Children's Emotion Recognition and Aggression:

A Multi-Cohort Longitudinal Study

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Abstract

Difficulty recognizing negative emotions (NEs) in children is linked to increased antisocial traits and externalizing problems. However, crucial aspects of this relation remain unclear, such as: whether NE recognition is associated with externalizing problems in general or only a particular subcomponent (i.e., aggression); whether subcomponents of NE recognition (i.e., insensitivity and misspecifications) are relatively more important; and how these relations change over the course of development. We assessed emotion recognition, overt aggression, attention deficit hyperactivity disorder (ADHD) symptoms, and oppositional defiant disorder (ODD) symptoms in an ethnically diverse sample of Canadian children ($N = 150$; 4-year-olds, $N = 148$; 8-year-olds) and followed-up with them one year later (86.9% retention). Emotion recognition was assessed using a behavioral task and caregivers reported on children's externalizing symptoms. Children with lower NE recognition had higher initial, but not subsequent, overt aggression, even when controlling for non-aggressive externalizing symptoms (i.e., ADHD and ODD symptoms). NE recognition was not concurrently or longitudinally associated with non-aggressive externalizing symptoms. Age and gender did not moderate these findings. Both higher NE insensitivity (e.g., reporting a sad face appears neutral) and misspecifications (e.g., reporting a sad face appears angry) were significantly associated with higher concurrent overt aggression. In conclusion, both NE insensitivity and misspecifications were found to be uniquely important for children’s overt aggression. These findings highlight the importance of different forms of NE recognition and differentiating between aggressive and non-aggressive externalizing problems in children.

Keywords: facial expression; aggression; children; longitudinal studies; cohort studies; emotions

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Conflict de-escalation relies on accurately sending and receiving emotional messages (Halberstadt et al., 2001). For example, if a child understands that a peer is acting aggressively, returning submissive cues may diffuse the conflict. However, this relies on both parties being able to accurately recognize hostile (anger) and negative non-hostile (e.g., fear and sadness) emotion cues (R. J. R. Blair, 1995; Drews, 1993). One of the most crucial sources of emotional information that we receive are in the form of facial expressions (Nelson, 2001). The capacity to recognize and differentiate between facial expressions generally continues to improve throughout childhood and is thought to contribute to children's abilities to select and learn appropriate social behavior (Herba & Phillips, 2004; Nelson, 1987). For instance, if a child decides to push another, being able to recognize that they made the other individual feel bad may reduce the likelihood of them hurting others in similar situations in the future. Yet, it is not well-understood how emotion recognition is associated with current and subsequent aggressive behavior over the course of childhood. Previous studies have predominantly used behavioral assessments that include a broad range of problem behavior (Trentacosta & Fine, 2010). Although often overlapping, non-aggressive externalizing problems are conceptually and developmentally distinct from behavior that is overtly aggressive (Burt, 2012; Moffitt & Caspi, 2001; Tremblay, 2010). To address this, we assessed how emotion recognition is linked to overt aggression concurrently and longitudinally in early and middle childhood when also considering non-aggressive externalizing problems (attention deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD) symptoms).

Emotion Recognition's Links to Aggression in Childhood

Improvements in emotion recognition over the course of childhood are thought to result in more advanced social capacities and inhibition of aggressive behavior (Eisner & Malti, 2015; Herba & Phillips, 2004; Izard et al., 2001; Roskam, 2019). Yet, the limited research that has focused on emotion recognition and aggression in children has been mixed (Arsenio et al., 2000; C. Blair et al., 2005; Miller et al., 2006; Parker et al., 2013; Schultz et al., 2004; Walker, 1981). Studies that have not demonstrated connections between emotion recognition and aggression have, however, likely been underpowered (N = 15 to 60) and none presented emotional expressions that changed in intensity or ambiguity, reducing their ecological validity (Miller et al., 2006; Parker et al., 2013; Walker, 1981). Studies that have not shown emotion recognition-aggression links have additionally used measures of aggression that included items that do not directly assess the intentional harm of others (i.e., aggression; Coie & Dodge, 1998). For instance, Miller et al., (2006) found no link between emotion recognition and aggression, however, they used the Preschool Behavior Questionnaire for aggression, which includes items such as "does not share toys", "blames others", and is "inconsiderate of others" (Behar & Stringfield, 1974). If emotion recognition is uniquely linked to aggression, including items that are peripherally related to aggression may dilute this connection and impede its identification.

Trouble understanding others' emotional states makes it more challenging to empathize with others, which is expected to lead to increases in aggression (R. J. R. Blair, 1995). However, research on whether difficulties in emotion recognition precede changes in aggression in children is scarce. Only two groups of researchers to our knowledge have explored this question; both found that poor emotion recognition in children is longitudinally associated with increased aggression (Denham et al., 2002; Schuberth et al., 2019). However, these longitudinal studies used measures of aggression that included items that did not measure intentional harm of others. For instance, Denham et al., (2002) included a composite of anger-aggression and Schuberth et al., (2019) included items (e.g., "argues when denied own way") that could be more accurately described as non-aggressive externalizing problems. Research suggests that aggression may be etiologically distinct from non-aggressive externalizing problems (Burt, 2012; Moffitt & Caspi, 2001; Tremblay, 2010). This makes it unclear whether the associations found were due to specifically aggression or to externalizing problems more generally. These two longitudinal studies only included children ages 3- to 4-years-old, leaving it unknown as to whether these relations extend beyond early childhood. The association between facial expression recognition and aggression may differ across development as facial expressions are more heavily relied upon for communication during early childhood due to relatively simple language and social skills during this age period (Izard et al., 2001).

In summary, it remains unclear whether the relation between emotion recognition and aggression is present with more ecologically valid measures of emotion recognition, whether this relation changes over time, and whether it differs across developmental periods. Further, no research to our knowledge has attempted to discern whether associations are unique to aggression, as opposed to non-aggressive externalizing problems that often coincide with aggression (Malti & Rubin, 2018; Trentacosta & Fine, 2010). Lastly, we focused on *overt* aggression (e.g., direct physical and verbal harm) because it is a robust predictor of later antisocial conduct (Brame et al., 2001; Broidy et al., 2003; Eisner & Malti, 2015).

Emotion Recognition: Senstivity and Specificity

Previous research suggests that differentiating between subcomponents of emotion recognition is important for understanding children's psychopathology (Lopez-Duran et al., 2013; Pollak et al., 2000). A child that cannot detect that an individual is experiencing a NE at all (NE insensitivity) may exhibit different behavior than a child who can tell another is feeling something but has trouble determining the specific emotion (NE misspecification). Difficulty *detecting* distress in others has been theorized to lead to less inhibition of aggression, as it may be more problematic if a child detects no NE rather than mistaking a NE for another emotion (e.g., perceiving sadness as fear; R. J. R. Blair, 1995). In real world conditions, facial expressions are dynamic and are displayed at different intensities based on the situation. Yet, much of the research in this area to date has used measures of emotion recognition that do not vary in emotion intensity (e.g., includes only 100% intensity emotional faces) or only includes ambiguous mixed-emotion facial expressions (e.g., a face morphed to have a mix of fear and anger), both of which tend to ignore children's emotion insensitivities (Gao & Maurer, 2009). We addressed this issue by assessing both NE insensitivity and misspecifications in the present study.

The Present Study

In summary, we examined concurrent and longitudinal links between overall NE recognition, NE misspecifications, and NE insensitivity and overt aggression in an ethnically diverse, community sample of children in early and middle childhood. Previous research suggests that poor emotion recognition is associated with externalizing problems in children, therefore, we additionally examined whether NE recognition was related uniquely to aggression as opposed to externalizing problems more generally (Trentacosta & Fine, 2010). ADHD, ODD, and conduct disorder symptoms are externalizing problems that are prevalent in children (Lavigne et al., 2009; Maughan et al., 2004; Sayal et al., 2018). However, some conduct disorder symptoms include overt aggression and include acts that are less applicable in early childhood (e.g., running away from home; Achenbach & Rescorla, 2000, 2001). Thus, ODD and ADHD symptoms were used as our measures of non-aggressive externalizing problems.

As emotion recognition abilities are still developing over the course of childhood, we recruited 4- and 8-year-olds to assess potential developmental relations. These ages were selected as 4-year-olds have just entered the school system, which is a critical period in their social development. Further, by 4 years of age children have developed language skills strong enough for them to be able to follow the instructions necessary to complete the emotion recognition task. Lastly, 8-year-olds were selected as they are in middle childhood and are several years older than the 4-year-old cohort maximizing our ability to detect developmental differences between these two age periods.

Compared to other emotions, difficulty recognizing NEs is more strongly associated with antisociality (R. J. R. Blair & Coles, 2000; Dawel et al., 2012; Marsh & Blair, 2008); therefore we focused specifically on NE recognition in the present study. Additionally, in accordance with prior theorizing, we predicted that difficulty detecting the presence of NEs (i.e., higher NE insensitivity) would be uniquely associated with higher aggression (R. J. R. Blair, 1995). We also expected that the relation would be stronger in younger compared to older children, as they may rely more heavily on facial expression recognition (Izard et al., 2001). Lastly, we predicted that initial levels of NE insensitivity would be associated with both current and future levels of aggression as long-term difficulties in reading others' emotions could dampen children's sensitivity to negative feedback about inappropriate behavior. This could lead those children to continue behaving aggressively while their peers learn to desist. Gender was also assessed as a potential moderator as previous researchers have reported gender differences in overt aggression (Smith et al., 2010). We also assessed verbal ability and household income (as an indicator of socio-economic status) as potential control variables due to reported differences in children's emotion recognition and externalizing problems (Kong, 2014; Lawrence et al., 2015; Letourneau et al., 2013).

Method

Participants

Participants were 4 (M_{age} = 4.53, SD = .30, n = 150, range = 4.03 – 4.99, 50% girls) and 8 years of age at the initial assessment (M_{age} = 8.52, SD = .27, n = 148, range = 8.01 – 8.97, 50% girls). Families were recruited from local community centers, events, and summer camps in an urban Canadian city as part of a longitudinal study (2016 - ongoing) on children's social-emotional development. The only exclusion criterion was the presence of an autism spectrum disorder, as the study contains social tasks that may be uncomfortable for children on the spectrum to complete. The sample was ethnically diverse and included the following ethnic backgrounds: 22% Western European, 16% South/Southeast Asian, 10% East Asian, 8% Central/South American & Caribbean, 6% Eastern European, 3% African, 1% West/Central Asian, 1% Middle Eastern, 18% multi-ethnic, and 3% other; 11% missing/chose not to answer. All children and caregivers were fluent in English. Participating caregivers reported their relationship to the children as follows: 98.3% biological parent, 0.7% step parent, 0.3% foster parent, and 0.7% chose not to answer. The sample's median household income was $80,000 to

$125,000 CAD, which was similar to recent census data for the sampled city (Statistics Canada, 2017).

Procedure

The University of Toronto ethics review board granted approval prior to the start of data collection ("Longitudinal Study of Emotions, Aggression, and Physiology", # 00028256). At the initial testing (T1) and at the one-year follow-up (T2), written informed consent was obtained from caregivers and oral assent was obtained from children. Testers were undergraduate and graduate psychology students with extensive training on child interview techniques. Each child and their caregiver(s) visited the laboratory for approximately 60 minutes. Children were assessed in a designated testing room while their caregiver remained in a nearby waiting area to complete questionnaires on a touch-screen tablet. After the assessments, caregivers were debriefed and children received an age-appropriate book. The child assessments were recorded (video and audio). Each family was contacted again via phone and email one year later to be scheduled for a second visit where they completed the same testing procedure again.

Measures

Emotion Recognition

At T1 children completed a previously validated facial expression recognition task assessing their recognition of angry, happy, fearful, and sad facial expressions (Gao & Maurer, 2010). They were presented 10 pictures of each emotion, and each picture ranged from expressing an emotion from 10% to 100% intensity, which was created by morphing emotional faces with a neutral face. One neutral facial expression (i.e., no emotion) was also presented. The faces presented were of one individual Caucasian woman from the NimStim Set of Facial

Expressions (Tottenham et al., 2009). This task was a sorting game in which the child put photographs of faces into houses labeled with corresponding emoticons (including a neutrally expressive emoticon). Children were presented the faces in a random order and they had to classify each face as either neutral, happy, sad, fearful, or angry.

Three different measures of emotion recognition were calculated: overall NE recognition, NE insensitivity, and NE misspecifications. The NEs included in analyses were fear, anger, and sadness, these were grouped together as a composite as research suggests they all have similar relations to antisociality in children (Dawel et al., 2012). We included these three measures to determine whether a particular subcomponent of emotion recognition was driving relations found between overall accuracy and aggression.

Overall NE recognition was calculated as the proportion of NE expressions children correctly identified (4-year-olds $\alpha = .72$, 8-year-olds $\alpha = .72$). NE misspecification was calculated as the proportion of NEs the child misclassified as the incorrect emotion (4-year-olds $\alpha = .78$, 8-year-olds $\alpha = .66$). For example, classifying a sad face as happy added to their NE misspecification score. The sum of NEs identified as incorrect emotions was divided by the total number of NEs presented (i.e., 30). NE insensitivity was the proportion of NEs a child identified as showing no emotion (i.e., identifying a 30% sad face as neutral; 4-year-olds $\alpha = .80$, 8-year-olds $\alpha = .78$). The sum of NEs identified as neutral was divided by the total number of NEs presented (i.e., 30). Thus, scores could range from 0 to 1. For example, if a child identified seven (out of a possible thirty) negative emotions as neutral they would have a NE insensitivity score of 0.23. This score is interpretable as a percentage, i.e., this child identified 23% of the negative emotive faces as neutral.

Overt Aggression

Caregivers reported on children's overt aggression at both T1 and T2 using items drawn from the aggressive behavior syndrome subscale of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000, 2001). Only items tapping into overt aggression (i.e., direct harm towards others) were included. Four items from the CBCL (1.5 – 5 years version) were used for 4-year-olds (destroys things belonging to his/her family or others, gets in fights, physically attacks people, hits others). Five items from the CBCL (6 – 18 years version) were used for 8-year-olds (destroys things belonging to his/her family or others, gets in fights, physically attacks people, cruelty, bullying, or meanness to others, threatens people). Items were assessed on a seven-point scale (0 = never to 6 = almost always). Reliability estimates were acceptable across age groups and over time (T1 4-year-olds $\alpha = .83$, 8-year-olds $\alpha = .79$; T2 5-year-old $\alpha = .85$, 9-year-olds $\alpha = .78$).

ADHD Symptoms

Caregivers reported on children's ADHD symptoms at both T1 and T2 using the 6-item (4-year-olds) and 7-item (8-year-olds) CBCL's attention deficit/hyperactivity problems DSM-oriented scale (e.g., "can't concentrate, can't pay attention for long"; T1 4-year-olds $\alpha = .77$, 8-year-olds $\alpha = .87$; T2 5-year-old $\alpha = .78$, 9-year-olds $\alpha = .87$). Items were assessed on a seven-point scale (0 = never to 6 = almost always).

ODD Symptoms

Caregivers reported on children's ODD symptoms at both T1 and T2 using the 6-item (4-year-olds) and 5-item (8-year-olds) CBCL's oppositional defiant disorder DSM-oriented scale (e.g., “defiant”; T1 4-year-olds $\alpha = .87$, 8-year-olds $\alpha = .80$; T2 5-year-old $\alpha = .85$, 9-year-olds $\alpha = .81$). Items were assessed on a seven-point scale (0 = never to 6 = almost always).

Control Variables

Children’s verbal ability at T1 was tested using the verbal knowledge subtest of the Kaufman Brief Intelligence Test (KBIT-2; Kaufman & Kaufman, 2004), which has been found to be a reliable and validated proxy for verbal intelligence in children. On average, the test takes less than 10 minutes to implement and is comprised of 60-items. The experimenter says a word or a phrase then asks the child to match the vocabulary with the picture (from six options) it represents. When the child made four errors in a row, the test was halted. Scores were calculated by subtracting the number of errors they made by how far they got through the list of items before the test was stopped. This score was then centered based on the average score for their age group. Household income and children’s gender (coded as: girl = 0, boy = 1) were reported by caregivers at T1. Household income was used as a proxy for socio-economic status. The income scale’s possible options ranged from 1 (less than $9,999) to 9 (over $125,000).

Data Analysis

An *a priori* power analysis using G*Power 3.1 was performed to assess whether our analyses were adequately powered to detect a relation between emotion recognition and overt aggression (Faul et al., 2009). A meta-analysis by Trentacosta and Fine (2010) found that the average correlation between emotion recognition and externalizing problems was $r = -.17$. We predicted that overt aggression would explain this relation, therefore, we expected that the emotion recognition-aggression relation would have a similar or larger effect size. Thus, we inputted the following parameters: estimated $r = -.17$, α (one-sided) = .05, and power = .80. The power analysis results suggested that $N = 212$ was required to detect an effect, suggesting our sample was adequately powered.

Independent sample t-tests were performed to assess whether there were significant mean-level differences in emotion recognition and behavioral outcomes between age groups. We performed path analyses in RStudio (Version 1.1.463) using the *lavaan* package by Rosseel (2012) to examine whether NE recognition was related to overt aggression, ADHD symptoms, and ODD symptoms initially (T1) and at the one year follow up (T2). Scatterplots were created using the *jtools* package by Long (2018).

We tested a total of twelve path models using observed variables. First, we estimated cross-sectional (Models 1a, b, c) and longitudinal links (Model 2a, b, c) between overall NE recognition and overt aggression, ADHD symptoms, and ODD symptoms (respectively). Then we tested similar cross-sectional (Model 3a, b, c) and longitudinal (Model 4a, b, c) models examining the two subcomponent scores of NE recognition (i.e., NE insensitivity and misspecifications) to determine which was more strongly associated to overt aggression, ADHD symptoms, and ODD symptoms (respectively). Models were tested in four steps. We first examined main effects while controlling for potentially confounding variables (e.g., age). In a second step, age interaction effects were examined to assess whether relations differed for younger and older children; these effects were examined in both overall and subtype NE recognition models as the subtypes were differentially related to the age of the children (see Table 1). As levels of externalizing symptoms differed between boys and girls (see Table 2), gender interaction effects were examined for the overall NE recognition models. In a fourth step, for “a” models (i.e., aggression as the criterion), ADHD and ODD symptoms were added to the model as control variables. In "b" and "c" models, overt aggression was added to the models as a control variable. This last step allowed us to examine whether relations found were due to what these externalizing problems share in common versus what makes them unique.

All path model estimates are reported in Tables 3 and 4, with the exception of non-significant age and gender interaction terms, which are reported in-text. Similarly, estimates for main effects when other externalizing problems were controlled are included in-text if they did not meaningfully alter findings. Longitudinal models were auto-regressive to test for relative changes over time. Because NE insensitivity and misspecification scores were correlated due to the nature of the task, both insensitivity and misspecifications were entered together in each analysis to determine their individual contributions. Gender, verbal ability, and income's relations to outcome variables were assessed in zero-order correlations. If they related to any form of externalizing problem they were included as covariates in all analyses to control for potentially confounding effects. NE misspecification data was positively skewed (skewness = 1.11, SE = .14) and therefore the MLR estimator was used, which accommodates non-normal variable distributions (Lai, 2018). All models were just-identified, therefore fit statistics were not reported.

Missing Data

At T1, four children did not complete the emotion recognition task, 11 did not complete the KBIT-2, and 43 caregivers did not report their income. Of the families that participated in T2, four caregivers did not complete the CBCL questionnaire. Retention from T1 to T2 was 86.9% ($n = 259$). Little's missing-completely-at-random test was significant, X^2 (81, $N = 298$) = 153.47, $p < .001$, suggesting that the presence of missing data was associated with observed scores across the study variables. Follow up analyses indicated that having lower NE misspecifications was significantly associated with missing data for T2 externalizing behavior ($r = .13$, $p = .02$). Additionally, T1 ODD, T1 overt aggression, T2 ODD, and T2 ADHD scores were significantly ($r = -.20$, $p < .001$; $r = -.12$, $p = .04$; $r = -.14$, $p = .03$; $r = -.17$, $p = .008$, respectively) associated with missing data for verbal ability, such that having higher externalizing problems was associated missing data. Lastly, lower income was significantly associated with missing emotion recognition data ($r = .14$, $p = .02$). Given that missing data was associated with observed scores, missing data was estimated using full information maximum likelihood under the missing-at-random assumption.

Results

Descriptive Statistics

For T1 emotion recognition scores, one extreme outlier (3 * interquartile range) was identified using a box-plot. This 8-year-old participant also had a note by the experimenter stating that the participant did not perform the task properly, which was further corroborated by them performing 6.4 SD below the average of the other 8-year-olds on the task. This data point was treated as missing in all analyses.

Descriptive statistics for all variables are provided in Table 1. For group comparisons between 4- and 8-year-olds, the Levene's Tests for equality of variances were significant ($p < .001$), therefore Welch independent sample t-tests were performed. These t-tests revealed that 4-year-olds had significantly lower overall NE recognition abilities when compared to 8-year-olds, $t(263) = -11.35$, $p < .001$, which was due to 4-year-olds making significantly more NE misspecifications, $t(230) = 10.18$, $p < .001$. NE insensitivity did not significantly differ between age groups, $t(230) = 0.77$, $p = .44$. The 4-year-old cohort also had significantly higher aggression ($t(257) = 6.32$, $p < .001$; $t(228) = 5.00$, $p < .001$), ADHD symptoms ($t(277) = 3.41$, $p = .001$; $t(256) = 4.05$, $p < .001$), and ODD symptoms ($t(296) = 4.90$, $p < .001$; $t(256) = 4.84$, $p < .001$) than the 8-year-old group at both T1 and T2, respectively.

For gender group comparisons, the Levene's Tests for equality of variances were only significant ($p < .05$) for measures of aggression; therefore, Welch independent sample t-tests were performed for aggression comparisons. These t-tests revealed that girls and boys did not significantly differ in overall NE recognition ($t(291) = 0.16$, $p = .87$), NE insensitivity ($t(291) = -0.05$, $p = .96$), NE misspecifications ($t(291) = -0.12$, $p = .90$), and in their ODD symptoms at T1 ($t(296) = -0.56$, $p = .58$) and T2 ($t(256) = -1.18$, $p = .24$). Both overt aggression at T1 ($t(254) = -3.19$, $p = .002$) and T2 ($t(247) = -2.72$, $p = .007$) and ADHD symptoms at T1 ($t(296) = -2.63$, $p = .009$) and T2 ($t(256) = -2.09$, $p = .04$) were higher in boys compared to girls.

Table 2 includes zero-order correlations between all variables, by age group. Verbal ability was significantly negatively associated with 4-year-olds' T1 and T2 ADHD symptoms, whereas income was not significantly correlated with any outcome. Income was therefore included as an auxiliary variable in all subsequent analyses to aid with missing data estimation. Higher T1 overall NE recognition was significantly associated with lower T1 and T2 overt aggression in 4-year-olds, but not in 8-year-olds. NE recognition was not significantly associated with either ADHD or ODD symptoms at T1 or T2 for either age group. NE misspecifications were not significantly associated with any externalizing symptoms, whereas NE insensitivity was significantly positively correlated with 4-year-olds' overt aggression at T1, but not at T2. Together, these correlations suggest that lower overall NE recognition is associated with higher overt aggression in 4-year-olds, but not 8-year-olds, and that they may be linked longitudinally. Further, NE insensitivity appears to be more important for this relation than NE misspecifications. To further probe these relations and control for potentially confounding variables, path analyses were performed.

Overall NE Recognition and Externalizing Problems

In Model 1a, we found a significant main effect of T1 overall NE recognition on T1 overt aggression, such that higher overall NE recognition was associated with lower overt aggression (see Table 3). This relation remained significant when controlling for non-aggressive externalizing problems (B = -.82, SE = .27, p = .002). There was no significant interaction between T1 NE recognition and age (B = .02, SE = .02, p = .13) or gender (B = -.69, SE = .53, p = .20) on T1 overt aggression.

In Model 1b and 1c, overall NE recognition was not significantly associated with either ADHD or ODD symptoms (see Table 3). This relation remained non-significant when controlling for children's aggressive behavior (B = .05, SE = .49, p = .93; B = .41, SE = .36, p = .26, respectively). There was no significant interaction between T1 NE recognition and age (B = .30, SE = .29, p = .30; B = .21, SE = .22, p = .33) or gender (B = .10, SE = .87, p = .91; B = -.65, SE = .72, p = .37) on T1 ADHD or ODD symptoms, respectively.

Next in Model 2a, there was no significant main effect of T1 overall NE recognition on T2 overt aggression (T1 aggression controlled; see Table 3). This relation remained non-significant when controlling for T2 non-aggressive externalizing problems (B = -.34, SE = .33, p = .30). There was no significant interaction between T1 NE recognition and age (B = .02, SE = .02, p = .15) or gender (B = .05, SE = .63, p = .94) on T2 overt aggression.

In Model 2b and 2c, T1 overall NE recognition was not significantly associated with either T2 ADHD or ODD symptoms (see Table 3). These relations remained non-significant when controlling for aggressive behavior ($B = .00$, $SE = .36$, $p = .99$; $B = .13$, $SE = .30$, $p = .67$, respectively). There was no significant interaction between T1 NE recognition and age ($B = -.11$, $SE = .21$, $p = .61$; $B = .26$, $SE = .17$, $p = .14$) or gender ($B = .17$, $SE = .59$, $p = .77$; $B = -.01$, $SE = .57$, $p = .99$) on T2 ADHD or ODD symptoms, respectively. Together, these findings suggest that overall NE recognition is uniquely associated with children's concurrent overt aggression, but is not associated with rank-order changes in overt aggression one year later.

NE Insensitivity and Misspecifications and Externalizing Problems

In Model 3a, we found that both higher NE insensitivity and misspecifications were significantly associated with higher concurrent overt aggression (see Table 4, Figure 1, and Figure 2). These relations remained significant when controlling for non-aggressive externalizing problems ($B = 1.17$, $SE = .35$, $p = .001$; $B = .65$, $SE = .26$, $p = .01$, respectively). Age did not significantly moderate any relations between NE insensitivity ($B = -.03$, $SE = .02$, $p = .10$) or misspecifications ($B = -.01$, $SE = .02$, $p = .37$) and T1 overt aggression.

In Model 3b and 3c, NE insensitivity and misspecifications were not significantly concurrently associated with either ADHD or ODD symptoms (see Table 4). These relations remained non-significant when controlling for aggression (ADHD: $B = -.22$, $SE = .56$, $p = .70$; $B = .01$, $SE = .51$, $p = .98$, ODD: $B = -.61$, $SE = .47$, $p = .19$; $B = -.34$, $SE = .36$, $p = .35$, respectively). Age did not significantly moderate any relations between NE insensitivity ($B = -.34$, $SE = .33$, $p = .31$; $B = -.25$, $SE = .26$, $p = .34$) or misspecifications ($B = -.29$, $SE = .33$, $p = .38$; $B = -.19$, $SE = .24$, $p = .44$, respectively) and T1 ADHD or ODD symptoms.

In Model 4a, neither T1 NE insensitivity nor misspecifications were associated with relative increases in T2 aggressive behavior (when controlling for T1 aggression; Table 4). These relations remained non-significant when controlling for non-aggressive externalizing problems (B = .33, SE = .42, p = .44; B = .34, SE = .32, p = .29, respectively). Again, no significant interactions with age were found between NE insensitivity (B = -.02, SE = .02, p = .34) or misspecifications (B = -.03, SE = .02, p = .09) and T2 overt aggression.

In Model 4b and 4c, T1 NE insensitivity and misspecifications were not significantly associated with either T2 ADHD or ODD symptoms (see Table 4). These relations remained non-significant when controlling for aggressive behavior (ADHD: B = .52, SE = .47, p = .27; B = -.29, SE = .38, p = .43, ODD: B = -.32, SE = .37, p = .39; B = -.06, SE = .32, p = .86, respectively). Age did not significantly moderate any relations between NE insensitivity (B = .46, SE = .28, p = .10; B = -.17, SE = .22, p = .43) or misspecifications (B = -.10, SE = .23, p = .68; B = -.30, SE = .18, p = .10, respectively) and T2 ADHD or ODD symptoms. Together, these findings suggest that higher NE insensitivity and misspecifications are independently associated with higher concurrent overt aggression in children. However, neither were associated with rank-order changes in aggression one year later.

Discussion

In the present study we examined whether distinct subtypes of emotion recognition were uniquely associated with overt aggression as opposed to externalizing problems more generally. The questions were assessed using an ethnically diverse, multi-cohort, multi-wave community sample of children in early and middle childhood. Assessing both emotion recognition insensitivity and misspecifications, our multi-cohort and longitudinal design, and our inclusion of aggressive and non-aggressive externalizing symptoms are all novel contributions of this paper to the clinical-developmental literature.

Our findings suggest that poor NE recognition is associated with concurrent higher overt aggression in early and middle childhood, and that this association is explained by a reduced sensitivity to NEs and more difficulty accurately identifying the type of NE. This could be because a child who has done something hurtful to another may not be able to detect the NEs they have elicited in the other, allowing them to act aggressively without having to share the negative feelings the other is experiencing. Additionally, when this child is able to detect a NE, they may have more difficulty identifying which emotion is being displayed resulting inappropriate responses. This implies that these children may have more difficulty understanding and feeling for others, leading to more conflict. Child maltreatment has been linked to difficulties in emotion recognition and aggression later in life (Chen et al., 2012; Young & Widom, 2014). Thus, it is possible that emotion recognition mediates the relation between childhood maltreatment and overt aggression. Alternatively, child maltreatment could influence both emotion recognition and aggression leading to the observed relations between these variables. As child maltreatment was not measured in the present study, future research should explore this possibility.

Our results demonstrating a link between emotion recognition and aggression differed from some studies showing no relation between emotion recognition and aggression (Miller et al., 2006; Parker et al., 2013; Walker, 1981). This may be due, in part, to prior studies being underpowered and using aggression measures that included items that do not assess intentional harm. Further, these studies that did not find links between emotion recognition and aggression used facial expressions that did not change in intensity, which would have impaired their ability to detect this relation as NE insensitivity appears to contribute more to this relation than NE misspecifications.

Contrary to our hypothesis, we did not find a longitudinal relation between overall NE recognition, NE insensitivity, or NE misspecifications and overt aggression. Researchers have previously found that emotion recognition is associated with changes in aggression in 3- and 4-year-olds (Denham et al., 2002; Schuberth et al., 2019). These divergent findings could be explained by the prior studies focusing only on early childhood, as our zero-order correlations suggest that the relation between NE recognition and aggression is stronger in younger children. Further, we focused specifically on overt aggression, whereas the studies that did find relations did not exclusively measure overt aggression, e.g., Denham et al., 2002 used an anger-aggression composite measure. Thus, it is possible that the relation is more directly linked to precursors of aggression, such as anger. Further research is needed to determine if any of the above may have played a role in our null longitudinal findings.

Some developmental researchers have argued that aggressive behavior has a different etiology than non-aggressive externalizing problems, suggesting that researchers should differentiate between them (Burt, 2012; Moffitt & Caspi, 2001; Tremblay, 2010). In support of this theory, we found an association between NE recognition and concurrent aggression, which persisted even when non-aggressive externalizing problems were controlled. Further, NE recognition was not significantly concurrently or longitudinally associated with ADHD or ODD symptoms, regardless of whether overt aggression was controlled. This suggests that NE recognition is independently related to aggression. Previous links between emotion recognition and externalizing problems could therefore be largely explained by aggression, which often coincides with other externalizing problems (Eisner & Malti, 2015).

Research on how emotion recognition is associated with aggression has typically used measures focusing solely on emotion misspecifications, thus it has been unclear whether emotion insensitivity is important. Our findings suggest that insensitivity to NEs may contribute even more to this relation than misspecifications. This has implications on how best to train emotion recognition, which is often a part of early socio-emotional interventions (Bierman et al., 2010; Izard, 2009). Training children who display overt aggression to differentiate neutral faces from negative emotive faces may be equally if not more important to target than teaching them to differentiate NEs. Importantly, we included children in early and middle childhood and found no significant age or gender moderation effects. This supports that this relation is present in both early and middle childhood, potentially making NE recognition important to target for interventions across a range of ages in childhood.

This study is not without limitations. Although we used a longitudinal design, our findings are correlational, thus causal inferences were not possible. It is plausible that aggression may affect emotion recognition; acting aggressively may damage peer relations, leading these children to have more limited social contact with peers. This may result in them having less opportunities to practice recognizing negative emotional cues in others. We also used a measure of emotion recognition that only included the face of one Caucasian woman. Researchers have shown that people are better at recognizing faces of their own race, which could have influenced the results as our sample was ethnically diverse (Elfenbein & Ambady, 2002). However, these effects tend to be smaller when greater exposure to other groups is experienced, which is likely the case in the diverse urban city that was sampled. There is also an ‘own-age’ bias in children, such that they are better at recognizing faces that are close in age to them (Rhodes & Anastasi, 2012). It is possible that the older cohort had a slight advantage in this respect as they are a few years closer in age to the actress in our task. Further research should explore whether using non-age matched stimuli for emotion recognition tasks impacts results.

The use of a community sample was a strength and limitation of this study. Community samples are useful for understanding why deviations in typical development occur, whereas clinical samples are more applicable for understanding how processes relate to the severity and presentation of symptoms among those already identified as developing atypically. In the present study, we assessed externalizing problems as a continuum as opposed to binary diagnoses. One issue that could arise from not accounting for clinical diagnoses is how the use of medication may have impacted results. For example, children diagnosed with ADHD may be on medication that improves their attention, which may help their performance in an emotion recognition task. However, because the sample was recruited from the community, the number of children that likely met clinical levels of externalizing disorders was relatively low.

The focus of this research was limited to overt aggression, as this form of aggression in youth is related to more negative outcomes than relational aggression (Achenbach & Rescorla, 2000, 2001; Gower et al., 2014; Tackett et al., 2013). However, overt and relational aggression are related to one another in children, leaving the question of whether these findings generalize to other forms of aggression (Ojanen & Kiefer, 2013). Further, subcomponents of NE recognition could differentially relate to differing forms of aggression. For instance, proactive aggression—i.e., aggression enacted to achieve a goal—is associated with callous-unemotional traits (Jambon et al., 2019; Kerig & Stellwagen, 2010). Children who have difficulty picking up on negative emotions in others may have more trouble feeling sympathy toward them, which could specifically increase their proactive aggression. Whereas reactive aggression—i.e., aggression in response to provocation—is associated to hostile attribution biases, suggesting that they may be more likely to misinterpret social cues (Bailey & Ostrov, 2008). Thus, NE misspecifications may be especially linked to reactive aggression. Future research should further explore the potential nuances of the relations found.

In summary, our findings suggest that higher NE insensitivity and misspecifications in early and middle childhood are associated with higher current, but not future, overt aggression. Including non-aggressive externalizing symptoms in the models did not change those findings and NE recognition was not associated to non-aggressive externalizing symptoms. This suggests the presence of a unique relation between NE recognition and aggression. Lastly, we found that relations were not significantly moderated by age or gender. These findings suggest that early intervention research on children with aggressive behavior may benefit from including training on how to detect the presence of subtle NEs in addition to how to differentiate between them.

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Table 1

Descriptive Statistics by Age Group

	4-year-olds (*N* = 150)			8-year-olds (*N* = 148)		
	M	*SD*	Range	*M*	*SD*	Range
T1 overall NE recognition	0.53	0.14	0.13 – 0.83	0.69	0.10	0.43 – 0.83
T1 NE misspecifications	0.24	0.16	0.00 – 0.73	0.10	0.09	0.00 – 0.33
T1 NE insensitivity	0.23	0.14	0.00 – 0.67	0.22	0.07	0.00 – 0.43
T1 aggression	0.84	0.75	0.00 – 4.50	0.38	0.49	0.00 – 2.40
T2 aggression	0.79	0.65	0.00 – 4.25	0.37	0.37	0.00 – 2.40
T1 ODD	1.77	0.92	0.00 – 5.00	1.27	0.86	0.00 – 4.75
T2 ODD	1.67	0.65	0.00 – 4.17	1.15	0.66	0.00 – 3.60
T1 ADHD	2.13	0.94	0.17 – 5.17	1.70	1.21	0.00 – 6.00
T2 ADHD	2.14	0.80	0.20 – 4.80	1.66	0.80	0.00 – 5.43

Note. Child Behavior Checklist caregiver-reported scales ranged from 0 (never) to 6 (always). Missing data was estimated using full information maximum likelihood. M = mean, SD = standard deviation, T1 = time one, T2 = time two, NE = negative emotion, ODD = oppositional defiant disorder symptoms, ADHD = attention deficit hyperactivity disorder symptoms.

Table 2

Zero-Order Correlations between All Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Income	–	.10	.29	.15	.05	-.25**	.05	.08	.10	-.04	.01	-.01
2. Gender	.10	–	-.03	.08	-.13	.05	.19*	.09	.03	.02	.13	.14
3. Verbal ability	.20*	-.11	–	.07	.00	-.10	-.01	-.08	.04	-.09	-.02	-.09
4. NE overall recognition	.20*	-.07	.11	–	-.67***	-.52***	-.05	.02	.03	.09	.03	-.04
5. NE misspecifications	-.17	.08	-.11	-.58***	–	-.28***	.02	-.03	-.02	-.08	-.03	-.09
6. NE insensitivity	-.02	-.02	.01	-.36***	-.55***	–	.05	.01	-.02	-.03	.00	.15
7. T1 aggression	-.06	.20**	-.01	-.22**	.04	.19*	–	.66***	.50***	.51***	.37***	.29***
8. T2 aggression	.01	.18*	-.03	-.24**	.11	.13	.63***	–	.39***	.57***	.20*	.34***
9. T1 ODD	-.05	.04	.02	-.08	.02	.06	.56***	.43***	–	.66***	.72***	.60***
10. T2 ODD	-.03	.06	.03	-.15	.08	.05	.54***	.59***	.74***	–	.57***	.66***
11. T1 ADHD	-.14	.19*	-.19*	-.15	.08	.06	.44***	.33***	.57***	.44***	–	.78***
12. T2 ADHD	.01	.11	-.18*	-.12	.02	.10	.27**	.35***	.52***	.55***	.67***	–

Note. Zero-order correlations for children's T1 NE recognition and T1 and T2 Child Behavior Checklist caregiver-reported overt aggression, ODD, and ADHD symptoms. Top half of table are correlations for 8-year-olds ($N = 148$), while the bottom half of correlations are for 4-year-olds ($N = 150$). Missing data was estimated using full information maximum likelihood. Gender was coded as boy = 1 and girl = 0. T1 = time one, T2 = time two, NE = negative emotion, ODD = oppositional defiant disorder symptoms, ADHD = attention deficit hyperactivity disorder symptoms.

$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table 3

Models 1 and 2 Estimates

		Cross-sectional					Longitudinal				
	Predictors	B	SE	95% CI	β	*p*	B	SE	95% CI	β	*p*
Overt Aggression											
	T1 Aggression	–	–	–	–	–	.65	.07	[0.50, 0.79]	.64	.000
	NE Recognition	-.94	.32	[-1.56, -0.32]	-.20	.003	-.25	.35	[-0.93, 0.44]	-.05	.484
	Age	-.08	.02	[-0.12, -0.04]	-.23	.000	-.02	.02	[-0.06, 0.02]	-.06	.240
	Gender	.25	.07	[0.11, 0.38]	.18	.001	.03	.06	[-0.09, 0.15]	.02	.635
	Verbal Ability	.00	.01	[-0.01, 0.02]	.01	.861	-.01	.01	[-0.02, 0.01]	-.03	.471
ADHD Symptoms											
	T1 ADHD	–	–	–	–	–	.72	.05	[0.63, 0.81]	.72	.000
	NE Recognition	-.52	.50	[-1.50, 0.46]	-.07	.297	-.22	.35	[-0.90, 0.47]	-.03	.533
	Age	-.09	.04	[-0.16, -0.02]	-.16	.014	-.04	.03	[-0.09, 0.02]	-.07	.212
	Gender	.32	.12	[0.08, 0.56]	.15	.009	.02	.09	[-0.16, 0.20]	.01	.836
	Verbal Ability	-.02	.01	[-0.04, 0.01]	-.07	.197	-.02	.01	[-0.04, 0.00]	-.08	.028
ODD Symptoms											
	T1 ODD	–	–	–	–	–	.68	.05	[0.58, 0.78]	.71	.000
	NE Recognition	-.31	.41	[-1.12, 0.50]	-.05	.447	-.24	.34	[-0.91, 0.43]	-.04	.483
	Age	-.11	.03	[-0.17, -0.06]	-.25	.000	-.04	.02	[-0.08, 0.01]	-.08	.127
	Gender	.06	.10	[-0.14, 0.26]	.03	.544	.04	.07	[-0.11, 0.18]	.02	.591
	Verbal Ability	.01	.01	[-0.01, 0.02]	.03	.602	-.01	.01	[-0.02, 0.01]	-.04	.370

Note. Path model estimates for children's overall NE recognition and T1 and T2 Child Behavior Checklist caregiver-reported overt aggression, ODD symptoms, and ADHD symptoms. (N = 298). Income is included as an auxiliary variable in analyses. B = unstandardized beta, SE = standard error, CI = confidence interval, β = standardized beta, T1 = time one, T2 = time two, NE = negative emotion, ODD = oppositional defiant disorder symptoms, ADHD = attention deficit hyperactivity disorder symptoms.

Table 4

Models 3 and 4 Estimates

	Predictors	Cross-sectional					Longitudinal				
		B	SE	95% CI	β	*p*	B	SE	95% CI	β	*p*
Overt Aggression											
	T1 Aggression	–	–	–	–	–	.65	.07	[0.51, 0.79]	.64	.000
	NE Insensitivity	1.32	.41	[0.52, 2.13]	.21	.001	.16	.44	[-0.71, 1.03]	.03	.723
	NE Misspecifications	.73	.32	[0.10, 1.37]	.16	.024	.27	.34	[-0.40, 0.94]	.06	.424
	Age	-.09	.02	[-0.13, -0.04]	-.25	.000	-.02	.02	[-0.06, 0.02]	-.06	.260
	Gender	.25	.07	[0.11, 0.38]	.18	.000	.03	.06	[-0.09, 0.15]	.02	.644
	Verbal Ability	.00	.01	[-0.01, 0.02]	.01	.854	-.01	.01	[-0.02, 0.01]	-.03	.471
ADHD Symptoms											
	T1 ADHD	–	–	–	–	–	.72	.05	[0.63, 0.81]	.72	.000
	NE Insensitivity	.58	.58	[-0.55, 1.71]	.06	.312	.81	.46	[-0.09, 1.71]	.08	.080
	NE Misspecifications	.46	.54	[-0.60, 1.51]	.06	.395	-.14	.38	[-0.88, 0.60]	-.02	.719
	Age	-.09	.04	[-0.16, -0.02]	-.16	.012	-.05	.03	[-0.10, 0.01]	-.09	.108
	Gender	.32	.12	[0.08, 0.56]	.15	.008	.02	.09	[-0.16, 0.20]	.01	.813
	Verbal Ability	-.02	.01	[-0.04, 0.01]	-.07	.197	-.02	.01	[-0.04, 0.00]	-.08	.027
ODD Symptoms											
	T1 ODD	–	–	–	–	–	.68	.05	[0.58, 0.78]	.71	.000
	NE Insensitivity	.41	.51	[-0.58, 1.40]	.05	.420	.18	.43	[-0.66, 1.10]	.02	.677
	NE Misspecifications	.23	.45	[-0.65, 1.10]	.04	.612	.25	.35	[-0.45, 0.94]	.04	.485
	Age	-.12	.03	[-0.18, -0.06]	-.25	.000	-.04	.02	[-0.08, 0.01]	-.08	.129
	Gender	.06	.10	[-0.14, 0.26]	.03	.544	.04	.07	[-0.11, 0.18]	.02	.594
	Verbal Ability	.01	.01	[-0.01, 0.02]	.03	.608	-.01	.01	[-0.02, 0.01]	-.04	.372

Note. Path model estimates for children's NE insensitivity and misspecification and T1 and T2 Child Behavior Checklist caregiver-reported overt aggression, ODD symptoms, and ADHD symptoms. (N = 298). Income is included as an auxiliary variable in analyses. B = unstandardized beta, SE = standard error, CI = confidence interval, β = standardized beta, T1 = time one, T2 = time two, NE = negative emotion, ODD = oppositional defiant disorder symptoms, ADHD = attention deficit hyperactivity disorder symptoms.

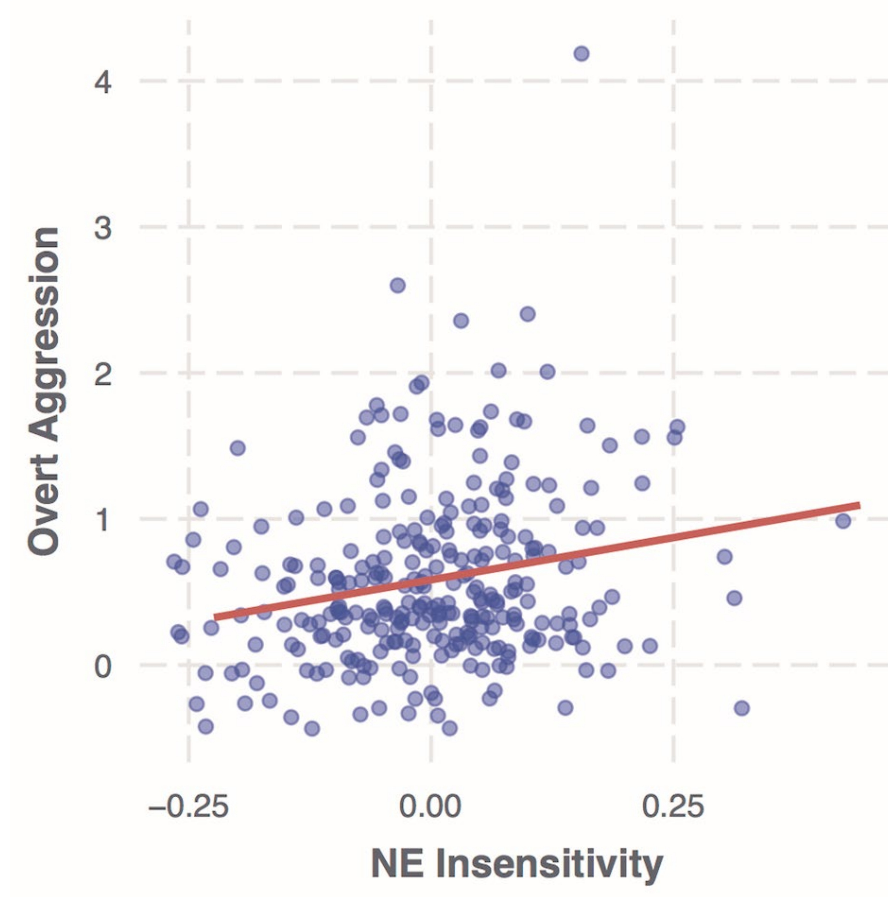

Figure 1. Negative emotion insensitivity's relation to concurrent overt aggression. Scatterplot was created using partial residuals to control for effects of age, gender, verbal ability, and NE misspecifications. Jitter (0.05) was added to points for improving visibility of point density. NE insensitivity is mean-centered. NE = negative emotion.

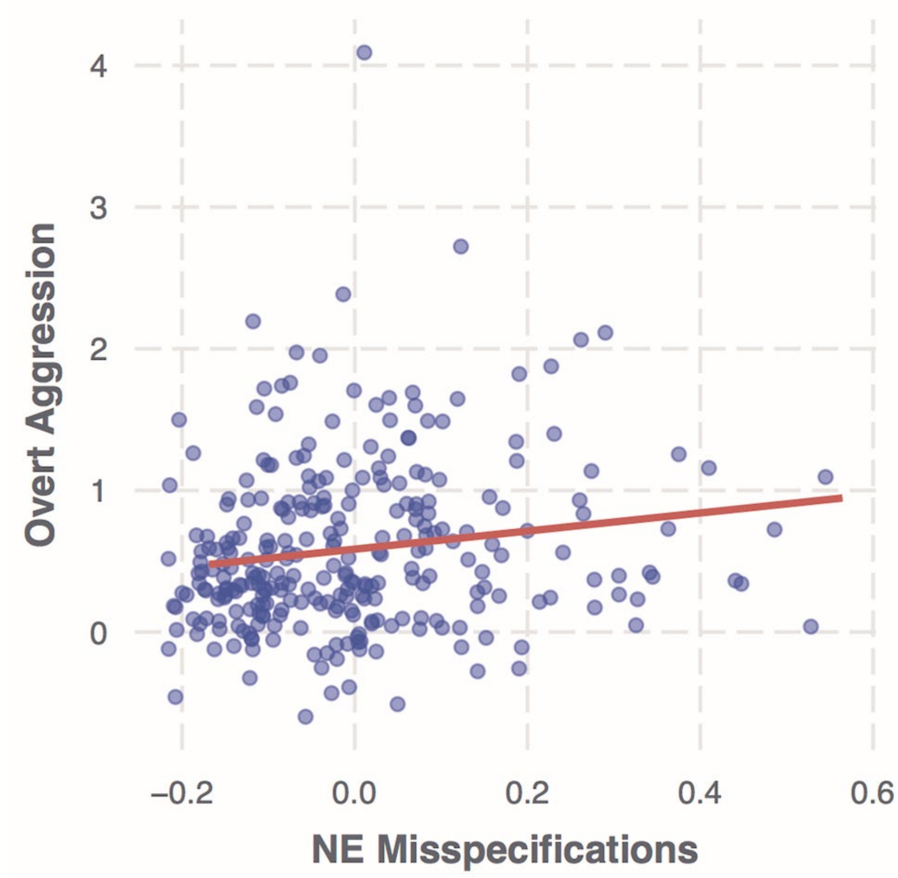

Figure 2. Negative emotion misspecifications' relation to concurrent overt aggression. Scatterplot was created using partial residuals to control for effects of age, gender, verbal ability, and NE insensitivity. Jitter (0.05) was added to points for improving visibility of point density. NE misspecifications are mean-centered. NE = negative emotion.