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Longitudinal Associations among Child Maltreatment, Social Functioning, and Cortisol Regulation

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Abstract

Child maltreatment increases the risk for impaired social functioning and cortisol regulation. However, the longitudinal interplay between these factors is still unclear. This study aims to shed light on the effect of maltreatment on social functioning and cortisol regulation over time. The sample consisted of 236 children (mean age 7.64 years, SD = 1.36; 125 maltreated children and 111 nonmaltreated children, 128 boys and 108 girls) who attended a week-long summer camp for two consecutive years. Saliva was collected during five days at 9:00 a.m. and 4:00 p.m.. Means of morning and afternoon cortisol, and cortisol change (difference between morning and afternoon levels, controlled for morning levels) were grouped into low, medium, and high cortisol groups. Prosocial, disruptive/aggressive, and withdrawn behaviors were assessed using information from peers and counselors. Maltreated children showed less prosocial, and more disruptive/aggressive and withdrawn behavior. Results of Structural Equation Modeling analyses indicated that there were indirect effects of maltreatment on year 2 morning cortisol via prosocial disruptive/aggressive behavior: Lower levels of prosocial behavior and higher levels of disruptive/aggressive behavior were related to lower morning cortisol levels one year later. Withdrawn behavior was related to higher afternoon cortisol values one year later. Results of this study suggest that maltreated children are more likely to experience difficulties in social functioning, which in turn is related to cortisol regulation one year later. This altered HPA-axis functioning may put children at risk for later psychopathology.

Keywords

maltreatment; cortisol; social functioning; longitudinal

Maltreatment is one of the most severe and stressful experiences that affect the development of children (Cicchetti & Lynch, 1995). It has been shown to influence social development (Kessler et al., 1997; Kim & Cicchetti, 2003) as well as the functioning of the hypothalamic-pituitary-adrenocortical (HPA) axis (see Gunnar & Quevedo, 2007). Several studies have demonstrated that maltreated children with impaired social functioning have dysregulated stress-systems, as indicated by hypo- or hypercortisolism (e.g., Cicchetti & Rogosch, 2001a; Cicchetti, Rogosch, Gunnar, & Toth, 2010). Because the large majority of these studies are cross-sectional, one can only speculate about the direction of effects. To date, it is unclear whether maltreatment directly influences social competence or the HPA-axis (or both). The effect of maltreatment on social functioning may be mediated by HPA-axis functioning and/or the effect of maltreatment on the HPA-axis may be mediated by social functioning. In the

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current study we distinguish three dimensions of social functioning (prosocial, withdrawn, and disruptive/aggressive behavior) and we aim to clarify the direction of the relation between maltreatment, social competence, and cortisol levels by assessing these constructs in a longitudinal design. Investigating these developmental processes may help to understand pathways to adaptation and maladaptation.

Cortisol is a hormone that is produced by one of the body's major stress regulatory systems: the hypothalamic-pituitary-adrenocortical (HPA) axis. This axis can be considered a cascade of hormones resulting in the production of cortisol. As a first step, the hypothalamus releases corticotrophin-releasing hormone (CRH), which triggers the release of adrenocotropic hormone (ACTH) by the pituitary gland and as a result of that, the adrenal cortex releases corticosteroids (cortisol in humans). The production of cortisol normally follows a circadian rhythm with levels being high in the morning and declining during the course of the day (Kirschbaum & Hellhammer, 1989). During stress, the HPA-axis starts to increase the production of cortisol, which serves different functions, such as mobilizing energy and preparing the body for similar future stressors (Sapolsky, Romero, & Munck, 2000). When stress is prolonged and the individual is not able to effectively deal with the stressors, the sensitivity of receptors in the HPA-axis may either increase or decrease, affecting the production of cortisol and altering other brain structures such as the hippocampus (Gunnar & Vazquez, 2001).

Several studies have shown that individuals who have experienced childhood maltreatment show dysregulated cortisol levels (e.g., DeBellis et al., 1999; Gunnar & Quevedo, 2007). More specifically, low morning cortisol levels have been found in children who have been maltreated (including children who have lived in orphanages under deprived circumstances; e.g., Bruce, Fisher, Pears, & Levine, 2008). This may reflect a down-regulation of the HPA-axis in response to initial increases in cortisol as a result of early stress (see Gunnar & Vazquez, 2001). However, not all studies support this downregulation of the HPA-axis in maltreated children. For example, DeBellis et al. (1999) studied children with chronic PTSD as a result of maltreatment experience in early childhood and found that these children had elevated cortisol levels. Moreover, the duration of the maltreatment correlated positively with cortisol levels. Hence, there appears to be evidence of elevated as well as suppressed cortisol levels related to maltreatment.

It may be that the impact of maltreatment on the HPA-axis reflects the child's suffering from social problems and the nature of these problems (Gunnar & Donzella, 2002). Several studies have shown that dysregulation of the HPA-axis is related to impaired social competence (e.g., Gunnar, Sebanc, Tout, Donzella, & Van Dulmen, 2003; McBurnett, Lahey, Rathouz, & Loeber, 2000). In general, studies have focused on three dimensions of social behavior: withdrawn/internalizing behavior, aggressive or externalizing behavior, and social competence. Several researchers report a positive association between withdrawn or shy behavior and basal cortisol levels (e.g., Schmidt, Santesso, Schulkin, & Segalowitz, 2007). The findings on cortisol and aggressive or externalizing behavior are somewhat equivocal. The majority of studies report a negative association between externalizing problems and cortisol (e.g., McBurnett et al., 2000; Oosterlaan, Geurts, Knol, & Sergeant, 2005). However, positive associations are also reported (e.g., Van Bokhoven et al., 2005). To summarize the different findings on the relationship between cortisol and externalizing behavior, Alink and colleagues (2008) performed a meta-analysis and showed that higher levels of externalizing behavior were related to lower levels of basal cortisol in school-aged children, although this association was modest, and that there was no significant association between cortisol reactivity to stress and externalizing problems. Another dimension of social behavior that may be related to HPA axis activity is prosocial behavior. In their review on social modulation of stress responses, DeVries, Glasper, and Detillion (2003) argued that prosocial behavior can buffer the reactivity of the HPA axis. Prosocial interactions with other children may result in a less reactive cortisol response in case of stressful situations.

Similar associations between cortisol and social and emotional competence have been found in maltreated children. Cicchetti and Rogosch (2001b) have shown that maltreated children with internalizing problems showed higher cortisol levels throughout the day as compared to nonmaltreated children and maltreated children without internalizing problems. The authors concluded that the experience of maltreatment strengthens the effects of internalizing problems in childhood on neuroendocrine functioning. In addition, nonmaltreated boys with externalizing problems could be distinguished from the other groups by their low levels of morning and average cortisol, which is suggestive of hypocortisolism in children with externalizing problems. In a sample of maltreated and nonmaltreated preschoolers, Hart, Gunnar, and Cicchetti (1995) found that maltreated children scored lower on social competence (teacher reported positive and assertive peer skills and observed appropriate social behavior) and higher on shy, and acting out behavior. These three behavioral variables were not significantly correlated with median cortisol, but social competence was positively correlated with cortisol reactivity (ratio of quartile ranges) and shy behavior was negatively correlated with cortisol reactivity.

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Thus, there is evidence that cortisol and social functioning are related in maltreated and nonmaltreated children. However, the direction of effects over time is still unclear. Longitudinal studies investigating the relation between cortisol and social functioning in maltreated children are virtually absent, but there are a few studies with a longitudinal research design on nonmaltreated children reporting that cortisol levels predict social functioning (e.g., Davies, Sturge-Apple, Cicchetti, & Cummings, 2007; Shirtcliff & Essex, 2008). Showing the bi-directional nature of this association, Granger and colleagues reported that adrenocortical activity in response to social challenge predicted children’s subsequent internalizing problems and anxiety six months later and that increasing behavior problem levels across time were related to higher cortisol responses and decreasing behavior problem levels predicted lower adrenocortical reactivity at follow-up (Granger, Weisz, McCracken, Ikeda, & Douglas, 1996). Unfortunately, not all longitudinal studies have a symmetrical design with both cortisol and behavior assessed at all time points (e.g., Gunnar et al., 2003; Van Bokhoven et al., 2005). If a symmetrical design has not been used, it is not possible to draw conclusions about the direction of effects. The longitudinal relation may simply exist because of concurrent relations between cortisol and behavior that are stable over time. Without a symmetrical cross-lagged research design, two alternative hypotheses on the direction of effects cannot be evaluated: 1) Cortisol predicts social functioning and 2) Social functioning predicts cortisol (evidently both hypotheses may be accepted).

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The association between social functioning and stress system functioning may not be of the same direction or strength in all children. Several potential moderators of this relationship have been delineated. First, the direction and strength may depend on whether or not the child has experienced maltreatment. Two hypotheses may be formulated here. First, the association between HPA-axis dysregulation and social problems may be more pronounced in maltreated children. This hypothesis is partly supported by the findings of Cicchetti and Rogosch (2001b), which show that maltreated children with clinical-level internalizing problems had higher morning, afternoon, and average daily cortisol levels as compared to nonmaltreated children and maltreated children without internalizing problems. Second, the association between social functioning and cortisol may be stronger in nonmaltreated children. The findings of Murray-Close et al. (2008) are consistent with this hypothesis. They found that relational as well as physical aggression was related to greater cortisol dysregulation among nonmaltreated as compared to maltreated children. The authors explain this finding utilizing the *social push perspective*, in which biological correlates of behavior problems would be most influential among individuals from relatively benign backgrounds as compared to individuals from high risk environments (Raine, 2002). Cortisol may thus be differentially related to behavior, depending on maltreatment status. In the current study, we sought to test whether the relation between cortisol and social functioning would be moderated by maltreatment status. Another question that is addressed in the current study is whether the relation between social functioning and cortisol is moderated by sex. There are indications that this association would be more pronounced in boys (e.g., Proustka et al., 2010; Tout, De Haan, Campbell, & Gunnar, 1998).

In the current study we tested the longitudinal relations among maltreatment, cortisol, and social functioning. Many studies have assessed only a single domain of social functioning. It is likely that different aspects of social functioning are interrelated. For example, children who score low on prosocial behavior may also be withdrawn or aggressive. Therefore, we assessed different dimensions of social functioning in the current study and analyzed these dimensions separately, as well as combined, in order to determine which dimension(s) of social functioning would be uniquely related to cortisol production. In addition, because it is important to study cortisol levels at different time points as well as the change in cortisol levels throughout the day (see Murray-Close et al., 2008), we assessed morning and afternoon cortisol on five different days and tested the association between social functioning and cortisol change over the day as well. We tested whether the relation between cortisol and social functioning was moderated by maltreatment and whether the associations among maltreatment, cortisol, and social functioning were moderated by gender. Finally, there are indications that different subtypes of maltreatment are differentially related to cortisol production and social functioning (see also Cicchetti & Valentino, 2006). For example, Cicchetti and Rogosch (2001a) reported that children who had been both physically and sexually abused had substantial elevations in morning cortisol levels as compared to nonmaltreated children, emotionally maltreated, neglected, and physically abused groups. Regarding behavior, it seems that physical neglect is more strongly related to internalizing behavior than other subtypes, and that children who have been emotionally, physically, or sexually abused are more likely to exhibit high levels of externalizing behavior (Manly, Kim, Rogosch, & Cicchetti, 2001). Therefore, we explored whether social functioning and cortisol differed between maltreatment subtypes in our sample.

Method

Participants

The sample consisted of 125 maltreated (76 boys, 49 girls) and 111 nonmaltreated (52 boys, 59 girls) children who attended a week-long summer camp for inner-city children during two consecutive years. The mean age of these children at Time 1 was 7.64 years (SD = 1.36) and the time between Time 1 and Time 2 was one year. About half of the sample were African-American (53%), 19% were Caucasian, 8% were Hispanic, and 20% were biracial or other ethnicity. The socio-economic status (SES) of the participating families was low: 94% of the families received public assistance. Finally, 36% of the mothers were married or living with a partner.

The research was reviewed and approved by the University of Rochester Institutional Review Board (IRB). Parents provided informed consent for their child's participation and for examination of any local Department of Human Services (DHS) records pertaining to the family, and children provided signed assent agreeing to participate. Children in the maltreated group had experienced child abuse and/or neglect, based on investigation by DHS Child Protective Services. A random sample of eligible maltreating families was contacted by a DHS recruitment liaison who explained the study. If parents were interested, they signed consent to have their contact information released to the project team for recruitment. Families were free to choose whether or not to participate. This resulted in a sample that is representative of the local DHS population. The DHS records were coded according to the maltreatment nosology specified in the *Maltreatment Classification System* (MCS: Barnett, Manly, & Cicchetti, 1993; see below). In addition, the *Maternal Maltreatment Classification Interview* (Cicchetti, Toth, & Manly, 2003) was administered.

The maltreated children were predominantly from low SES families, which is consistent with national demographic characteristics of maltreating families (NIS-4; Sedlak et al., 2010). Consequently, the nonmaltreated group was comprised of children from families who were eligible for Temporary Assistance for Needy Families (TANF) to ensure a low SES-group that is demographically comparable to the maltreated group. These low-income nonmaltreating families were also contacted by a DHS recruitment liaison. To verify the absence of maltreatment, DHS record searches were performed. In addition, trained research assistants interviewed mothers of children recruited for the nonmaltreated group using the *Maternal Maltreatment Classification Interview* (Cicchetti et al., 2003) to confirm a lack of DHS involvement. In the year following camp attendance, record searches were conducted to verify that all available information had been accessed. Only children from families without any history of documented abuse and/or neglect, who had not received preventive services through DHS, and for whom maltreatment was not reported during the maternal interview were retained in the nonmaltreatment group.

The number of families who had a history of and/or were currently receiving public assistance did not significantly differ between the maltreated (94%) and the nonmaltreated group (93%). There were also no significant differences between maltreated and nonmaltreated children in terms of age, however, there were somewhat more boys in the maltreated group (61%) than in the nonmaltreated group (47%), $\chi 2(1, N = 236) = 4.61$, $p < .05$, and therefore, sex was included in all of the main analyses.

Design and Procedure

Data were collected during 1-week summer camp sessions for inner-city children (see Cicchetti & Manly, 1990, for detailed descriptions of camp procedures). Children were transported by bus to the camp each day, with travel time averaging 45 min. At the beginning of each camp week, children were assigned to groups consisting of six to eight same-sex, same-age peers, with about the same number of maltreated and comparison children, led by three counselors who were each unaware of the maltreatment status of the children and the hypotheses of the study. The camp consisted mainly of social activities for the children and no formal counseling took place. In addition, children provided morning and afternoon saliva samples. After each camp week, the group counselors completed ratings of children's behavior based on their observations of the children in their respective groups across the camp session (approximately 35 hours of observation).

Measures

Maltreatment Classification System—The Maltreatment Classification System (MCS; Barnett et al., 1993) was used to assess several aspects of maltreatment the children had experienced. The MCS utilizes Child Protective Services (CPS) records detailing investigations and findings regarding maltreatment occurrences in families. Independent determinations of maltreatment experiences are made by coding all information available on a particular family. Trained research assistants, doctoral students, and clinical psychologists coded the CPS records. The system has been proven to be reliable and valid in classifying maltreatment incidents (see Manly, 2005). In a recent study using the MCS, coders demonstrated acceptable reliability (weighted κ's with the criterion ranging from .86 to .98 and κ's for presence vs absence of maltreatment subtypes ranging from .90 to 1.00;

Cicchetti et al., 2010). Based on operational definitions contained in the MCS, different subtypes of maltreatment were distinguished: sexual abuse, physical abuse, neglect, and emotional abuse1. More than half of the maltreated children (60%) experienced multiple subtypes of abuse. Among the maltreated children, 6% had experienced sexual abuse, 26% had experienced physical abuse, 70% had experienced neglect, and 62% had experienced emotional maltreatment. Given the low frequency of sexual abuse and physical abuse, relative to neglect and emotional maltreatment, children experiencing these forms of abuse were categorized into an abuse group (PASA, *n* = 40). The remaining maltreated children had not been abused, but had experienced neglect and/or emotional maltreatment; they were categorized in a physical neglect/emotional maltreatment group (PNEM, *n* =78). Most of the children in the PASA group had also experienced neglect or emotional maltreatment. Finally, the individual subtype of 7 (6%) children could not be determined as a result of incomplete records.

Peer nominations—Children evaluated the characteristics of their peers in their respective camp groups using a peer nomination method on the last day of camp, after they had interacted with each other during the camp week (cf. Coie & Dodge, 1983). Counselors conducted the peer rating assessment with individual children. For each peer in their camp group, children were given five brief behavioral descriptors characterizing different types of social behavior, including a child who was: cooperative, a leader, shy, disruptive, and a fighter. The children were asked to select one peer from the group who best fit the behavioral description. The total number of nominations that each individual child received from peers in each category was determined. These totals were converted to proportions of the possible nominations in each category, and these scores in each category were standardized within each year of camp.

Behavior ratings—Observations of individual children's social behavior were made based on the methodology of Wright (1983). Camp counselors rated the behavior of individual children on nine items tapping three aspects of interpersonal functioning, including prosocial behavior (e.g., considerate and thoughtful, interested and involved, helpful and cooperative), aggressiveness (e.g., verbally abusive and threatening, hit, pushed, acted out against others, acted impulsively), and social withdrawal (e.g., untalkative, low activity level, quiet, isolated, avoided contact with others). Seven-point ratings were completed on two days based on 45-min observations of children in structured and unstructured camp settings (e.g., sports, free play). Interrater reliabilities based on average intraclass correlations among pairs of raters across the years of assessment ranged from .68 to .80 (M = .76) for prosocial, .70 to .84 (M = .77) for aggression, and .61 to .77 (M = .71) for withdrawal. Individual counselor assessments for each of the three scales across measurement occasions were averaged to generate individual child scores.

Pupil Evaluation Inventory (PEI)—Camp counselors completed the PEI (Pekarik, Prinz, Liebert, Weintraub, & Neale, 1976) for children in their respective groups at the end of each camp week. The PEI consists of 35 items assessing social behavior, yielding three homogeneous and stable factors, including likeability, aggression, and withdrawal. Similar to peer nomination procedures, counselors were asked to select no more than two children

[1] *Sexual abuse* involves any attempted or actual sexual contact between a child and caregiver for purposes of the caregiver's sexual satisfaction or financial benefit. *Physical abuse* is operationalized as the infliction of physical injury on a child other than by accidental means (e.g., beating the child causing bruises, welts, broken bones, burns, choking). Injuries may range from minor and temporary to permanently disfiguring. *Neglect* involves failure to provide for children's basic physical needs (i.e., adequate food, clothing, shelter, medical treatment), lack of supervision (leaving child without adult supervision, exposure to firearms, leaving child in care of dangerous caregivers), or moral-legal or educational neglect (e.g., exposing the child to criminal activity, failure to send the child to school). Finally, *emotional abuse* is operationalized as extreme thwarting of children's basic emotional needs for psychological safety and security, acceptance and self-esteem, and age-appropriate autonomy.

who were best characterized by each individual item. Interrater reliabilities based on intraclass correlations across the years of camp ranged from .72 to .85 (M = .78) for likeability, .85 to .90 (M = .88) for aggression, and .72 to .84 (M = .78) for withdrawal.

Composite indicators of social functioning: Prosocial, disruptive-aggressive, withdrawn—Based on the peer and adult measures described above, three composite indicators were generated (cf. Cicchetti & Rogosch, 2007). First, a prosocial composite combined peer nomination scores for leader and cooperative with counselor behavior rating scores for prosocial behavior and counselor PEI scores for likeability. Internal consistencies of this composite were .71 to .68 for Time 1 and Time 2, respectively. Second, a withdrawn composite was comprised of peer nomination scores for shy, counselor behavior ratings for withdrawn, and counselor PEI scores for the withdrawn subscale. Alphas were .64 and .65 for Time 1 and Time 2, respectively. Third, a disruptive-aggressive composite included peer nominations of disruptive and fights, and counselor behavior ratings of aggressive and counselor PEI scores for aggressiveness. The internal consistencies for this composite were . 83 for both time points. For each of these composites, component variables were standardized and these standardized variables were averaged to generate the composite scores for each child.

Cortisol—Each camp day upon arrival to the camp at 9:00 a.m. and prior to the children's departure at 4:00 p.m., trained research assistants obtained saliva samples from each child. The children had not consumed food or drink for at least 30 minutes before each saliva sample was obtained. Given the approximate 45-minute transportation time and the time spent being greeted by camp staff, children had been awake at least one hour prior to providing the morning saliva samples. Because cortisol levels are volatile and sharply rise and fall during the first hour after morning awakening, the so-called cortisol awakening response (cf. Susman et al., 2007), the timing of morning samples likely occurred after the cortisol awakening response, when relative stability in morning level was established, before gradually declining over the course of the day. Samples were collected following Granger et al. (1999). The children chewed Trident® sugarless original flavor gum to stimulate saliva flow and then passively drooled though a short drinking straw into a 20 ml plastic vial. The samples were frozen and stored at −80 °C. Each week, the samples were shipped overnight on dry ice for next day delivery to Salimetrics Laboratories (State College, PA) for assay.

Cortisol was assayed from the saliva samples for each day and time across the week. Each sample was thawed, 4–5 1 mL aliquots were placed into 1.8 ml cryogenic storage vials and all aliquots were then frozen at −80°C until assayed. On the day of testing, samples were brought to room temperature, centrifuged at 3,000 RPM for 15 minutes, and the clear top-phase of the sample was pipetted into appropriate test tubes/wells. Salivary cortisol was assayed using a commercially available enzyme immunoassay kit (Salimetrics, State College, PA). The test uses 25 μl of saliva, has a lower limit of sensitivity of 0.007 μg/dl (range up to 1.8 μg/dl), and average intra-and inter-assay coefficients of variation less than 5.0% and 10.0%, respectively. Units of cortisol are expressed in μg/dl (micrograms per deciliter). As cortisol values were positively skewed and leptokurtotic (mean skewness = 0.08, range = −13.74 – 7.98, all values < −1.0 or > 1.0; mean kurtosis = 61.39, range = 1.94 – 197.71), we log transformed the cortisol values. After this transformation, the mean skewness was 0.27, with a range of −1.38 to 1.42 and only two values < −1.0 or > 1.0, and the mean kurtosis was 2.65, with a range of 0.47 to 7.61. The coefficients of variation for the morning and afternoon log transformed cortisol variables were 14.6% and 16.8% at Time 1 and 15.4% and 13.6% at Time 2.

All correlations between morning or afternoon cortisol values across the week were significant at both time points (all *p*s < .01) and Cronbach's alphas for morning and afternoon cortisol within both camp years were between .69 and .84. We averaged the log transformed cortisol values for the morning samples and the log transformed cortisol values for the late afternoon samples to obtain a mean morning and a mean afternoon cortisol variable. We only computed means for morning or afternoon cortisol if children had at least two valid cortisol values on the same time point (morning or afternoon) during the camp week. The mean number of samples across the five camp days was 4.5 for morning and 4.5 for afternoon cortisol at Time 1 and 4.6 for morning and 4.6 for afternoon cortisol values at Time 2. Residualized scores reflecting the difference between the mean morning and the mean afternoon samples, were used in the analyses as an indicator for cortisol change over the day. In these analyses, the level of morning cortisol was controlled for. There may be nonlinear relations between maltreatment and behavior on the one hand and cortisol on the other, with abnormal levels of cortisol being reflected in the lowest and the highest values. Therefore, we created dummy variables reflecting values below 1 SD below the mean, values higher than 1 SD above the mean, and values in between. This resulted in the following sample sizes. AM cortisol at Time 1: 30 low, 172 medium, and 34 high; AM cortisol at Time 2: 32 low, 170 medium, and 34 high; PM cortisol at Time 1: 30 low, 177 medium, and 29 high; PM cortisol at Time 2: 35 low, 167 medium, and 34 high; cortisol change at Time 1: 34 low (ranging from slightly increasing to slightly decreasing levels), 165 medium, and 37 high (strongly decreasing levels); cortisol change at Time 2: 43 low, 156 medium, and 37 high. In the analyses, the middle groups were used as reference groups.

Results

Correlations and Group Differences

Bivariate correlations are shown in Table 1. In addition, we investigated differences between groups based on maltreatment status and sex in separate analyses. Results are shown in Table 2. Maltreated children showed more disruptive/aggressive behavior, more withdrawn behavior, and lower AM cortisol levels than nonmaltreated children at Time 1, and less prosocial behavior than nonmaltreated children at Times 1 and 2. Finally, girls showed a sharper decline in cortisol levels over the day than boys at Time 1 and Time 2.

We also tested differences between children who experienced overt physical or sexual abuse (PASA) as compared to emotional abuse or neglect (PNEM) and differences between these groups and the nonmaltreated group. We did not find differences on any of the behavior and cortisol variables between the maltreatment groups at both time points. However, on some variables one of the maltreatment groups differed from the nonmaltreated group whereas the other did not. The PASA group showed significantly more disruptive/aggressive behavior at Time 1 than the nonmaltreated group ($p < .01$), and there were more PASA children in the Time 1 medium afternoon cortisol group as compared to the nonmaltreated group ($p < .05$), whereas the differences between the PNEM group and the nonmaltreated group were not significant ($p = .26$ for disruptive/aggressive behavior and $p = .12$ for cortisol). In addition, the PNEM group showed significantly less prosocial behavior at Time 2 as compared to the nonmaltreated group ($p < .01$), whereas the difference between the PASA group and the nonmaltreated group was not significant ($p = .18$). We performed all of the SEM analyses with the maltreatment subtype groups but did not find any differential effects for the different subtype groups. Therefore, we present the analyses with all of the maltreated children in one group, irrespective of maltreatment subtypes.

Maltreatment, Behavior, and Cortisol over Time: A Series of Structural Equation Models

We tested the longitudinal relation among maltreatment, behavior (prosocial, disruptive/aggressive, withdrawn), and the dummy cortisol variables (low vs medium and high vs medium) using Structural Equation Modeling (SEM; Figure 1). The longitudinal panel model estimates stability coefficients (i.e., auto-regressive effects) of the different behavior variables and cortisol as well as cross-lagged effects between them. Age and sex were included as covariates. To evaluate the overall goodness of fit of each model, we focused on the comparative fit index (CFI) and root mean square error of approximation (RMSEA) statistic. CFI close to 1 indicates a very good fit. The value of RMSEA of about .05 or less is considered to indicate a close fit of the model, values of about .08 or less would indicate an acceptable fit of the model, and values greater than .1 would indicate poor fit (Browne & Cudeck, 1993).

The fit for all models was good (Table 3). Behavior was significantly stable over time in all models (*p*s < .01). The dummy variables reflecting low AM cortisol and low cortisol change values (reflecting slightly increasing to slightly decreasing levels) were stable over time in all models (*p*s < .01), but the stability of the dummy variables reflecting low PM cortisol was not significant, $p = .19$ for the model on prosocial behavior and $p = .15$ for the models on disruptive behavior and withdrawn behavior. The stability over time of the dummy variables reflecting high AM and PM cortisol values was significant in all models (*p*s < .05), except for the model on AM cortisol and withdrawn behavior (this was marginally significant: $p = .06$). The relations between the dummy variables reflecting high cortisol change values at both time points were marginally significant ($p = .06$ for prosocial and disruptive behavior and $p = .07$ for withdrawn behavior). Maltreatment was significantly related to Time 1 prosocial, disruptive/aggressive, and withdrawn behavior in all models (*p*s < .05 for the models on AM, PM cortisol and cortisol change), to Time 2 prosocial behavior (*p*s = .05 for the models on AM, PM cortisol and cortisol change), and to the Time 1 high PM cortisol dummy variable in the three models on the different behavioral variables (maltreated children were less often in the high PM cortisol group as compared to the medium PM cortisol group than nonmaltreated children, $p < .05$).

Because we were mainly interested in relations between maltreatment, behavior, and cortisol over time, we present the models in which these relationships were significant in Figures 2–5. In the model for prosocial behavior, we found that maltreatment was related to lower levels of prosocial behavior and children with lower levels of prosocial behavior were more at risk for low morning cortisol levels one year later (Figure 2). To test whether there was an indirect effect of maltreatment status on Time 2 morning cortisol through its effect on Time 1 prosocial behavior, a Sobel test was performed (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Sobel, 1982). Results indicated that the indirect effect of maltreatment on Time 2 morning cortisol through its effect on prosocial behavior was significant ($Z = 2.47$, $p < .05$).

For disruptive/aggressive behavior and AM cortisol (Figure 3), the regression estimate reflecting the relationship between maltreatment and disruptive/aggressive behavior was significant, as was the regression estimate for the relationship between Time 1 disruptive/aggressive behavior and Time 2 AM cortisol. Results of a Sobel test indicated that this indirect effect was indeed significant ($Z = 2.18$, $p < .05$). If children had been maltreated, then they showed higher levels of disruptive/aggressive behavior. In turn, children with high levels of disruptive/aggressive behavior were more at risk for showing low levels of morning cortisol one year later.

For withdrawn behavior, we also found that maltreatment was significantly related to higher levels of withdrawn behavior at Time 1 and Time 1 withdrawn behavior was significantly related to afternoon cortisol (Figure 4) and cortisol change (Figure 5). Children with high levels of withdrawn behavior were less likely to be in the low afternoon cortisol group and the high cortisol change group, or in other words, they had higher cortisol levels in the afternoon as compared to children with lower levels of withdrawn behavior. However, results of Sobel tests indicated that the indirect effects for both of these models were not significant ($Z = -1.49$, $p = .14$ for afternoon cortisol and $Z = -1.58$, $p = .11$ for cortisol change).

Because the effects of the different behavior variables may not be unique (some of these were interrelated; Table 1), we also tested the cross-lagged relationships between the different behavior variables and cortisol in three different models (separately for morning cortisol, afternoon cortisol, and cortisol change) including all three behavior variables (prosocial, disruptive/aggressive, and withdrawn behavior). The fit of these models was good (df =13), $\chi^2 = 22.00$, $p = .06$, CFI = .976, RMSEA = .054 for morning cortisol; $\chi^2 = 18.26$, p = .15, CFI = .985, RMSEA = .042 for afternoon cortisol; and $\chi^2 = 18.63$, $p = .14$, CFI = .984, RMSEA = .043 for cortisol change. In all models, maltreatment was significantly related to behavior at Time 1. In the model on morning cortisol, only the effect of prosocial behavior (and not the effect of disruptive/aggressive behavior) on the low cortisol dummy was significant (b = −.20, $p < .01$). Similar to the separate models, the indirect effect of maltreatment → prosocial behavior → cortisol was significant, $Z = 2.15$, $p < .05$, indicating that maltreated children showing lower levels of prosocial behavior were more likely to have lower levels of cortisol in the morning one year later. In the model on cortisol change there was still a significant effect of withdrawn behavior on the dummy variable reflecting high cortisol change (b = −.14, $p < .05$). However, the indirect effect maltreatment → withdrawn behavior → cortisol was not significant, $Z = -1.43$, $p = .15$. The effect of withdrawn behavior on the dummy variable reflecting low cortisol in the model on afternoon cortisol was marginally significant (b = −.13, $p = .06$). Again, the indirect effect was not significant, Z = −1.40, $p = .16$.

Investigating the Moderating Roles of Maltreatment and Sex

We tested a series of longitudinal moderated mediation models (MacKinnon et al., 2002) to examine whether the overall model depends on maltreatment status or sex. Two-group SEM was used to test the significance of group differences. We first tested the configural invariance model in which all the parameters estimated were allowed to vary across the two maltreatment status or sex groups. The configural invariance model tested if the patterns of structural relations, rather than the actual numerical values, were invariant between the two groups. In the subsequent models, numeric invariance on certain parameters was introduced. In the equal cross-lagged effect model, we added equality constraints for testing numeric invariance of cross-lagged effects between social functioning and cortisol across the two groups. Finally, in the equal maltreatment effects or equal sex effects model, we imposed numeric invariance on the effects of maltreatment or sex to test if the effects of maltreatment or sex on social functioning and cortisol differed between the two groups. For the comparisons of the three nested models, the difference in fit was simply indexed by subtraction.

First, we tested the moderating effect of maltreatment status. For all three cortisol variables in combination with all three behavioral measures, the configural invariance model fitted the data very well. Constraining the auto-regressive coefficients to be invariant across the maltreated and nonmaltreated groups did not lead to a significant deterioration in model fit, indicating that the stabilities of behavior and cortisol did not differ between groups. Similarly, constraining the regression coefficients for the cross-lagged effects did not lead to a significant decrease in model fit. This suggests that the cross-lagged effects also did not differ between the maltreated and nonmaltreated groups (Table 4). In summary, maltreatment status did not moderate the longitudinal relations between behavior and morning cortisol. Similarly, there were no significant moderating effects of sex on the longitudinal relations between behavior and cortisol (Table 5).

Discussion

Results of this study revealed longitudinal associations among maltreatment, social functioning, and cortisol regulation. First of all, our study is unique in that it has a longitudinal research design and we have shown that all cortisol values (morning, afternoon, and change over the day) were stable over a one-year period. Second, as has been reported by several other researchers (e.g., Bolger, Patterson, & Kupersmidt, 1998; Kim & Cicchetti, 2003; Rogosch, Cicchetti, & Aber, 1995), we found that children who have experienced maltreatment show poorer social functioning as compared to nonmaltreated children: They showed lower levels of prosocial behavior, and more aggressive/disruptive and withdrawn behavior. Because our comparison group was also from a high risk, low SES background, we can conclude that there is something specific about having been maltreated that affects the development of social functioning. Maltreated children may feel insecure in relationships with others and have low self-esteem (Kaufman & Cicchetti, 1989), based on their own experience of being rejected by a caregiver. As a consequence, social experiences may be a challenge for these children with which they are not able to cope well. Being among peers is a common daily activity for children in middle childhood: They go to school at least five days a week and play with children in their neighborhood. The continuous stress of these social encounters for children with impaired social functioning (i.e., children who show much aggressive and disruptive behavior, withdrawn behavior, or low levels of prosocial behavior) may affect the production of stress-hormone cortisol.

In line with this reasoning, we found that, despite the stability of cortisol values and behavior over time, there were indirect effects of maltreatment on cortisol regulation through its effect on social functioning, whereas the effects of cortisol on behavior over time and within time points were not significant. First, prosocial behavior mediated the effect of maltreatment on morning cortisol one year later. Maltreated children showed lower levels of prosocial behavior as compared to nonmaltreated children and as a result had cortisol values that fell more often in the low morning cortisol group. Similar results were found for disruptive/aggressive behavior: Maltreated children were more at risk for higher levels of disruptive/aggressive behavior and this in turn was related to lower levels of morning cortisol one year later. When we entered all social functioning variables in one model testing the effect on morning cortisol, we found that only prosocial behavior had a unique effect on cortisol regulation.

Next, our results regarding withdrawn behavior indicated that maltreated children showed higher levels of withdrawn behavior than nonmaltreated children and that withdrawn children had higher cortisol levels in the afternoon and (as a result) had a smaller decline of cortisol levels over the day as compared to children with lower levels of withdrawn behavior. However, the mediation effects of maltreatment on afternoon cortisol and cortisol change through the effect on withdrawn behavior were not significant.

In interpreting these findings it is difficult to disentangle state from trait effects of cortisol. However, the camp context was very similar to other social activities of the children, such as going to school or entering a new sports team. The camp situation, with experienced counselors regulating the activities, could not be considered more stressful for the children compared to other daily activities (in the children's rough, dangerous, low-income neighborhoods), so it would be unlikely that the cortisol values would differ largely from values measured in other contexts. Nevertheless, we would like to emphasize that, as in all research on cortisol, one has to take into account the context in which cortisol was assessed when interpreting the results. Furthermore, it should be noted that the magnitude of the associations between cortisol and behavior was modest, indicating that only a small part of the variance of social behavior was explained by variations in cortisol levels.

It appears that maltreated children are at risk for altered cortisol regulation partly because of their difficulties with social interactions. Not knowing how or not being able to act prosocially may result in negative reactions from peers. In their influential meta-analysis on stressors affecting cortisol production, Dickerson and Kemeny (2004) have shown that stressors including an element of social-evaluative threat and unpredictability are most likely to evoke a stress-response. Maltreated children who are not able to exhibit effective prosocial behavior may consider social situations threatening and unpredictable because of the risk of being rejected. Therefore, it is likely that in these children the HPA-axis is activated during social interactions with peers. Indeed, Gunnar and colleagues (2003) showed that children who experienced rejection by classmates had higher levels of cortisol than other children. However, we found *lower* cortisol levels in children with low levels of prosocial behavior. This discrepancy can be explained by the hypocortisolism findings described by Gunnar and Vazquez (2001). They reported that many researchers have found a flatter daytime rhythm, due to lower morning cortisol levels, in children who have experienced mild to severe stressors. Fries, Hesse, Hellhammer, and Hellhammer (2005) also noted that this hypocortisolism is a likely consequence of chronic stress (cf. Cicchetti & Rogosch, 2001a,b). Support for this attenuation hypothesis comes from the longitudinal study of Trickett, Noll, Susman, Shenk, and Putnam (2010), which showed that cortisol levels of maltreated females were initially higher than those of nonmaltreated females, but that these levels were lower in maltreated females in early adulthood. The exact theoretical mechanism for hypocortisolism is still unclear, but it has been proposed that the HPA-axis may adapt at various points as a protective response to elevated production of neurotransmitters and hormones. For example, adrenal ACTH receptors may be down-regulated as a response to elevated levels of ACTH, secreted by the pituitary, resulting in lower cortisol production (Gunnar & Vazquez, 2001; Heim, Ehlert, & Hellhammer, 2000). The study by Gunnar and colleagues focused on preschool children and it may be that after initial (chronic) activation of the HPA-axis, it eventually downregulates. This may explain the *lower* morning cortisol levels in school-aged children with impaired prosocial skills in our study (Trickett et al., 2010).

The hypothesis that a lack of positive peer interactions is linked to altered cortisol regulation partly because of the risk of being rejected may be supported by evidence on the buffering role of social support and friends on cortisol production. Thorsteinsson and James (1999) performed a meta-analysis on experimental studies on the effect of social support on different indicators of physiological stress. All of these studies tested the effect of someone who provides support (friend, research confederate) in the form of verbal comments or physical presence, during a stressful task. Although the results have to be interpreted with caution, the meta-analysis showed that challenging social situations become increasingly stressful when there is no social support. Translated to our study, this may mean that children who do not show (high levels of) prosocial behavior may not experience social support from their peers, and as a result, have an HPA-axis that is becoming more sensitive to challenging social situations.

In the long run, children with altered HPA-axis functioning (possibly because of a lack of social skills in peer interactions) may be at risk for future psychiatric problems (e.g., depression, anxiety, or antisocial behavior). Indeed, several longitudinal studies have found that cortisol predicts mental health problems (e.g., Davies et al., 2007; Granger et al., 1996; Shirtcliff & Essex, 2008). Repetti, Taylor, and Seeman (2002) proposed a model in which growing up in a family at risk for maltreatment predicts altered stress-responsive biological regulatory systems as well as impaired social competence, which are both related to mental health problems. Integrating this model with our results, we can add that impaired social competence may also influence stress-systems and therefore, the risk for future mental health problems seems even more severe.

We did not find any moderation effects for maltreatment status and gender. The longitudinal relationships between social functioning and cortisol were similar across maltreated and nonmaltreated children and boys and girls. This suggests that in our sample, there were no differences in vulnerability of the HPA-axis to different types of social (dys)functioning. The social push perspective, which predicts that biological correlates of behavior problems would be more influential among individuals from more benign backgrounds as compared to individuals from high risk environments (Raine, 2002) was not confirmed in our study.

There are some limitations in the design of this study that need to be considered. First of all, in testing differences between subtypes of maltreatment it is impossible to completely disentangle groups with nonoverlapping maltreatment experiences because of the high overlap between different subtypes. Second, there were somewhat more boys in our maltreated group than in the nonmaltreated group. Therefore, we controlled for sex in all of our analyses.

In conclusion, we found that maltreated children are at risk for altered cortisol regulation, partly because of their vulnerability for problems in social functioning. Results of this study can inform attempts to design interventions in order to improve the quality of life of maltreated children. Interventions aimed at improving their social skills may therefore be effective in reducing daily stress and normalizing the activity of the HPA-axis. Gunnar and Fisher (2006) have stated that with improved care, low morning cortisol levels of young maltreated children will exhibit more normal patterns of daily cortisol production. Based on our results we would like to argue that, in addition to improving the quality of family care, interventions should incorporate a focus on improving the social skills of maltreated children.

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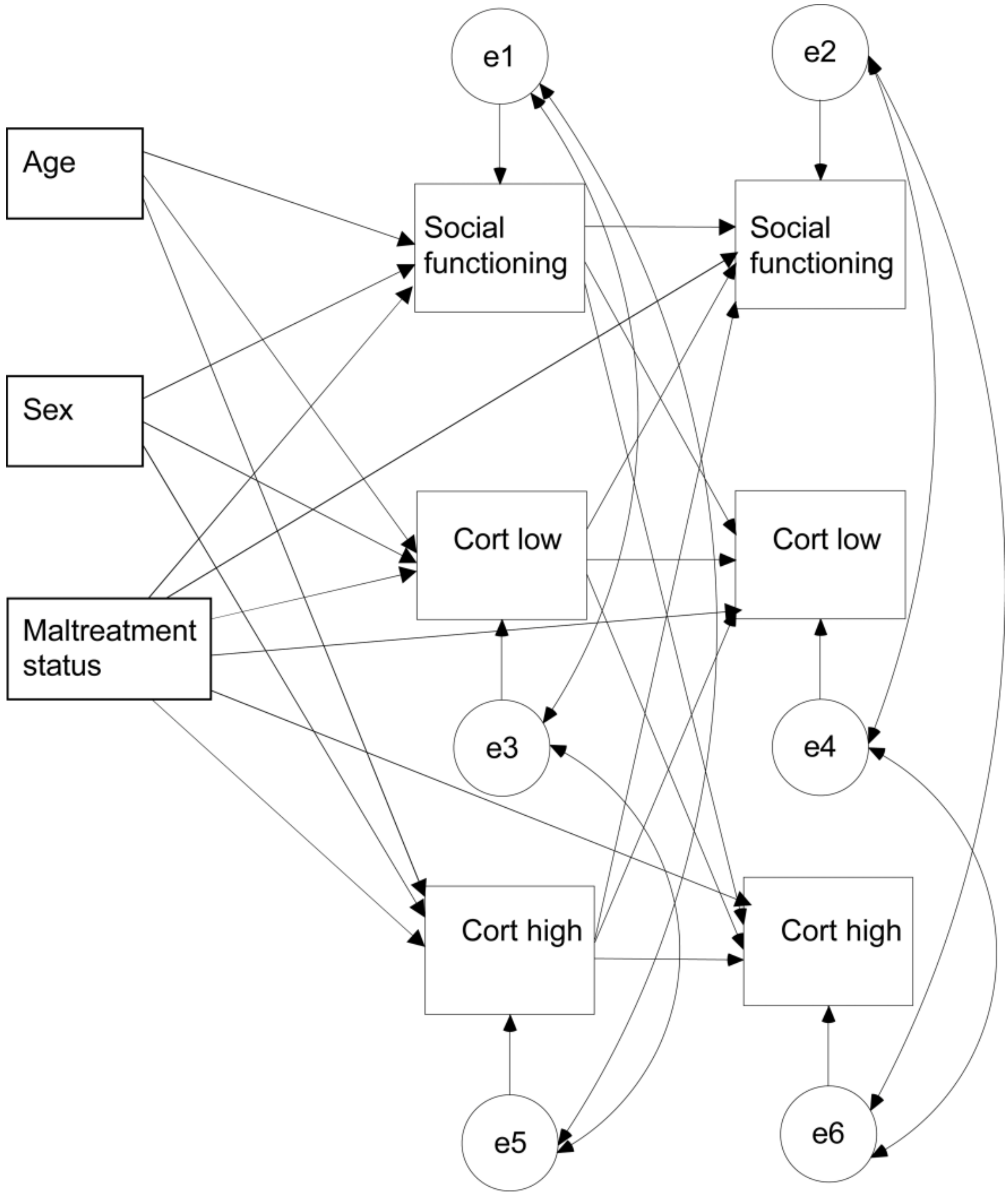

Figure 1.
Structural equation model for the longitudinal relation between maltreatment, social functioning, and cortisol.

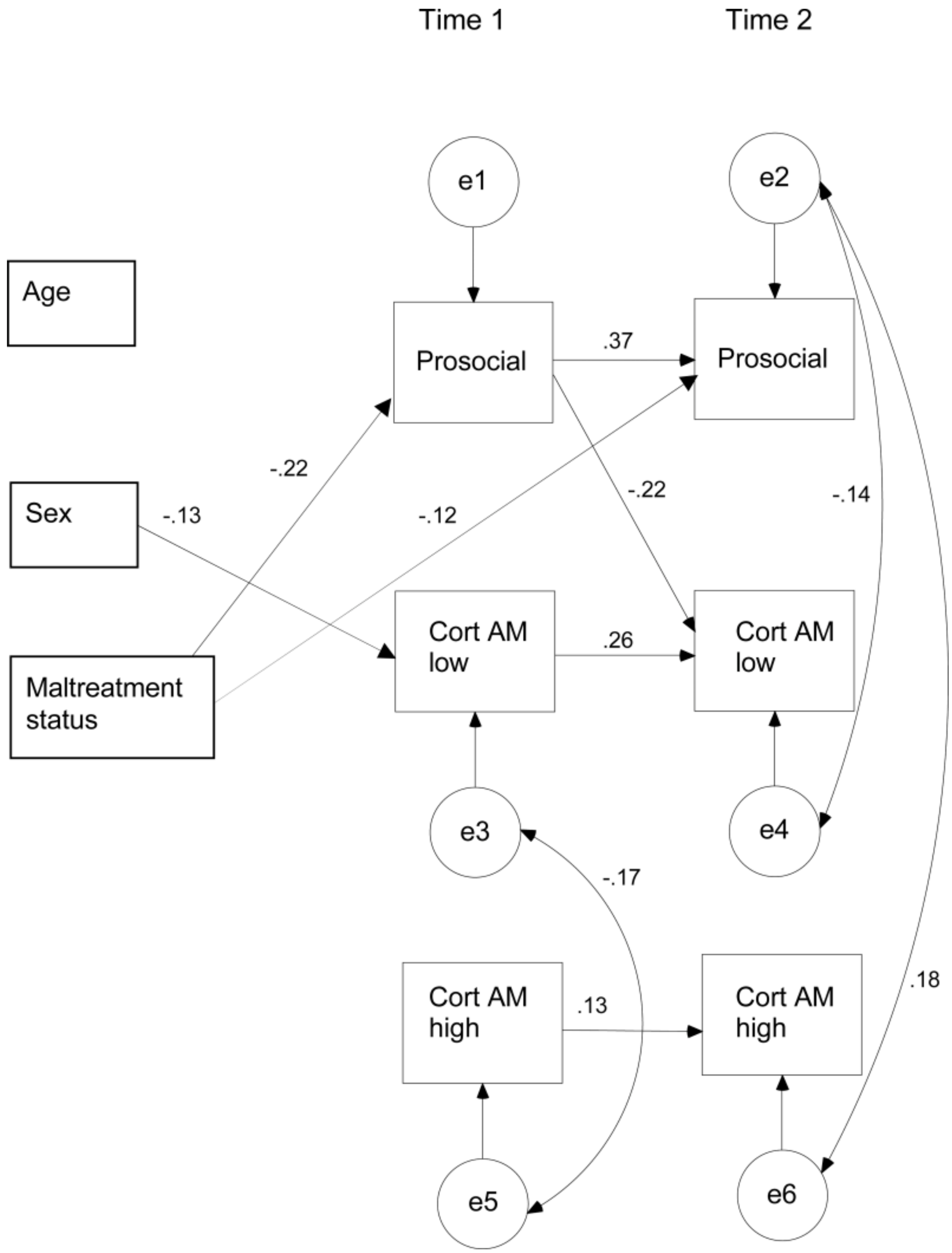

Figure 2.
Standardized regression weights for the models on morning cortisol and prosocial behavior.
Note. Lines reflecting nonsignificant effects are not shown
Sex: 1 = male, 0 = female
Maltreatment status: 1 = maltreated, 0 = nonmaltreated
Cortisol AM low: 1 = low values (– 1 SD), 0 = other
Cortisol AM high: 1 = high values (+ 1 SD), 0 = other

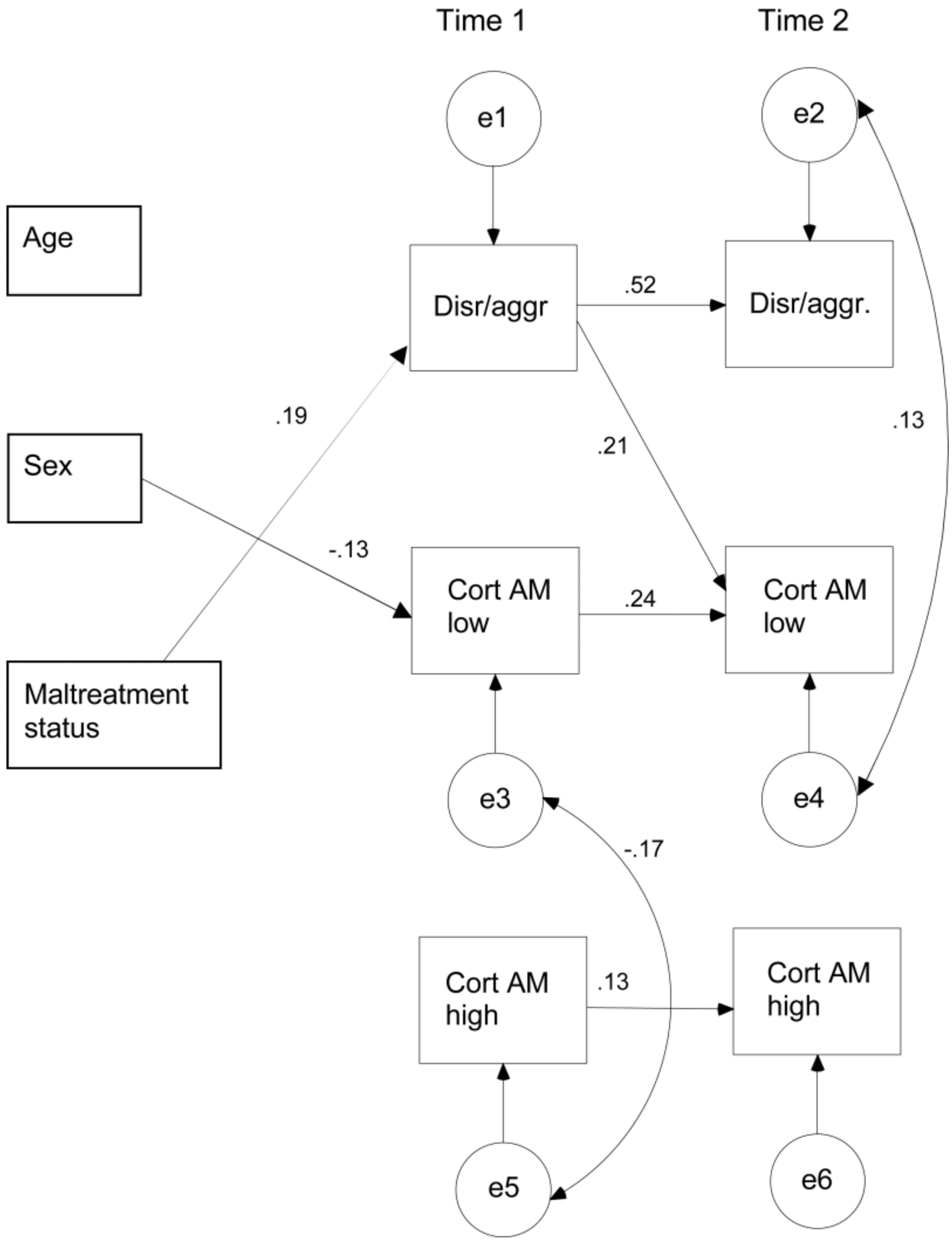

Figure 3.
Standardized regression weights for the models on morning cortisol and disruptive/aggressive behavior.
Note. Lines reflecting nonsignificant effects are not shown
Sex: 1 = male, 0 = female
Maltreatment status: 1 = maltreated, 0 = nonmaltreated
Cortisol AM low: 1 = low values (− 1 SD), 0 = other
Cortisol AM high: 1 = high values (+ 1 SD), 0 = other

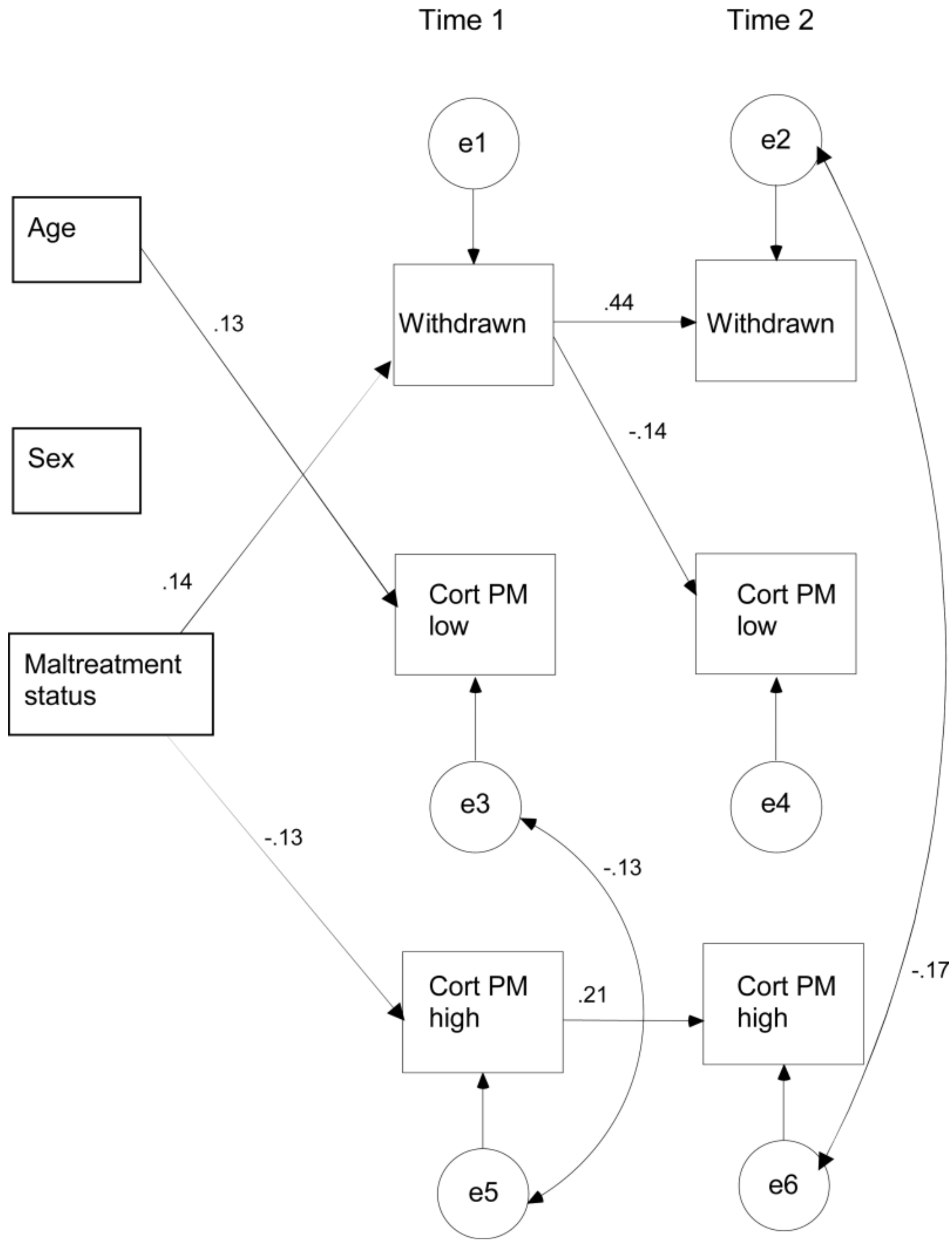

Figure 4.
Standardized regression weights for the models on afternoon cortisol and withdrawn behavior.
Note. Lines reflecting nonsignificant effects are not shown
Sex: 1 = male, 0 = female
Maltreatment status: 1 = maltreated, 0 = nonmaltreated
Cortisol PM low: 1 = low values (– 1 SD), 0 = other
Cortisol PM high: 1 = high values (+ 1 SD), 0 = other

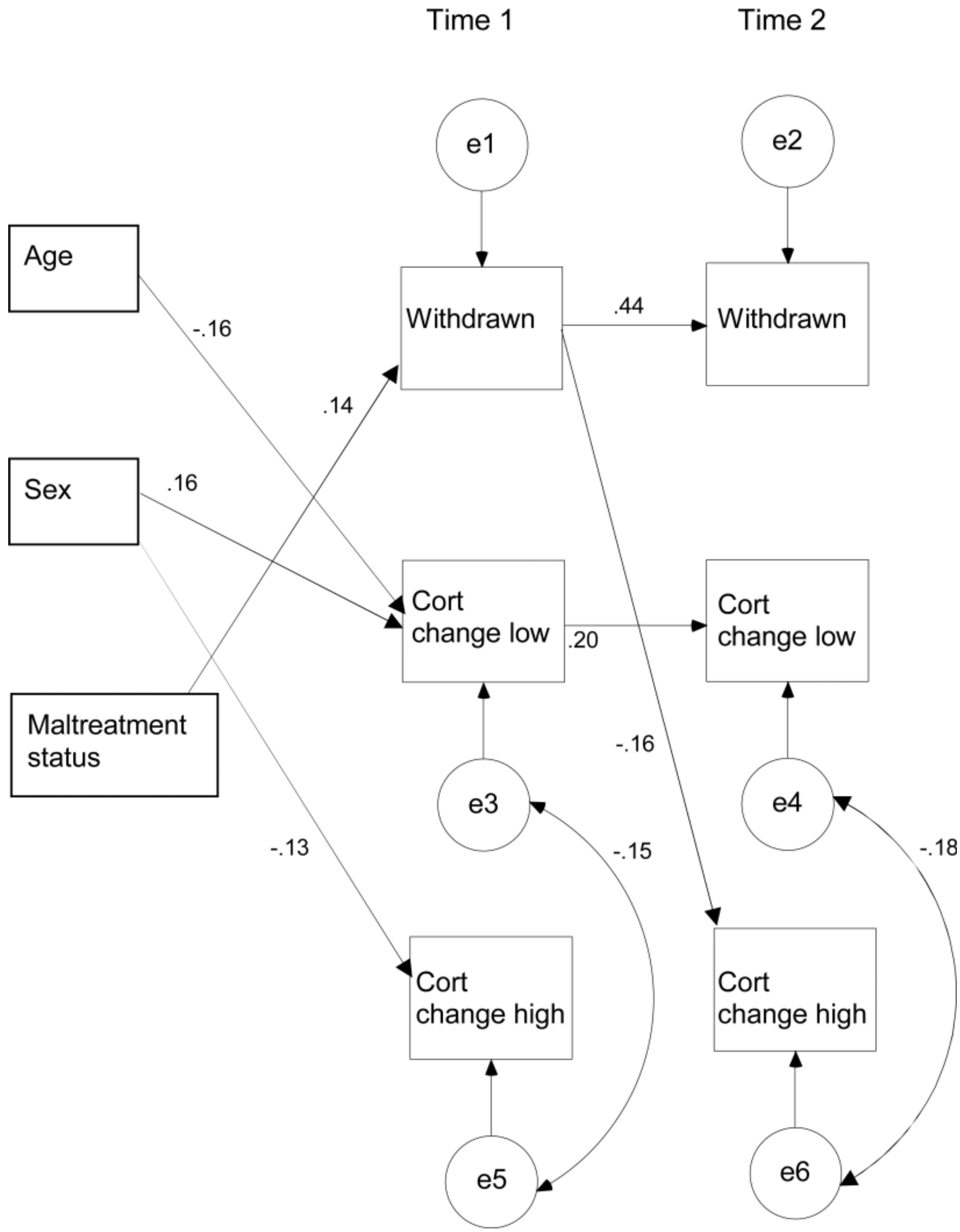

Figure 5.
Standardized regression weights for the models on cortisol change and withdrawn behavior.
Note. Lines reflecting nonsignificant effects are not shown
Sex: 1 = male, 0= female
Maltreatment status: 1 = maltreated, 0 = nonmaltreated
Cortisol change low: 1 = low values (– 1 SD), reflecting slightly increasing to slightly decreasing levels, 0 = other
Cortisol change high: 1 = high values (+ 1 SD), reflecting sharply falling levels, 0 = other

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Table 1

Correlations between Social Functioning and Cortisol on Both Time Points (N = 236)

		Time 1						Time 2				
		Prosocial	**Disr/aggr**	**Withdr**	**Cort AM**	**Cort PM**	**Cort change**	**Prosocial**	**Disr/aggr**	**Withdr**	**Cort AM**	**Cort PM**
Time 1	Prosocial											
	Disr/aggr	−.45**										
	Withdrawn	−.24**	−.10									
	Cort AM	−.09	.02	.01								
	Cort PM	−.06	−.05	.11	.46**							
	Cort change	.02	.07	−.12	.00	−.89**						
Time 2	Prosocial	.39**	−.31**	−.15*	.05	.08	−.06					
	Disr/aggr	−.37**	.51**	−.08	.03	−.10	.12	−.48**				
	Withdrawn	−.04	−.09	.44**	−.10	.01	−.05	−.16*	−.16*			
	Cort AM	.10	−.11	.02	.39**	.10	.09	.22**	−.16*	.01		
	Cort PM	−.03	−.06	.13*	.04	.23**	−.24*	.09	−.05	−.02	.44**	
	Cort change	.08	.02	−.13*	.15*	−.21**	.31**	.01	−.03	.03	.00	−.90**

* $p \leq .05$.

** $p \leq .01$.

Note. Disr/aggr = disruptive/aggressive; cort AM = morning cortisol; cort PM = afternoon cortisol; cort change = residualized scores (controlled for morning cortisol) reflecting difference between mean morning and mean afternoon samples

Table 2

Maltreatment Status and Sex Differences

		Maltreatment status			Sex		
			Nonmal $n = 111$	Mal $n = 125$		Girls $n = 108$	Boys $n = 128$
		F	Mean (SD)		F	Mean (SD)	
Time 1	Prosocial[1]	11.41**	0.17 (0.77)	−0.15 (0.72)	0.49	−0.04 (0.77)	0.03 (0.75)
	Disr/aggr[1]	7.73**	−0.16 (0.75)	0.15 (0.94)	0.40	0.04 (0.89)	−0.03 (0.84)
	Withdrawn[1]	4.51*	−0.12 (0.76)	0.10 (0.83)	0.05	−0.01 (0.81)	0.01 (0.80)
	Cort AM[2]	3.79*	−0.80 (0.18)	−0.85 (0.16)	1.02	−0.82 (0.19)	−0.84 (0.15)
	Cort PM[2]	0.79	−1.01 (0.17)	−1.03 (0.16)	3.16	−1.04 (0.16)	−1.00 (0.16)
	Cort change[2]	0.00	0.00 (0.14)	−0.00 (0.15)	7.52*	0.03 (0.13)	−0.02 (0.15)
Time 2	Prosocial[1]	9.96**	0.16 (0.81)	−0.14 (0.67)	1.41	−0.06 (0.71)	0.05 (0.79)
	Disr/aggr[1]	0.98	−0.06 (0.89)	0.05 (0.87)	2.09	0.09 (0.94)	−0.08 (0.81)
	Withdrawn[1]	0.31	−0.03 (0.89)	0.03 (0.78)	0.31	−0.03 (0.81)	0.03 (0.86)
	Cort AM[2]	1.92	−0.79 (0.18)	−0.83 (0.19)	0.00	−0.81 (0.19)	−0.82 (0.18)
	Cort PM[2]	0.00	−1.01 (0.14)	−1.01 (0.13)	2.17	−1.03 (0.14)	−1.00 (0.13)
	Cort change[2]	0.40	0.01 (0.12)	−0.00 (0.12)	2.82	0.01 (0.11)	−0.01 (0.13)

* $p \le .05$.

** $p \le .01$.

[1] Subscales were standardized

[2] Log-transformed

Note. Nonmal = nonmaltreated; mal = maltreated; disr/aggr = disruptive/aggressive; cort AM = morning cortisol; cort PM = afternoon cortisol; cort change = residualized scores (controlled for morning cortisol) reflecting difference between mean morning and mean afternoon samples

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Table 3

Model Fit Statistics for the Different Models on Social Functioning and Cortisol over Time

Behavior	**Cortisol**	χ^2	***df***	***p***	**CFI**	**RMSEA**
Prosocial	AM	16.36	9	.06	.935	.059
	PM	12.80	9	.17	.953	.042
	Change	12.61	9	.18	.959	.041
Disr/aggr	AM	19.50	9	.02	.919	.070
	PM	16.79	9	.05	.930	.061
	Change	17.03	9	.05	.934	.062
Withdrawn	AM	14.97	9	.09	.933	.053
	PM	12.92	9	.17	.952	.043
	Change	12.93	9	.17	.958	.043

Note. Disr/aggr = disruptive/aggressive; AM = morning cortisol; PM = afternoon cortisol; change = residualized scores (controlled for morning cortisol) reflecting difference between mean morning and mean afternoon samples

Table 4

Model Fit Statistics for the Different Models Testing Moderation Effects of Maltreatment Status

		Prosocial			Disruptive/aggressive			Withdrawn		
		AM	**PM**	**Change**	**AM**	**PM**	**Change**	**AM**	**PM**	**Change**
M1: Configural invariance										
	χ^2	16.16	12.79	9.70	22.59	19.81	16.51	15.49	15.31	10.99
	df	14	14	14	14	14	14	14	14	14
	p	.30	.54	.78	.07	.14	.28	.35	.36	.69
	CFI	.976	1.000	1.000	.925	.942	.979	.982	.981	1.000
	RMSEA	.026	.000	.000	.051	.042	.028	.021	.020	.000
M2: Equal cross-lagged effects										
	χ^2	17.89	17.04	10.33	23.17	24.25	21.75	19.89	19.66	17.29
	df	18	18	18	18	18	18	18	18	18
	p	.46	.52	.92	.18	.15	.24	.34	.35	.50
	CFI	1.000	1.000	1.000	.955	.937	.969	.977	.976	1.000
	RMSEA	.000	.000	.000	.035	.039	.030	.021	.020	.000
M3: Equal sex effects										
	χ^2	22.13	19.29	11.71	26.24	25.51	22.04	23.42	21.34	17.95
	df	21	21	21	21	21	21	21	21	21
	p	.39	.57	.95	.20	.23	.40	.32	.44	.65
	CFI	988	1.000	1.000	.954	.955	.991	.97	.995	1.000
	RMSEA	.015	.000	.000	.033	.030	.015	.022	.008	.000
Nested models										
M1–M2	χ^2	1.73	4.25	0.64	0.59	4.44	5.24	4.40	4.35	6.30
	df	4	4	4	4	4	4	4	4	4
	p	.79	.37	.96	.96	.35	.26	.36	.36	.18
M2–M3	χ^2	4.24	2.25	1.38	3.07	1.26	0.29	3.53	1.68	0.66
	df	3	3	3	3	3	3	3	3	3
	p	.24	.52	.71	.38	.74	.96	.32	.64	.88

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Table 5

Model Fit Statistics for the Different Models Testing Moderation Effects of Sex

		Prosocial			Disruptive/aggressive			Withdrawn		
		AM	PM	Change	AM	PM	Change	AM	PM	Change
M1: Configural invariance model										
	χ^2	7.68	7.02	7.95	12.18	10.04	12.33	8.32	6.51	7.94
	df	8	8	8	8	8	8	8	8	8
	p	.47	.53	.44	.14	.26	.14	.40	.59	.44
	CFI	1.000	1.000	1.000	.964	.980	.957	.996	1.000	1.000
	RMSEA	.000	.000	.000	.047	.033	.048	.013	.000	.000
M2: Equal cross-lagged effects										
	χ^2	11.11	9.20	12.40	20.39	12.47	16.73	10.05	15.23	9.55
	df	12	12	12	12	12	12	12	12	12
	p	.52	.69	.41	.06	.41	.16	.61	.23	.66
	CFI	1.000	1.000	.994	.929	.995	.953	1.000	.962	1.000
	RMSEA	.000	.000	.012	.055	.013	.041	.000	.034	.000
M3: Equal maltreatment effects										
	χ^2	17.34	16.87	17.22	26.59	20.59	21.47	17.04	24.40	15.03
	df	18	18	18	18	18	18	18	18	18
	p	.50	.53	.51	.09	.30	.26	.52	.14	.66
	CFI	1.000	1.000	1.000	.927	.974	.965	1.000	.926	1.000
	RMSEA	.000	.000	.000	.045	.025	.029	.000	.039	.000
Nested models										
M1–M2	χ^2	3.44	2.18	4.46	8.21	2.43	4.40	1.73	8.72	1.61
	df	4	4	4	4	4	4	4	4	4
	p	.49	.70	.35	.08	.66	.35	.79	.07	.81
M2–M3	χ^2	6.23	7.66	4.82	6.19	8.12	4.74	6.99	9.17	5.48
	df	6	6	6	6	6	6	6	6	6
	p	.40	.26	.57	.40	.23	.58	.32	.16	.48