ-SF; för mer information se Bernstein m.fl., 2003). Ett medeltal räknades ut av alla frågor. Tre frågor som mätte validitet exkluderades. Aggressivt beteende i vuxenålder mättes i uppföljningen år 2013 med en fysisk och verbal aggressionsskala från Buss and Perry Aggression Questionnaire (AQ; för mer information se Buss & Perry, 1992). Ett medeltal räknades ut av alla 14 frågor. HAB mättes år 2013 med Social Information Processing–Attribution and Emotional Response Questionnaire (SIP–AEQ; för mer information se Coccaro m.fl., 2009). Frågeformuläret mäter flera aspekter gällande social informationsprocessering men i

analyserna använde sig denna studie endast av frågor som mätte fientlig avsikt och indirekt fientlig avsikt (båda är mått på HAB). Ett gemensamt medeltal räknades ut för alla frågor som mätte dessa två kategorier.

Beskrivande statistik och Pearsons korrelation utfördes för råvariablerna med IBM SPSS Statistics version 24.0 för Windows (IBM Corp., 2016). I huvudanalyserna användes strukturell ekvationsmodellering (SEM) för att analysera regressiva banor mellan barnmisshandel, HAB och aggressivt beteende med programmet Mplus version 7.4 (Muthén & Muthén, 2015). Huvudanalyserna utfördes i tre steg. Inledningsvis analyserades banorna för hela samplet, det vill säga för alla tvillingar och deras systrar ($N = 2167$). Därefter analyserades banorna inom alla tvillingpar (oberoende av zygositet; n par = 239). Slutligen analyserades banorna inom tvillingparen, men MZ och DZ tvillingparen skilt för sig (131 MZ tvillingpar och 100 DZ par). I steg två och tre användes den disharmoniska tvillingmetoden (för mer information se Vitaro et al., 2009).

Resultat

Som förväntat korrelerade alla råvariabler (barnmisshandel, HAB och aggressivt beteende) positivt med varandra. På basen av visuell inspektion så var barnmisshandel och aggressivt beteende inte normalfördelade och därför transformerades (log transformation) de för de övriga analyserna.

Huvudanalyserna utförda med SEM för hela samplet stämde överens med tidigare studiers resultat. Barnmisshandel var positivt och signifikant associerad med HAB och aggressivt beteende (bekräftar hypotes 1). HAB var också positivt associerad med aggressivt beteende (bekräftar hypotes 2). Det fanns även en signifikant indirekt effekt av barnmisshandel på aggressivt beteende som medierades av HAB (bekräftar hypotes 3).

Alla analyser utförda med den disharmoniska tvillingmetoden i denna studie var icke-signifikanta. De disharmoniska tvillinganalyserna visade att, totalt sett, så var effektstorlekarna mindre för alla de disharmoniska tvillinganalyserna jämfört med analyserna gjorda med hela samplet (hypotes 4). Detta tyder på att associationerna mellan variablerna var åtminstone delvis påverkade av delade underliggande genetiska effekter eller gemensamma omgivningseffekter. Vissa av associationerna i de disharmoniska tvillinganalyserna var oklara, och det kan bero på att analyserna har blivit förvrängda på grund av slump eller på grund av att

sampelstorlekarna var små. Angående hypotes 5, så visade resultaten att associationen mellan HAB och aggressivt beteende inte enbart var påverkad av gemensamma omgivningseffekter utan även av delade genetiska effekter.

Diskussion

Resultat från tidigare studier tyder på att det finns en indirekt effekt mellan barnmisshandel och aggressivt beteende som medieras av HAB (Calvete & Orue, 2011; Coccaro m.fl., 2009; Dodge m.fl., 1990; Richey m.fl., 2016). Det är dock oklart ifall associationen är kausal. Det är möjligt att associationen påverkas av familjära faktorer. Såvitt skribenten vet, så är denna studie den första som studerar denna indirekta association och som samtidigt kontrollerar för familjära förväxlingsfaktorer med den disharmoniska tvillingmetoden (Vitaro m.fl., 2009) i ett stort populationsbaserat sampel av kvinnliga tvillingar och deras systrar. Resultaten i denna studie visade att alla variabler var positivt och signifikant associerade med varandra, vilket är i linje med fynd från tidigare studier. I praktiken betyder detta att individer som har blivit misshandlade i barndomen tenderar att i större grad tolka andras avsikter som fientliga i oklara sociala situationer. Barn som blivit misshandlade tenderar också att visa mera aggressivt beteende. Individer som tolkar andras avsikter som fientliga tenderar också att bete sig aggressivt. Resultaten visade även att det fanns en indirekt, positiv och signifikant effekt mellan barnmisshandel och aggressivt beteende som medierades av HAB. Att bli misshandlad har psykologiska effekter på individens sätt att tolka andras avsikter och motiv. Individer som har blivit utsatta för misshandel i barndomen tenderar att tolka andras avsikter som fientliga i oklara sociala situationer, vilket i sin tur kan öka risken att individen beter sig aggressivt.

Det är viktigt att förstå orsaken till aggressivt beteende så att man kan fokusera på förebyggande åtgärder samt rätt behandling. Social informationsprocessering har använts i behandlingsprogram för aggressivt beteende och visat goda resultat (Li, 2013; Terzian, 2015; Wilson, Lipsey, & Wilson, 2006). Richey m.fl. (2016) föreslog dock att man kunde endast fokusera på HAB aspekten i social informationsprocessering när det kommer till behandling av aggressivt beteende, detta skulle spara tid och resurser. Denna studie tyder på att förebyggande åtgärder gällande barnmisshandel kunde minska aggressivt beteende hos individer senare i livet. I och med att HAB medierade associationen mellan barnmisshandel

och aggressivt beteende, kunde det vara bra att inkludera individers sociala informationsprocessering i förebyggande åtgärder och behandling av aggressivt beteende hos individer som blivit misshandlade i barndomen.

När det kommer till analyserna utförda med den disharmoniska tvillingmetoden så visade resultaten att totalt sett var effektstorlekarna för alla analyserna inom tvillingpar mindre jämfört med analyserna utförda mellan individerna. Detta tyder på att associationerna mellan variablerna var åtminstone delvis påverkade av familjära faktorer. En person som blivit misshandlad i sin barndom inte är alltså inte den enda orsaken som leder till att personen börjar bete sig aggressivt. Denna association påverkas även av familjära faktorer (gener eller omgivning, dock kan vi inte här säga vilkendera). Exempelvis kan en förälder som har en genetisk benägenhet till aggressivt beteende också börja bete sig aggressivt och misshandla sina egna barn. Det är också möjligt att barn som har ärvt benägenheten att bete sig aggressivt väcker frustration hos föräldrarna som kan leda till misshandel. Detta beror på att barn ärver en del av föräldrarnas gener och därmed också en viss del av den genetiska benägenheten till aggression. Analyserna som utfördes med alla tvillingar kan enbart antyda att det finns en familjär förväxlingsfaktor (gener eller omgivning) men de kan inte urskilja olika former av förväxlingsfaktorer (genetisk eller omgivningsmässig). Därför separerades MZ tvillingpar från DZ tvillingpar. När MZ tvillingpar jämfördes med DZ tvillingpar kom det fram att associationen mellan HAB och aggressivt beteende inte endast var påverkad av gemensamma omgivningseffekter, utan även av delade genetiska effekter. Detta betyder att personer som tenderar att tolka andras avsikter som fientliga är mer benägna att bete sig aggressivt, och att individens gener påverkar denna association till en viss del. Dock var alla de disharmoniska tvillinganalyserna icke-signifikanta och därför är det svårt att säga ifall effekten kvarstår när man kontrollerar för familjära faktorer.

En styrka med denna studie var att samplet var ett stort populationsbaserat kvinnligt sampel ($N = 2167$) och resultaten kan därmed generaliseras till kvinnopopulationen. En styrka var också att man i studien hade kontroll över potentiella familjära förväxlingsfaktorer med hjälp av ett tvillingsampel och den disharmoniska tvillingmetoden (Vitaro m.fl., 2009). En svaghet med studien var att samplet endast bestod av kvinnor. Tidigare studier har visat att det finns vissa skillnader mellan könen beträffande bland annat aggression (Card, Stucky, Sawalani,

& Little, 2008) och sexuella övergrepp i barndomen (Pereda, 2009a, 2009b; Stoltenborgh, Van Ijzendoorn, Euser, & Bakermans-Kranenburg, 2011) och därför är det oklart ifall resultaten från denna studie kan generaliseras till män. En viktig aspekt att minnas är att även om tvillingarna i studien delade gener och omgivning så delade de inte nödvändigtvis alla sina personliga erfarenheter (t.ex. mobbning) (Vitaro m.fl., 2009) och därmed har vi inte haft kontroll över sådana potentiella förväxlingsfaktorer. Det är också möjligt att associationerna har påverkats av faktorer som inte alls mättes i denna studie (t.ex. ångest, impulsivitet). Därför kan vi inte heller garantera att associationerna är kausala för vi har inte möjlighet att kontrollera för alla potentiella förväxlingsfaktorer (Forsman & Långström, 2012). Som mätinstrument användes frågeformulär som i sig för med sig vissa svagheter; barnmisshandel mättes i efterhand vilket gör att detta mätinstrument inte alltid är pålitligt (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008).

Sammanfattningsvis tyder denna studie på att barnmisshandel, HAB och aggressivt beteende är associerade med varandra och att det finns en indirekt effekt mellan barnmisshandel och aggressivt beteende som medieras av HAB. Resultaten från de disharmoniska tvillinganalyserna tyder på att associationerna mellan alla variabler är åtminstone delvis påverkade av gener eller omgivningseffekter. Vidare tyder denna studie att associationen mellan HAB och aggressivt beteende inte endast påverkas av gemensamma omgivningseffekter utan även av delade genetiska effekter. När det kommer till förebyggande åtgärder och behandling av aggressivt beteende tyder denna studie på att HAB och familjära faktorer har en inverkan. I framtiden borde denna studie replikeras med ett stort sampel som innehåller individer från alla kön och en jämförelsegrupp av icke-tvillingar.

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PRESSMEDDELANDE

Sambandet mellan barnmisshandel och aggressivt beteende medieras av fientlig attributionsbias hos kvinnor

Pro gradu-avhandling i psykologi
Fakulteten för humaniora, psykologi och teologi, Åbo Akademi

Resultaten från en pro-gradu avhandling vid Åbo Akademi tyder på att associationen mellan barnmisshandel och aggressivt beteende medieras av fientlig attributionsbias. Studiens resultat tyder också på att det finns en association mellan barnmisshandel, fientlig attributionsbias och aggressivt beteende. Avhandlingen undersökte även ett möjligt kausalt samband mellan dessa variabler genom att använda en disharmonisk tvillingmetod. Resultaten tyder på att associationerna mellan barnmisshandel, fientlig attributionsbias och aggressivt beteende var åtminstone delvis påverkade av delade gener eller gemensamma omgivningseffekter. Även den indirekta effekten av barnmisshandel medierad av fientlig attributionsbias på aggressivt beteende var påverkad av delade gener och gemensamma omgivningseffekter. Vidare tyder resultaten att associationen mellan fientlig attributionsbias och aggression inte enbart påverkas av gemensamma omgivningseffekter utan även av delade genetiska effekter.

Studien hade ett sampel på 2167 deltagare, som bestod av kvinnliga tvillingar och deras systrar från Finnish population-based Genetics of Sexuality and Aggression (GSA) projektet. Information gällande variablerna i fråga införskaffades med frågeformulär. Analyserna utfördes i fyra delar; för hela samplet, för alla tvillingar, för tvåäggstvillingar och till slut för enäggstvillingar. De disharmoniska tvillinganalyserna utfördes med strukturell ekvationsmodellering.

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