Check for updates

ORIGINAL ARTICLE

WILEY

Hostile interpretation as a transdiagnostic factor for cooccurring anxiety in boys with aggressive behavior problems

Sophie C. Alsem[1,2] 🆔 | **Anouk van Dijk**[2] 🆔 | **Esmée E. Verhulp**[1] 🆔 | **Bram O. De Castro**[2] 🆔

[1]Department of Developmental Psychology, Utrecht University, Utrecht, The Netherlands

[2]Research Institute of Child Development and Education, University of Amsterdam, Amsterdam, The Netherlands

Correspondence
Sophie C. Alsem, Research Institute of child Development and Education, University of Amsterdam, PO Box 15776, 1001 NG Amsterdam, The Netherlands.
Email: S.c.alsem@uva.nl

Abstract

Many children with aggressive behavior problems also suffer from anxiety. This cooccurrence may perhaps be explained by transdiagnostic factors. Identifying these factors seems crucial, as they may be important targets to treat these cooccurring problems effectively. This two-study paper investigates whether hostile interpretation of others' intentions is a transdiagnostic factor for cooccurring aggression and anxiety problems, examining two samples of boys in middle childhood. We assessed boys' aggression and anxiety using teacher-report in Study 1 ($N = 84$, $M_{age} = 10.10$), and parent-report in Study 2 ($N = 115$, $M_{age} = 10.55$). In both studies, we assessed hostile interpretation using vignettes describing ambiguous provocations by peers. Both studies revealed a strong association between aggression and anxiety problems, underscoring the necessity to examine factors that can explain this cooccurrence. However, in neither study was this association reduced when we added hostile interpretation to the model, suggesting that hostile interpretation did not function as a transdiagnostic factor in our samples. One possible explanation for these findings is that hostile interpretation predicts both aggression and anxiety problems,

but in different children. We, therefore, encourage scholars to conduct more research to explain the high comorbidity of aggression and anxiety problems in children. Future research should also examine hostile interpretation as predictor or transdiagnostic factor for aggression and anxiety problems in more diverse population, including girls and other age groups.

KEYWORDS
aggression, anxiety, children, comorbidity, transdiagnostic factors

1 | INTRODUCTION

Many children who display aggressive behavior problems also suffer from anxiety (Boylan et al., 2007; Granic, 2014; Marsee et al., 2008). In children with aggressive behavior problems, rates of anxiety disorders range from 22% in community samples up to 75% in clinically referred samples (Frick et al., 1999; Zoccolillo, 1992). Both aggression and anxiety problems can affect children's social relations and interactions with peers (Prinstein et al., 2005). Until now, little attention has been devoted to factors that may be responsible for the high cooccurrence between aggression and anxiety problems (McLaughlin et al., 2014). Transdiagnostic frameworks aim to identify factors that cut across multiple cooccurring symptoms or disorders, such as cognitive, emotional, neurobiological, or environmental factors (Aldao & Nolen-Hoeksema, 2012; McLaughlin et al., 2014; Nolen-Hoeksema & Watkins, 2011). Identified factors underlying multiple, comorbid problems are called transdiagnostic factors. Identifying such transdiagnostic factors seems crucial, as they may be important intervention targets to treat cooccurring problems effectively. In fact, untreated cooccurring anxiety problems may be one reason why current treatments targeting children's aggressive behavior problems have only modest effects (Granic, 2014; Granic et al., 2012; McCart et al., 2006). Possibly, children with cooccurring problems may benefit more from one comprehensive treatment targeting identified transdiagnostic factors than from separate treatments targeting one problem each (Oland & Shaw, 2005). The present study therefore took a transdiagnostic approach to explain comorbid aggression and anxiety problems in two independent samples of boys in middle childhood (7–13 years old), examining hostile interpretation—the tendency to interpret ambiguous social information as negative—as transdiagnostic factor.

1.1 | Boys' social functioning in middle childhood

By middle childhood, peers have become increasingly important to children's social functioning (Lam et al., 2014). Accordingly, children's interpretational style may start to play a key role in how they respond to their peers: prosocially, or—in the case of hostile interpretation—perhaps with aggression and anxiety. Indeed, the cooccurrence of aggression and anxiety problems has been found to be the strongest in children from 9 to 14 years old (Marmorstein, 2007). One possible explanation for this stronger cooccurrence may be that children in middle childhood express anxiety by acting out aggressively (e.g., fighting to defend themselves, or overtly refusing to do things) while older children or adolescents may be able to cope with their anxiety more adaptively (Marmorstein, 2007). This idea may also explain why the cooccurrence of aggression and anxiety problems is more common in boys than in girls (Marmorstein, 2007; Marsee et al., 2008), as overt forms of aggression are more common in boys than girls (Björkqvist, 2018; Card et al.,

2008; Granic, 2014). In this first study on hostile interpretation as transdiagnostic factor for aggression and anxiety, we therefore chose to examine boys in middle childhood.

1.2 | The merits of transdiagnostic research

There is a growing call for transdiagnostic research. Many clinicians and scholars are worried about the fragmentation of explanatory frameworks and treatments for an ever growing number of highly specific diagnostic labels, such as numerous subtypes of aggressive behavior disorders and anxiety disorders (Barlow et al., 2004; Chorpita et al., 2005). Many psychological problems in children are studied and targeted in isolation, which may not only obscure their cooccurrence in children, but may also prevent researchers from identifying transdiagnostic factors explaining their cooccurrence. This practice may lead to a cumulation of apparently distinct treatment protocols that cannot realistically be combined for children suffering from cooccurring problems. Specifically, it seems unattainable for clinicians to incorporate multiple protocols for a single client with comorbid conditions. Transdiagnostic research can identify specific factors explaining comorbidity across problems (Nolen-Hoeksema & Watkins, 2011). As such, transdiagnostic frameworks have the potential to more parsimoniously advance our understanding of developmental psychopathology, and improve treatments for children with cooccurring problems (McLaughlin & Nolen-Hoeksema, 2011). Specifically, transdiagnostic treatments could be more effective, less time consuming, and might save costs in the long-term compared to using distinct treatment protocols for each comorbid problem (Lucassen et al., 2015). An integrative, modular intervention method targeting comorbid problems showed beneficial effects by outperforming usual care and standard evidence-based treatments on multiple clinical outcome measures (Weisz et al., 2012). This highlights the importance of taking comorbidity into account and assess potential transdiagnostic factors underlying comorbidity.

1.3 | Hostile interpretation as transdiagnostic factor

One likely transdiagnostic factor that may underlie both aggression and anxiety problems is children's hostile interpretation of other children's behavior (Crick & Dodge, 1996). Hostile interpretation reflects the tendency to interpret neutral or ambiguous behavior as negative, threatening or conducted with hostile intent (Crick & Dodge, 1994). Hostile interpretation is part of the social information processing model (Crick & Dodge, 1994; Lemerise & Arsenio, 2000), stating that children's interpretation of social situations influences their related behavior. According to this model, children's hostile interpretations may result in both feelings of anxiety and feeling impelled to defend themselves aggressively. Consequently, these feelings and behaviors will maintain children's hostile interpretation as children will more frequently evoke problematic social interactions (Granic, 2014). For example, when a peer bumps into a child while playing catch, this child may interpret this act as hostile or negative ("He wanted to hurt me"), even though the peer could have done it by accident or intended to engage in friendly rough play. Such a hostile interpretation may elicit feelings of anger ("He did it on purpose, I'll get him!"), anxiety ("He did it on purpose… Oh no, he's after me!"), or both ("I have to stand up to him, so he doesn't see I'm scared").

1.4 | Current evidence on hostile interpretation, aggression, and anxiety

There is a host of empirical research supporting the association of hostile or negative interpretation with either aggression (Lansford et al., 2010; Lochman & Wells, 2002; Verhoef et al., 2019) or anxiety (Bogels & Zigterman, 2000; Luebbe et al., 2010; Stuijfzand et al., 2018). Evidence from the separate fields of aggression and anxiety research, however, cannot support hostile interpretation as a transdiagnostic factor, because it has been assessed as

different concepts. For aggression, studies have mainly used scenarios describing *social interactions with peers* (e.g., a peer bumping into a child; De Castro & van Dijk, 2017). For anxiety, however, interpretation is often assessed as a broader concept, including not only scenarios with peers but also with *adults* (e.g., the head teacher is looking for you) or *non-social threats* (e.g., hearing a big crash in the night; Barrett et al., 1996; Creswell et al., 2014). To examine interpretation as transdiagnostic factor, it is important to assess the exact same concept in both aggression and anxiety. In the present study, we focused on hostile interpretation of peer behavior because children in middle childhood spend much time with peers (Lam et al., 2014), and so it seems plausible that a tendency to make hostile interpretations is associated to both aggression and anxiety problems.

Specifically focusing on hostile interpretation of *peer* behavior, there is abundant research supporting the association with aggression (for a meta-analysis, see: Verhoef et al., 2019), but limited research on the association with anxiety (which is generally studied regarding adults or non-social threats). Earlier researchers have found that anxious children were more likely to make hostile interpretations of benign peer interactions than non-anxious children, but revealed no such difference for ambiguous peer interactions (Bell-Dolan, 1995). Other researchers have found no associations between children's hostile interpretation and their anxiety or fear (Reid et al., 2006). Unexpectedly, this study also found no relation between hostile interpretation and aggression, which is in contrast to most earlier research (Verhoef et al., 2019). Last, a longitudinal study has shown that children's hostile interpretations in grade 6 were not associated with their anxious/depressed and withdrawn behavior 1 year later (Perren et al., 2013). Based on these studies, the support for an association between hostile interpretation and anxiety seems limited. However, these three studies examined community samples, which may have reduced the variance in hostile interpretation, obscuring a potentially relevant association. The present study therefore examines hostile interpretation as transdiagnostic factor in a mixed community-clinical sample and a full-clinical sample of children with aggressive behavior problems.

As a second goal, we examined whether hostile interpretation is a transdiagnostic factor for specifically *reactive* aggression and anxiety. Reactive aggression is defined as an emotional, impulsive reaction in response to a perceived provocation or threat. In contrast, proactive aggression is seen as planned behavior oriented toward instrumental or social gain (Dodge, 1990). These different types of aggression have been proposed to have distinct etiologies, with anxiety as a precursor of specifically reactive aggression (De Castro et al., 2005; Polman et al., 2009). Anxious children may more quickly feel threatened and react with defensive aggression (Granic, 2014). Indeed, research has shown that reactive aggression is related to anxiety and internalizing symptoms, whilst proactive aggression is not (Card & Little, 2006; Day et al., 1992; Fung et al., 2015; Kovacs & Devlin, 1998; Vitaro et al., 2002, but for an exception see: Tanaka et al., 2010). In line with this idea, hostile interpretation of peer behavior has consistently been linked to reactive aggression, and not proactive aggression (Arsenio et al., 2009; Crick & Dodge, 1996; Dodge & Coie, 1987).

1.5 | The present study

The present study investigated hostile interpretation as transdiagnostic factor for cooccurring anxiety problems in two samples of boys with aggressive behavior problems. Study 1 used teacher-report to assess boys' aggression and anxiety, and Study 2 used parent-report. In both studies, we first investigated if there was a significant correlation between aggression and anxiety problems. For illustrative purposes, we also calculated percentage of boys displaying clinical levels of aggression and anxiety problems. Second, we examined whether hostile interpretation predicted both aggression and anxiety problems. When both predictive paths are significant, this provides a first indication of hostile interpretation as transdiagnostic factor. Third, to examine whether hostile interpretation may function as a transdiagnostic factor, we tested whether the association between boys' aggression and anxiety decreased when we entered hostile interpretation as a predictor for both problems. A decrease in the association would imply that hostile interpretation (partly) accounts for the overlap between aggression and anxiety problems, and would thus provide additional indications for hostile interpretation as transdiagnostic factor. Last, we repeated these analyses to test whether

hostile interpretation was a significant predictor and transdiagnostic factor for anxiety and reactive, but not proactive, aggression.

Our samples included boys in middle childhood (ages 7–13). Although children develop rapidly within middle childhood, we did not expect age differences. The association between aggression and anxiety is found to be similar for children of 9–11 and 12–14 years old, whereas it was weaker for children of 15–17 years old (Marmorstein, 2007). Also, a recent meta-analysis showed no age differences in the association between hostile interpretation and aggression between children from 6 to 12 years old (Verhoef et al., 2019). Hence, we investigated hostile interpretation as transdiagnostic factor across the whole sample.

2 | STUDY 1

2.1 | Method

2.1.1 | Participants

We used data from an earlier study (De Castro et al., 2005). The sample consisted of 84 boys ages 7–13 years ($M = 10.10$, $SD = 17$ months). All boys were in elementary school during the study period. This study increased variance in aggression and anxiety by oversampling boys with aggressive behavior problems. Children were recruited in two elementary schools ($n = 30$), two schools providing special education ($n = 30$), and two clinical centers in the Netherlands ($n = 24$). Most boys were born in the Netherlands (83.3%). Most parents were unemployed or performed manual labor jobs: mothers (70.6%) and fathers (52.6%). Parents provided active written consent for participation in this study.

2.1.2 | Procedure

For this study, children were individually interviewed at their school by trained graduate students. Sessions lasted between 1 and 1.5 hour and included vignettes assessing social information processing steps, intelligence tasks, and a questionnaire. Interviews always started with the hostile interpretation assessment. Children were assured of the confidentiality of their answers. Teachers were asked to fill out questionnaires on paper.

2.1.3 | Measures

Aggression and anxiety problems
We assessed boys' aggression and anxiety problems using the Teacher Rating Form (TRF; Achenbach & Rescorla, 2001). Teachers rated all 118 items of the TRF on a 3-point scale (0 = *not true*, 1 = *somewhat true*, 2 = *very true or often true*). For the current study, we used only the aggressive behavior scale (20 items; e.g. 'screams a lot') and the anxious/depressed scale (16 items; e.g. 'fearful, anxious'). We used norm scores for Dutch children to calculate T-scores to examine the cooccurrence of (sub)clinical levels of aggression and anxiety problems, and used summed raw scores for all other analyses. The TRF showed good test-retest reliabilities ($r = .85$) and internal consistencies ($\alpha = .82$). Also, content and criterion validity were shown to be good, as international experts have indicated that TRF scales are very consistent with DSM diagnostic categories and research has shown that TRF scales can successfully discriminate between referred and non-referred children (Achenbach et al., 2008).
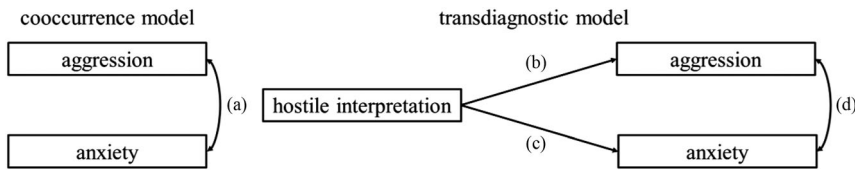
FIGURE 1 Statistical models used to estimate the cooccurrence of aggression and anxiety (left) and to examine hostile interpretation as transdiagnostic factor (right).

Reactive and proactive aggression

We assessed boys' reactive and proactive aggression using the Dutch translation of the Reactive and Proactive Aggression Questionnaire (Dodge & Coie, 1987; Hendrickx et al., 2003). Teachers rated three items on reactive aggression (e.g., 'when this child has been teased or threatened, he or she gets angry easily and strikes back') and three items on proactive aggression (e.g., 'this child uses physical force in order to dominate other kids') on a 5-point scale ranging from 1 (*never*) to 5 (*almost always*). Previous research showed that the reactive and proactive aggression scales had good internal consistencies (α = .90-.91) and convergent validity, as indicated by significant correlations to observational measures (Dodge & Coie, 1987). In the current study, internal consistency of the scales was adequate for both reactive aggression (α = .87) and proactive aggression (α = .90).

Hostile interpretation

We assessed hostile interpretation using four audiotaped vignettes describing ambiguous provocation by a peer (De Castro et al., 2005). For the previous study purposes, two parallel sets of vignettes were used (i.e., describing different provocation situations), which were randomly distributed over participants. No differences between the sets in mean scores of hostile interpretation were found, $t(76) = -0.36$, $p = .724$, so scores were combined for this study. Children were told that they would listen to stories about daily social events and were asked to imagine each story was really happening to them. One example vignette is: '*Imagine: You and a boy in your class are taking turns at a computer game. Now it's your turn, and you are doing great. You are reaching the highest level, but you only have one life left. You never came this far before, so you are trying very hard. The boy you are playing with watches the game over your shoulder. He sees how far you have come. Then he shouts "Watch out! You got to be fast now!" and he pushes a button. But it was the wrong button, and now you have lost the game!*'.

Children answered two questions following each vignette. First, they answered one open-ended question 'Why did he [provocative behavior in vignette]?'. Answers to this question were coded as *benign*, *accidental*, *ambiguous*, or *hostile*. Hostile codes were scored 1, all other codes were scored 0. The interrater agreement was high (i.e., 94%). Second, children answered the question 'What was the boy's intention?' on a 5-point rating scale ranging from *very nice* to *very mean*. We summed the hostile codes and averaged the rating scores across vignettes, and created a hostile interpretation scale by taking the standardized average of these two scores, which were highly correlated (r = .82). The internal consistency of this scale was adequate (α = .77). Previous research showed that these hypothetical vignettes had satisfactory inter-rater reliability (κ = .85–.96, 91%–97% agreement), as well as good discriminant and criterion validity (De Castro, 2000; De Castro et al., 2003; De Castro & Koops, 2005)

2.1.4 | Analytical approach

We conducted our analyses using Structural Equation Modeling (SEM) in Mplus 8. To test our first hypothesis on the cooccurrence of aggression and anxiety, we calculated the zero-order correlation between aggression and anxiety (Figure 1, path a). For illustrative purposes, we also calculated the percentage of boys with comorbid clinical levels of aggression and anxiety problems, using the TRF's T-score cut-offs for the 'subclinical range' (i.e., $T > 65$, 93rd

TABLE 1 Means (*M*), standard deviations (*SD*), minimum (Min), maximum (Max), and zero-order Pearson correlations of the study variables (*N* = 84).

	M	*SD*	Min	Max	1	2	3	4	5
1. Hostile interpretation	0.00	0.95	−1.80	1.75	–				
2. Aggression	14.32	11.04	0.00	38.00	.34**	–			
3. Anxiety	6.26	5.83	0.00	26.00	.26*	.47**	–		
4. Reactive aggression	3.07	1.03	1.00	4.67	.30**	.68**	.29**	–	
5. Proactive aggression	2.19	1.00	1.00	4.67	.26**	.72**	.32**	.71**	–

Note: Missing data on hostile interpretation for one child and for TRF aggression and anxiety scales for nine boys. Values reported in this table can slightly differ from reported statistics of the SEM models, as these models used missing data estimation. Boys reported on hostile interpretation, whilst teachers reported on all forms of boys' aggression and anxiety.
*$p < .05$.
**$p < .001$.

percentile). To investigate our second hypothesis on hostile interpretation as predictor for both aggression and anxiety problems, we tested the significance of both predictive paths (Figure 1, path b and c). When both predictive paths are significant, this provides a first indication of hostile interpretation as transdiagnostic factor. Although our model might seem complicated for our modest sample size, it only included three regression paths. To provide indications of the effect sizes, we calculated Beta coefficients and R^2 statistics. To investigate our third hypothesis, whether hostile interpretation functioned as a transdiagnostic factor for the cooccurrence, we tested whether the association between boys' aggression and anxiety decreased after including hostile interpretation as a predictor for both problems. If the association indeed significantly decreased, this would imply that hostile interpretation (partly) accounts for the overlap between aggression and anxiety problems, and would thus provide additional indications for hostile interpretation as transdiagnostic factor. To analyze this, we first estimated the partial correlation between aggression and anxiety problems (Figure 1, path d). We then fixed the zero-order correlation (path a) to the value of the partial correlation (path d), and compared these correlations using a chi-square test. Last, to test our fourth hypothesis on hostile interpretation as transdiagnostic factor for the cooccurrence of anxiety and specifically *reactive* aggression, we repeated these analyses with both reactive and proactive aggression, expecting a significant chi-square for the reactive, but not for the proactive model. As earlier research showed inflated overlap in reactive and proactive aggression scores measured by instruments such as the REPRO (Polman et al., 2007), we ran sensitivity analyses for reactive aggression while controlling for proactive aggression, and vice versa (see Appendix A). We used default settings in Mplus, maximum likelihood (MLR; Muthén & Muthén, 2019), to estimate missing data (4.3%).

2.2 | Results

Before we analyzed the research questions, we explored the parametric nature of the data with scatterplots, boxplots, p-p plots, and the Durbin-Watson test, indicating that parametric analyses were warranted.

2.2.1 | Cooccurrence of anxiety and aggression

Aggression and anxiety were strongly correlated, $r = .47, p < .001$ (Table 1). Results based on subclinical range cut-offs showed that 18 boys (24.0%) scored above the cut-off on both aggression and anxiety, 17 boys (22.7%) scored above the cut-off only on aggression, 8 boys (10.7%) scored above the cut-off only on anxiety, and 32 boys (42.7%) scored

in the normal range for both anxiety and aggression. Thus, 18 out of 43 boys with (sub)clinical problems (41.9%) had comorbid aggression and anxiety problems.

2.2.2 | Hostile interpretation as transdiagnostic factor

As expected, results showed that hostile interpretation was a significant predictor of both aggression, $\beta = .32$, $B = 3.89$, $SE = 1.34$, $p = .004$, $R^2 = .10$, and anxiety, $\beta = .27$, $B = 1.64$, $SE = 0.69$, $p = .017$, $R^2 = .07$. Next, we investigated whether the correlation between aggression and anxiety problems was significantly reduced after we entered hostile interpretation as a predictor for both aggression and anxiety. We found a small and nonsignificant reduction from $r = .48$ to $r = .44$, $\chi^2(1) = 0.49$, $p = .482$.

2.2.3 | Reactive versus proactive aggression

We found similar results for reactive aggression as for general aggression: Hostile interpretation was a significant predictor of both reactive aggression, $\beta = .30$, $B = 0.33$, $SE = 0.11$, $p = .004$, $R^2 = .09$ and anxiety, $\beta = .28$, $B = 1.73$, $SE = 0.69$, $p = .012$, $R^2 = .08$. We found a small and nonsignificant reduction in the association between reactive aggression and anxiety (i.e., from $r = .29$ to $r = .24$) after hostile interpretation was added, $\chi^2(1) = 0.39$, $p = .531$. When we controlled for proactive aggression in these models, the relation between hostile interpretation and reactive aggression disappeared (see Appendix A).

For proactive aggression, we did not expect associations with anxiety or hostile interpretation. However, results showed that hostile interpretation was a significant predictor of both proactive aggression, $\beta = .26$, $B = 0.27$, $SE = 0.11$, $p = .015$, $R^2 = .07$ and anxiety, $\beta = .28$, $B = 1.73$, $SE = 0.69$, $p = .012$, $R^2 = .08$. We found a small and nonsignificant reduction in the association between proactive aggression and anxiety (i.e., from $r = .33$ to $r = .29$) after hostile interpretation was added, $\chi^2(1) = 0.27$, $p = .601$. When we controlled for reactive aggression in these models, the relation between hostile interpretation and proactive aggression disappeared (see Appendix A).

2.3 | Discussion

Study 1 showed that aggression and anxiety problems were strongly associated in boys, and that hostile interpretation predicted both problems. However, findings provided no evidence for hostile interpretation as transdiagnostic factor explaining the cooccurrence of aggression and anxiety. One explanation may be that our sample included relatively few boys displaying aggression and anxiety problems in the clinical range. As earlier research showed stronger associations between hostile interpretation and aggression in clinical samples (Verhoef et al., 2019), we chose to also test the hypotheses regarding hostile interpretation as transdiagnostic factor for aggression and anxiety in a clinical sample in Study 2.

Also, we found no evidence for hostile interpretation as transdiagnostic factor for specifically reactive aggression and anxiety. However, analyses of the specific contributions of reactive and proactive aggression were hindered by the strong association between these two types of aggression. This may be due to our measure, which tends to confound both types of aggression (Polman et al., 2007), which may explain why results for reactive aggression became nonsignificant after controlling for proactive aggression, and vice versa. In Study 2, we therefore used another measure with clearer discriminant validity (Polman et al., 2009).

3 | STUDY 2

3.1 | Method

3.1.1 | Participants

Participants were 115 Dutch boys between 8 and 13 years old ($M = 10.55$, $SD = 1.45$), recruited from 15 clinical centers in the Netherlands providing mental health care for children with mild problems to serious and complex psychiatric disorders, including children with aggressive behavior problems. Therapists working in these institutions were asked to approach parents of boys whose casefiles met the following inclusion criteria: age 8–13 years, aggressive behavior problems, intelligence level above 80, no severe autism spectrum disorder, and no epilepsy or severe visual or auditory limitations. Most participating children (95.7%) were born in the Netherlands. In most families, both biological parents were born in the Netherlands (71.3%). In 14.8% of the families only one parent was born in the Netherlands, and in 13.9% both parents were born elsewhere. Parents attained middle levels of education (44.4%; ISCED 3–4), high education (39.1%; ISCED 5–8), or low education (16.5%; ISCED 0–2; UNESCO, 2012). Participation was voluntary and children and parents were assured of confidential use of their data. Parents provided written consent for participation in this study; 12- and 13-year old boys also provided written consent themselves. This study was approved by the Ethics Committee of the University Medical Center Utrecht.

3.1.2 | Procedure

This study was part of a randomized controlled trial investigating a cognitive behavioral treatment for boys with aggressive behavior problems (Alsem et al., 2023). For the current study, we used data from the pre-intervention assessment. Assessments were conducted face-to-face, either at the clinical institution or at families' homes. Boys were individually interviewed. They always completed the hostile interpretation vignettes first to avoid priming towards hostility by other questions, for example on their aggressive behavior. The interview lasted 20–30 min and was conducted by the first author or a research assistant. At the same time, parents were also asked to fill out questionnaires. In most cases, this was only one parent (75.7%). When both parents filled out the questionnaires ($n = 20$), we used mothers' report. The analyzed data came from 71 mothers and 44 fathers.[1]

3.1.3 | Measures

Aggression and anxiety problems
We measured boys' aggression and anxiety problems using the aggressive behavior and anxious/depressed scale of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001). Parents rated the items on a 3-point scale (0 = *not true*, 1 = *somewhat true*, 2 = *very true or often true*). The aggressive behavior scale consists of 18 items (e.g., 'argues a lot') and the anxious/depressed scale of 13 items (e.g., 'fears school'). Similar to Study 1, we used norms for Dutch boys to calculate T-scores to examine percentages of (sub)clinical levels of aggression and anxiety, and calculated sum scores for all other analyses. Earlier research has reported good internal consistency ($r = .82$), test-retest reliabilities ($r = .88$) and good content validity, criterion-related validity, and content validity for the CBCL (Achenbach et al., 2008). In the current study, the internal consistency was adequate for both the aggressive behavior ($\alpha = .89$) and the anxious/depressed scale ($\alpha = .86$).

Reactive and proactive aggression

We measured reactive and proactive aggression using an adapted version of the Instrument for Reactive and Proactive Aggression (IRPA; Polman et al., 2009). Parents first rated the frequency of aggression on seven items (e.g., 'How often did your child hit someone in the past month?'). Different than in the original version of the IRPA, parents then rated reactive and proactive motives for all aggression items at once, rather than for each aggression item separately. Parents rated three items on reactive aggression (e.g., 'Because he was angry') and three items on proactive aggression (e.g., 'Because he wanted to dominate others') on a 5-point scale ($1 = never$, $2 = rarely$, $2 = sometimes$, $3 = most of the times$, $4 = always$). Scores for reactive and proactive aggression were averaged across items. Children who scored zero on all aggression items had missing scores on the reactive and proactive aggression scales. Previous research demonstrated good discriminant and convergent validity, as the reactive and proactive scales were not correlated with each other ($r = .03$), but were correlated with similar scales ($r = .41–.62$; Polman et al., 2009). Also good construct validity was shown by expected associations for both scales with conduct problems, leadership, and bullying (Polman et al., 2009). The internal consistency was adequate for both reactive aggression ($\alpha = .73$) and proactive aggression ($\alpha = .69$), and the correlation between reactive and proactive aggression was small ($r = .26$, $p = .007$).

Hostile interpretation

We measured boys' hostile interpretation using two parallel sets of four audiotaped vignettes, each describing ambiguous peer provocations (De Castro et al., 2005). This assessment was similar to Study 1, except for two changes which were made to be able to compare the pre-intervention to the post-intervention assessment in the randomized controlled trial. First, instead of a parallel set with different provocation situations, we now used a parallel set with the same situations in a different context (e.g., we described the situation of losing a game on a tablet instead of on a computer). We counterbalanced the order of sets on the pre- and post-intervention assessment across participants. The situations used in this study were highly similar to the situations used in Study 1. Pre-assessment scores on hostile interpretation used for this study did not differ between sets, $t(112) = -1.16$, $p = .251$. Second, the open-ended question and 5-point rating scale were replaced by two 10-point rating scale questions (i.e., 'The other boy did [provocative behavior other boy]. Did he intend to be mean?' and 'Did he do this to bother you?'), which children answered on a 10-point scale ($1 = not at all$; $10 = very much$). The eight items were averaged to create a single hostile interpretation score ($\alpha = .89$). We did not expect that changing the response format influenced children's scores or study effects, as a recent meta-analysis showed similar effect sizes for hypothetical vignettes open and closed questions (Verhoef et al., 2019). Previous research demonstrated inter-rater reliability ($\kappa = .85-.96$, 91%–97% agreement), good discriminant and criterion validity for audiotaped hypothetical vignettes (De Castro, 2000; De Castro et al., 2003; De Castro & Koops, 2005).

3.1.4 | Analytical approach

We investigated the same hypotheses as in Study 1, using the same analytical approach. To estimate cooccurrence rates, we used parent-reported CBCL T-score cut-offs for the subclinical range (T-score > 64, 93rd percentile). Missing data (1.9%) were accounted for by default settings in Mplus.

3.2 | Results

Before we analyzed the research questions, we explored the parametric nature of the data with scatterplots, boxplots, p-p plots, and the Durbin-Watson test, indicating that parametric analyses were warranted.

TABLE 2 Means (*M*), standard deviations (*SD*), minimum (Min), maximum (Max), and Pearson correlations of the study variables (*N* = 115).

	M	*SD*	Min	Max	1	2	3	4	5
1. Hostile interpretation	4.26	2.31	1.00	9.88	–				
2. Aggression	17.26	7.01	3.00	34.00	−.05	–			
3. Anxiety	7.97	5.24	0.00	24.00	−.05	.42**	–		
4. Reactive aggression	3.45	0.93	1.00	5.00	.23*	.41**	.16	–	
5. Proactive aggression	2.23	0.91	1.00	4.67	−.03	.52**	.17	.26**	–

Note: Missing data on hostile interpretation for one child and for reactive and proactive aggression for five boys. Values reported in this table can slightly differ from reported statistics of the SEM models, as these models used missing data estimation. Boys reported on hostile interpretation, whilst parents reported on all forms of boys' aggression and anxiety.
*$p < .05$.
**$p < .001$.

3.2.1 | Cooccurrence of anxiety and aggression

To investigate the cooccurrence of aggression and anxiety, we first calculated the zero-order correlation between aggression and anxiety problems. As expected, these problems were strongly correlated, $r = .42$, $p < .001$ (Table 2). Results based on subclinical cut-offs showed that 49 boys (42.6%) scored above the cut-off on both aggression and anxiety, 39 boys (33.9%) scored above the cut-off only on aggression, 6 boys (5.2%) scored above the cut-off only on anxiety, and 21 boys (18.3%) scored in the normal range for both aggression and anxiety. Thus, 49 out of 94 boys with (sub)clinical problems (52.1%) had comorbid aggression and anxiety problems.

3.2.2 | Hostile interpretation as transdiagnostic factor

Unexpectedly, results showed that hostile interpretation did not predict aggression, $\beta = -.05$, $B = -0.16$, $SE = 0.29$, $p = .570$, $R^2 < .01$, or anxiety, $\beta = -.04$, $B = -0.10$, $SE = 0.21$, $p = .637$, $R^2 < .01$. Next, we investigated whether the correlation between aggression and anxiety problems was significantly reduced when we entered hostile interpretation as a predictor for aggression and anxiety. This was not the case: the correlation remained the same ($r = .42$) after hostile interpretation was added to the model, $\chi^2(1) < 0.01$, $p = .981$.

3.2.3 | Reactive versus proactive aggression

Hostile interpretation was a significant predictor of reactive aggression, $\beta = .24$, $B = 0.10$, $SE = 0.04$, $p = .012$, $R^2 = .06$, but not of anxiety, $\beta = -.05$, $B = -0.11$, $SE = 0.21$, $p = .620$, $R^2 < .01$. We found that the correlation between reactive aggression and anxiety did not change significantly, with $r = .15$ before, and $r = .17$ after hostile interpretation was added, $\chi^2(1) < 0.01$, $p = .940$.

For proactive aggression, we did not expect associations with either anxiety or hostile interpretation. Indeed, results showed that hostile interpretation did not predict proactive aggression, $\beta = -.03$, $B = -0.01$, $SE = 0.04$, $p = .786$, $R^2 < .01$, or anxiety, $\beta = -.05$, $B = -0.10$, $SE = 0.21$, $p = .633$, $R^2 < .01$. The correlation between proactive aggression and anxiety remained $r = .17$ after hostile interpretation was added, $\chi^2(1) < 0.01$, $p = .993$.

3.3 | Discussion

Findings from our Study 2 clinical sample replicated Study 1, in that the cooccurrence of aggression and anxiety problems was high. In this Study, however, hostile interpretation did not predict aggression or anxiety, although it did predict reactive aggression. We again found no evidence for hostile interpretation as transdiagnostic factor.

4 | GENERAL DISCUSSION

This study is the first to examine hostile interpretation as transdiagnostic factor for cooccurring anxiety in boys with aggressive behavior problems. We used a multi-informant approach and tested our hypotheses in two independent samples. In both studies, we found strong associations between aggression and anxiety problems. Comorbidity rates of (sub)clinical aggression and anxiety problems were substantial in both studies (i.e., 42-52%), which is in line with previous studies (Frick et al., 1999; Zoccolillo, 1992). This high level of comorbidity underscores the necessity to investigate transdiagnostic factors.

We found no support for hostile interpretation as transdiagnostic factor for the cooccurrence of aggression and anxiety problems in boys. As expected, Study 1 showed that hostile interpretation predicted both aggression and anxiety. However, it did not reduce the association between these problems. One explanation for these findings may be that hostile interpretation, anxiety, and aggression may have a different temporal sequence than we supposed. Instead of hostile interpretation leading to both aggression and anxiety, it may be that both hostile interpretation and anxiety precede, and act as risk factors for, the development of aggression (Granic, 2014). Alternatively, hostile interpretation may predict both aggression and anxiety but in different children—that is, children may follow divergent developmental trajectories (Nolen-Hoeksema & Watkins, 2011). Some boys high on hostile interpretation may develop anxiety problems, whereas others may develop aggressive behavior problems—possibly because of different underlying social problems or temperamental vulnerabilities (Rydell et al., 2003). Longitudinal research is needed to examine the temporal order and possible developmental trajectories in boys' aggression and anxiety problems (Granic, 2014).

Study 2, unexpectedly, showed no associations between hostile interpretation and aggression or anxiety problems in boys. This is in contrast with the findings of Study 1 and earlier studies (e.g., Creswell et al., 2005; Verhoef et al., 2019). A reason for this discrepancy might be that the clinical sample in Study 2 yielded only limited variation in aggression (i.e., SD = 7.01 vs. 11.04 in Study 1), restraining the potential explanatory power of predictors such as hostile interpretation (Field, 2017). Most earlier studies examined transdiagnostic factors in much larger samples (i.e., Ns > 400), or, as our Study 1, in samples with both clinical and non-clinical participants (Brenning et al., 2021; Heleniak et al., 2016; McLaughlin et al., 2014), enhancing the amount of variance to explain. To explore if using clinical-only samples indeed reduces variance, we reanalyzed our Study 1 data for only the subset of boys recruited from special education and clinical centers (n = 54; see Appendix B). In line with our reasoning, we found substantial reductions in the expected correlations of hostile interpretation with aggression (i.e., from r = .34 to r = .12) and anxiety (i.e., r = .26 to r = .12). This suggests that future research on transdiagnostic factors may best recruit samples of children with both clinical and non-clinical levels of problem behavior.

In both studies, hostile interpretation predicted boys' reactive aggression. This finding is in line with the definition of reactive aggression, which is described as aggressive behavior in response to a perceived threat or provocation (Dodge, 1990). Besides theoretical reasoning, also empirical evidence consistently showed a relation between hostile interpretation and reactive aggression (Verhoef et al., 2019). It is interesting though, that hostile interpretation did not predict the frequency of boys' aggressive behavior in Study 2. This finding may suggest that boys low on hostile interpretation still engaged in aggression, but for other motives than we assessed (De Castro et al., 2012). In clinical

samples where levels of aggression are high, it may be especially important to zoom in on children's motives for their aggression, providing tailored inroads for intervention.

Our study findings warrant further reflection on the role of hostile interpretation. Study 1 revealed that hostile interpretation predicted both anxiety and aggression, but did not explain their cooccurrence, suggesting that our hostile interpretation assessment may have tapped different aspects of interpretation in boys with anxiety versus aggression. Perhaps not only the interpretation of hostility, but also other interpretations may affect how children feel and behave in a certain situation (Frijda, 1988). For instance, the same interpretation that a peer acted by hostile intent may enhance feelings of fear or anxiety when children are uncertain about their ability to handle the situation, but may enhance feelings of anger when children feel certain that they can influence the situation. Our assessment may have tapped only one expression of hostile interpretation in each boy, whereas in practice, the same boy may express both, depending on the situation or his internal state (De Castro & van Dijk, 2017). If future research would support this hypothesis, this may imply that it is still relevant to target hostile interpretation in treatments for both aggression and anxiety, along with additional aspects of interpretation, such as the perceived controllability of social situations.

The present study had several strengths. First, we conducted thorough transdiagnostic analyses: we did not only investigate whether hostile interpretation predicted both aggression and anxiety problems but also tested whether the cooccurrence between these problems decreased due to this supposed transdiagnostic factor. Second, we tested our hypotheses across informants by examining both teacher and parent reports of boys' problem behavior. As anxiety and aggression can be context-dependent (De Los Reyes et al., 2015), such cross-informant research is important. Third, we used a two-study approach, which enabled us to overcome methodological limitations of the first study in the second study.

An important limitation of our findings is that they cannot be generalized to girls. For this study, we chose to focus on a relatively homogenous sample of boys in middle childhood as comorbidity rates between aggression and anxiety are highest in this population (Marmorstein, 2007; Marsee et al., 2008). These higher rates may reflect that boys are more likely than girls to express their anxiety by acting out aggressively (Marmorstein, 2007). However, these rates may also reflect that aggression problems in girls are underestimated, precisely because girls may use more covert forms of aggression (e.g., damaging others' friendships; Card et al., 2008; Delligatti et al., 2003). This is worrying, as girls with aggressive behavior problems suffer from severe outcomes, such as substance abuse, arrest, and failure to finish high school (Zoccolillo et al., 1996). Hence, future research to understand girls' cooccurring aggression and anxiety is important to provide more effective treatment. As the association between hostile interpretation and aggression is similar in boys and girls (Verhoef et al., 2019), and interpretation training has similar effects on anxiety levels of both boys and girls (Vassilopoulos et al., 2009), hostile interpretation could be a relevant factor to explain cooccurring aggression and anxiety problems in girls too.

Our research also had other limitations. First, as we used cross-sectional data to examine a predictor of aggression and anxiety problems in boys, we could not conclude anything about directions or causality. Future research could build upon our findings and adapt a longitudinal or experimental research to analyze hostile interpretation as transdiagnostic factor. Second, we used hypothetical vignettes to assess hostile interpretation, which might not be the most valid way to assess this construct. Hostile interpretation is an automatic and emotional process. Indeed, research has shown that hostile interpretation assessed in emotionally engaging situations predicts real-life aggression better than vignettes (Verhoef, van Dijk, et al., 2021). Future research may use more engaging methods such as virtual reality environments to assess hostile interpretation (Verhoef, Verhulp, et al., 2021). Third, we asked teachers and parents to report about boys' anxiety problems, but did not include child report which might have resulted in the under- or overestimation of anxiety problems. As anxiety can be covert in nature, other informants might not be aware of these problems or over-report them if they are very attuned to their child's anxiety (Barbosa et al., 2002; Merrell et al., 2002). Fourth, aggression and anxiety problems measured in both studies were assessed by the same reporter, which may have artificially inflated associations due to shared method variance. Although the correlation we found between anxiety and aggression was of similar magnitude as in studies using multiple informants (Marsee et al., 2008), future researchers should consider the use of multiple informants to prevent the possibility of single-informant inflation.

Fifth, we measured anxiety by the anxiety/depression scale, which might have influenced our results. Although hostile interpretation seems similarly related to depressive symptoms (Quiggle et al., 1992), future research could examine hostile interpretation as transdiagnostic factor specifically for anxiety or depression, and aggression. Sixth, we did not have information on which classes boys were from in Study 1, and so we could not conduct multi-level analyses to account for clustered data. Last, we tried to explain the cooccurrence between aggression and anxiety by focusing on only one potential transdiagnostic factor, while we know that other factors such as emotion regulation, parenting practices, peer victimization or environmental stressors might also explain the cooccurrence of aggression and anxiety (Granic, 2014). Future research could examine whether other factors can account for the cooccurrence between aggression and anxiety in children.

In conclusion, we have found that many boys with aggressive behavior problems also displayed comorbid anxiety problems, indicating that it is important to take this cooccurrence into account in current interventions for boys with aggressive behavior problems. Hostile interpretation could not explain this cooccurrence as transdiagnostic factor, but did predict children's reactive aggression in both studies, and anxiety in Study 1. This suggests that hostile interpretation may be a relevant target for the treatment of boys with cooccurring aggression and anxiety problems—although our findings do underscore the need for more research into the precise interpretation processes underlying these cooccurring problems. We hope that our study may inspire researchers to conduct further research to explain the high comorbidity of aggression and anxiety problems in children.

ORCID

Sophie C. Alsem https://orcid.org/0000-0002-6580-2114
Anouk van Dijk https://orcid.org/0000-0002-6186-0181
Esmée E. Verhulp https://orcid.org/0000-0002-5048-3480
Bram O. De Castro https://orcid.org/0000-0001-5110-6153

Note

[1] Results were the same when data of these 20 mothers were replaced by data of fathers.

AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design. Material preparation and data collection of Study 1 were coordinated by Bram De Castro and of Study 2 by Sophie Alsem. Data analyses were performed by Sophie Alsem. The first draft of the manuscript was written by Sophie Alsem and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data and analysis code are available at the Open Science Framework (Alsem et al., 2022).

ETHICS APPROVAL

This research was performed in line with the principles of the Declaration of Helsinki. Approval for Study 1 data collection was granted by the Ethics Committee of the Vrije Universiteit Amsterdam and Study 2 by the Ethics Committee of the University Medical Center Utrecht (NL67139.041.18). Active informed consent was obtained from the parents.

REFERENCES

Achenbach, T. M., Becker, A., Döpfner, M., Heiervang, E., Roessner, V., Steinhausen, H. C., & Rothenberger, A. (2008). Multicultural assessment of child and adolescent psychopathology with ASEBA and SDQ instruments: Research findings, applications, and future directions. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *49*(3), 251–275. https://doi.org/10.1111/j.1469-7610.2007.01867.x

Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the ASEBA School-Age Forms & Profiles*. Research center for children, youth, and families, University of Vermont.

Alsem, S. C., van Dijk, A., Verhulp, E. E., & De Castro, B. O. (2022). *Transdiagnostic factor for anxiety and aggression*. Open Science Framework, Retrieved from osf.io/kbqe9/. http://doi.org/10.17605/OSF.IO/KBQE9

Alsem, S. C., van Dijk, A., Verhulp, E. E., Dekkers, T. J., & De Castro, B. O. (2023). Treating children's aggressive behavior problems using cognitive behavior therapy with virtual reality: A multicenter randomized controlled trial. in press.

Aldao, A., & Nolen-Hoeksema, S. (2012). When are adaptive strategies most predictive of psychopathology? *Journal of Abnormal Psychology*, *121*(1), 276–281. https://doi.org/10.1037/a0023598

Arsenio, W. F., Adams, E., & Gold, J. (2009). Social information processing, moral reasoning, and emotion attributions: Relations with adolescents' reactive and proactive aggression. *Child Development*, *80*(6), 1739–1755. https://doi.org/10.1111/j.1467-8624.2009.01365.x

Barbosa, J., Tannock, R., & Manassis, K. (2002). Measuring anxiety: Parent-child reporting differences in clinical samples. *Depression and Anxiety*, *15*(2), 61–65. https://doi.org/10.1002/da.10022

Barlow, D. H., Allen, L. B., & Choate, M. L. (2004). Toward a unified treatment for emotional disorders. *Behavior Therapy*, *35*(6), 205–230. https://doi.org/10.4324/9781315724539-12

Barrett, P. M., Rapee, R. M., Dadds, M. M., & Ryan, S. M. (1996). Family enhancement of cognitive style in anxious and aggressive children. *Journal of Abnormal Child Psychology*, *24*(2), 187–203. https://doi.org/10.1007/BF01441484

Bell-Dolan, D. J. (1995). Social cue interpretation of anxious children. *Journal of Clinical Child Psychology*, *24*(1), 1–10. https://doi.org/10.1207/s15374424jccp2401_1

Björkqvist, K. (2018). Gender differences in aggression. *Current Opinion in Psychology*, *19*, 39–42. https://doi.org/10.1016/j.copsyc.2017.03.030

Bogels, S. M., & Zigterman, D. (2000). Dysfunctional cognitions in children with social phobia, separation anxiety disorder, and generalized anxiety disorder. *Journal of Abnormal Child Psychology*, *28*(2), 74–76. https://doi.org/10.1023/a:1005179032470

Boylan, K., Vaillancourt, T., Boyle, M., & Szatmari, P. (2007). Comorbidity of internalizing disorders in children with oppositional defiant disorder. *European Child and Adolescent Psychiatry*, *16*(8), 484–494. https://doi.org/10.1007/s00787-007-0624-1

Brenning, K., Soenens, B., Vansteenkiste, M., De Clercq, B., & Antrop, I. (2021). Emotion regulation as a transdiagnostic risk factor for (non)clinical adolescents' internalizing and externalizing psychopathology: Investigating the intervening role of psychological need experiences. *Child Psychiatry and Human Development*, *53*(1), 124–136. https://doi.org/10.1007/s10578-020-01107-0

Card, N. A., & Little, T. D. (2006). Proactive and reactive aggression in childhood and adolescence: A meta-analysis of differential relations with psychosocial adjustment. *International Journal of Behavioral Development*, *30*(5), 466–480. https://doi.org/10.1177/0165025406071904

Card, N. A., Stucky, B. D., Sawalani, G. M., & Little, T. D. (2008). Direct and indirect aggression during childhood and adolescence: A meta-analytic review of gender differences, intercorrelations, and relations to maladjustment. *Child Development*, *79*(5), 1185–1229. https://doi.org/10.1111/j.1467-8624.2008.01184.x

Chorpita, B. F., Daleiden, E. L., & Weisz, J. R. (2005). Modularity in the design and application of therapeutic interventions. *Applied and Preventive Psychology*, *11*(3), 141–156. https://doi.org/10.1016/j.appsy.2005.05.002

Creswell, C., Murray, L., & Cooper, P. (2014). Interpretation and expectation in childhood anxiety disorders: Age effects and social specificity. *Journal of Abnormal Child Psychology*, *42*(3), 453–465. https://doi.org/10.1007/s10802-013-9795-z

Creswell, C., Schniering, C. A., & Rapee, R. M. (2005). Threat interpretation in anxious children and their mothers: Comparison with nonclinical children and the effects of treatment. *Behaviour Research and Therapy*, *43*(10), 1375–1381. https://doi.org/10.1016/j.brat.2004.10.009

Crick, N. R., & Dodge, K. A. (1994). Review of social information processing in children social adjustment. *Psychological Bulletin*, *115*(1), 74–101. https://doi.org/10.1037/0033-2909.115.1.74

Crick, N. R., & Dodge, K. A. (1996). Social information-processing mechanisms in reactive and proactive aggression. *Child Development*, *67*(3), 993–1002. https://doi.org/10.1111/j.1467-8624.1996.tb01778.x

Day, D. M., Bream, L. A., & Pal, A. (1992). Proactive and reactive aggression: An analysis of subtypes based on teacher perceptions. *Journal of Clinical Child Psychology*, *21*(3), 210–216. https://doi.org/10.1207/s15374424jccp2103_2

De Castro, B. O. (2000). *Social information processing in antisocial boys* [Doctoral Dissertation]. Vrije Universiteit Amsterdam.

De Castro, B. O., & Koops, W. (2005). Social information processing in delinquent adolescents. *Psychology, Crime and Law*, *11*(4), 363–375. https://doi.org/10.1080/10683160500255307

De Castro, B. O., Merk, W., Koops, W., Veerman, J. W., & Bosch, J. D. (2005). Emotions in social information processing and their relations with reactive and proactive aggression in referred aggressive boys. *Journal of Clinical Child and Adolescent Psychology*, *34*(1), 105–116. https://doi.org/10.1207/s15374424jccp3401_10

De Castro, B. O., Slot, N. W., Bosch, J. D., Koops, W., & Veerman, J. W. (2003). Negative feelings exacerbate hostile attributions of intent in highly aggressive boys. *Journal of Clinical Child and Adolescent Psychology*, *32*(1), 56–65. https://doi.org/10.1207/S15374424JCCP3201_06

De Castro, B. O., & van Dijk, A. (2017). "It's gonna end up with a fight anyway". Social cognitive processes in children with disruptive behavior disorders. In J. E. Lochman & W. Matthys (Eds.), *The Wiley handbook of disruptive and impulse-control disorders.* John Wiley & Sons, Inc.

De Castro, B. O., Verhulp, E. E., & Runions, K. (2012). Rage and revenge: Highly aggressive boys' explanations for their responses to ambiguous provocation. *European Journal of Developmental Psychology*, *9*(3), 331–350. https://doi.org/10.1080/17405629.2012.680304

De Los Reyes, A., Augenstein, T. M., Wang, M., Thomas, S. A., Drabick, D. A. G., Burgers, D. E., & Rabinowitz, J. (2015). The validity of the multi-informant approach to assessing child and adolescent mental health. *Psychological Bulletin*, *141*(4), 858–900. https://doi.org/10.1037/a0038498

Delligatti, N., Akin-Little, A., & Little, S. G. (2003). Conduct disorder in girls: Diagnostic and intervention issues. *Psychology in the Schools*, *40*(2), 183–192. https://doi.org/10.1002/pits.10080

Dodge, K. A. (1990). The structure and function of reactive and proactive aggression. In D. Pepler & K. H. Rubin (Eds.), *The development and treatment of childhood aggression* (pp. 201–218). Erlbaum.

Dodge, K. A., & Coie, J. D. (1987). Social-information-processing factors in reactive and proactive aggression in children's peer groups. *Journal of Personality and Social Psychology*, *53*(6), 1146–1158. https://doi.org/10.1037/0022-3514.53.6.1146

Field, A. P. (2017). *Discovering statistics using IBM SPSS statistics.* Sage Publications Ltd.

Frick, P. J., Lilienfeld, S. O., Ellis, M., Loney, B., & Silverthorn, P. (1999). The association between anxiety and psychopathy dimensions in children. *Journal of Abnormal Child Psychology*, *27*(5), 383–392. https://doi.org/10.1023/A:1021928018403

Frijda, N. H. (1988). The laws of emotion. *American Psychologist*, *43*(5), 349–358. https://doi.org/10.4324/9781315086071

Fung, A. L. C., Gerstein, L. H., Chan, Y., & Engebretson, J. (2015). Relationship of aggression to anxiety, depression, anger, and empathy in Hong Kong. *Journal of Child and Family Studies*, *24*(3), 821–831. https://doi.org/10.1007/s10826-013-9892-1

Granic, I. (2014). The role of anxiety in the development, maintenance, and treatment of childhood aggression. *Development and Psychopathology*, *26*(4pt2), 1515–1530. https://doi.org/10.1017/S0954579414001175

Granic, I., Meusel, L. A., Lamm, C., Woltering, S., & Lewis, M. D. (2012). Emotion regulation in children with behavior problems: Linking behavioral and brain processes. *Development and Psychopathology*, *24*(3), 1019–1029. https://doi.org/10.1017/S095457941200051X

Heleniak, C., Lenness, J. L., van der Stoep, A., McCauley, E., & McLaughlin, K. A. (2016). Childhood maltreatment exposure and disruptions in emotion regulation: A transdiagnostic pathway to adolescent internalizing and externalizing psychopathology. *Cognitive Therapy and Research*, *40*(3), 394–415. https://doi.org/10.1007/s10608-015-9735-z

Hendrickx, M., Crombez, G., Roeyers, H., & de Castro, B. O. (2003). Psychometrische evaluatie van de Nederlandstalige versie van de Agressie Beoordelingsschaal van Dodge en Coie (1987) [Psychometric evaluation of the Dutch version of Doge & Coie's (1987) aggression rating scale]. *Tijdschrift Voor Gedragstherapie*, *36*, 33–43.

Kovacs, M., & Devlin, B. (1998). Internalizing disorders in childhood. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *39*(1), 47–63. https://doi.org/10.1017/S0021963097001765

Lam, C. B., Mchale, S. M., & Crouter, A. C. (2014). Time with peers from middle childhood to late adolescence: Developmental course and adjustment correlates. *Child Development*, *85*(4), 1677–1693. https://doi.org/10.1111/cdev.12235

Lansford, J. E., Malone, P. S., Dodge, K. a, Pettit, G. S., & Bates, J. E. (2010). Developmental cascades of peer rejection, social information processing biases, and aggression during middle childhood. *Development and Psychopathology*, *22*(3), 593–602. https://doi.org/10.1017/S0954579410000301

Lemerise, E. A., & Arsenio, W. F. (2000). An integrated model of emotion processes and cognition in social information processing. *Child Development*, *71*(1), 107–118. https://doi.org/10.1111/1467-8624.00124

Lochman, J. E., & Wells, K. C. (2002). Contextual social-cognitive mediators and child outcome: A test of the theoretical model in the Coping Power program. *Development and Psychopathology*, *14*(4), 945–967. https://doi.org/10.1017/S0954579402004157

Lucassen, M. F. G., Stasiak, K., Crengle, S., Weisz, J. R., Frampton, C. M. A., Bearman, S. K., Ugueto, A. M., Herren, J., Cribb-Su'a, A., Faleafa, M., Kingi-'Ulu'ave, D., Loy, J., Scott, R. M., Hartdegen, M., & Merry, S. N. (2015). Modular approach to therapy for anxiety, depression, trauma, or conduct problems in outpatient child and adolescent mental health services in New Zealand: Study protocol for a randomized controlled trial. *Trials*, *16*(1), 1–12. https://doi.org/10.1186/s13063-015-0982-9

Luebbe, A. M., Bell, D. J., Allwood, M. A., Swenson, L. P., & Early, M. C. (2010). Social information processing in children: Specific relations to anxiety, depression, and affect. *Journal of Clinical Child and Adolescent Psychology*, *39*(3), 386–399. https://doi.org/10.1080/15374411003691685

Marmorstein, N. R. (2007). Relationships between anxiety and externalizing disorders in youth: the influences of age and gender. *Journal of Anxiety Disorders*, 21(3), 420–432. https://doi.org/10.1016/j.janxdis.2006.06.004

Marsee, M. A., Weems, C. F., & Taylor, L. K. (2008). Exploring the association between aggression and anxiety in youth: A look at aggressive subtypes, gender, and social cognition. *Journal of Child and Family Studies*, 17(1), 154–168. https://doi.org/10.1007/s10826-007-9154-1

McCart, M. R., Priester, P. E., Davies, W. H., & Azen, R. (2006). Differential effectiveness of behavioral parent-training and cognitive-behavioral therapy for antisocial youth: A meta-analysis. *Journal of Abnormal Child Psychology*, 34(4), 527–543. https://doi.org/10.1007/s10802-006-9031-1

McLaughlin, K. A., & Nolen-Hoeksema, S. (2011). Rumination as a transdiagnostic factor in depression and anxiety. *Behaviour Research and Therapy*, 49(3), 186–193. https://doi.org/10.1016/j.brat.2010.12.006

McLaughlin, K. A., Wisco, B. E., Aldao, A., & Hilt, L. M. (2014). Rumination as a transdiagnostic factor underlying transitions between internalizing symptoms and aggressive behavior in early adolescents. *Journal of Abnormal Psychology*, 123(1), 13–23. https://doi.org/10.1037/a0035358

Merrell, K. W., McClun, L. A., Kempf, K. K. G., & Lund, J. (2002). Using self-report assessment to identify children with internalizing problems: Validity of the internalizing scale for children. *Journal of Psychoeducational Assessment*, 20(3), 223–239. https://doi.org/10.1177/073428290202000301

Muthén, L. K., & Muthén, B. (2019). *Mplus user's guide (1998-2019)*. Muthén & Muthén.

Nolen-Hoeksema, S., & Watkins, E. R. (2011). A heuristic for developing transdiagnostic models of psychopathology: Explaining multifinality and divergent trajectories. *Perspectives on Psychological Science*, 6(6), 589–609. https://doi.org/10.1177/1745691611419672

Oland, A. A., & Shaw, D. S. (2005). Pure versus co-occurring externalizing and internalizing symptoms in children: The potential role of socio-developmental milestones. *Clinical Child and Family Psychology Review*, 8(4), 247–270. https://doi.org/10.1007/s10567-005-8808-z

Perren, S., Ettekal, I., Ladd, G., Prinstein, M. J., Cheah, C. S. L., & Guyer, A. E. (2013). The impact of peer victimization on later maladjustment: Mediating and moderating effects of hostile and self-blaming attributions. *Journal of Clinical Child and Adolescent Psychology*, 34(1), 46–55. https://doi.org/10.1207/s15374424jccp3401_2

Polman, H., de Castro, B. O., Koops, W., van Boxtel, H. W., & Merk, W. W. (2007). A meta-analysis of the distinction between reactive and proactive aggression in children and adolescents. *Journal of Abnormal Child Psychology*, 35(4), 522–535. https://doi.org/10.1007/s10802-007-9109-4

Polman, H., de Castro, B. O. De, Thomaes, S., & van Aken, M. (2009). New directions in measuring reactive and proactive aggression: Validation of a teacher questionnaire. *Journal of Abnormal Child Psychology*, 37(2), 183–193. https://doi.org/10.1007/s10802-008-9266-0

Prinstein, M. J., Cheah, C. S. L., & Guyer, A. E. (2005). Peer victimization, cue interpretation, and internalizing symptoms: Preliminary concurrent and longitudinal findings for children and adolescents. *Journal of Clinical Child and Adolescent Psychology*, 34(1), 11–24. https://doi.org/10.1207/s15374424jccp3401_2

Quiggle, N. L., Garber, J., Panak, W. F., & Dodge, K. A. (1992). Social information processing in aggressive and depressed children. *Child Development*, 63(6), 1305–1320. https://doi.org/10.1111/j.1467-8624.1992.tb01696.x

Reid, S. C., Salmon, K., & Lovibond, P. F. (2006). Cognitive biases in childhood anxiety, depression, and aggression: Are they pervasive or specific? *Cognitive Therapy and Research*, 30(5), 531–549. https://doi.org/10.1007/s10608-006-9077-y

Rydell, A. M., Berlin, L., & Bohlin, G. (2003). Emotionality, emotion regulation, and adaptation among 5- to 8-year-old children. *Emotion*, 3(1), 30–47. https://doi.org/10.1037/1528-3542.3.1.30

Stuijfzand, S., Creswell, C., Field, A. P., Pearcey, S., & Dodd, H. (2018). Research review: Is anxiety associated with negative interpretations of ambiguity in children and adolescents? A systematic review and meta-analysis. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 59(11), 1127–1142. https://doi.org/10.1111/jcpp.12822

Tanaka, A., Raishevich, N., & Scarpa, A. (2010). Family conflict and childhood aggression: The role of child anxiety. *Journal of Interpersonal Violence*, 25(11), 2127–2143. https://doi.org/10.1177/0886260509354516

UNESCO Institute for Statistics. (2012). International Standard Classification of Education: ISCED 2011. Retrieved from: https://doi.org/10.15220/978-92-9189-123-8-en

Vassilopoulos, S. P., Banerjee, R., & Prantzalou, C. (2009). Experimental modification of interpretation bias in socially anxious children: Changes in interpretation, anticipated interpersonal anxiety, and social anxiety symptoms. *Behaviour Research and Therapy*, 47(12), 1085–1089. https://doi.org/10.1016/j.brat.2009.07.018

Verhoef, R. E. J., Alsem, S. C., Verhulp, E. E., & De Castro, B. O. (2019). Hostile intent attribution and aggressive behavior in children revisited: A meta-analysis. *Child Development*, 90(5), 525–547. https://doi.org/10.1111/cdev.13255

Verhoef, R. E. J., van Dijk, A., Verhulp, E. E., & De Castro, B. O. (2021). Interactive virtual reality assessment of aggressive social information processing in boys with behaviour problems: A pilot study. *Clinical Psychology and Psychotherapy*, 28(3), 489–499. https://doi.org/10.1002/cpp.2620

Verhoef, R. E. J., Verhulp, E. E., van Dijk, A., & De Castro, B. O. (2021). Interactive virtual reality versus vignette-based assessment of children's aggressive social information processing. *Research on Child and Adolescent Psychopathology*, *50*(5), 621–636. https://doi.org/10.1007/s10802-021-00879-w

Vitaro, F., Brendgen, M., & Tremblay, R. E. (2002). Reactively and proactively aggressive children: Antecedent and subsequent characteristics. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *43*(4), 495–505. https://doi.org/10.1111/1469-7610.00040

Weisz, J. R., Chorpita, B. F., Palinkas, L. A., Schoenwald, S. K., Miranda, J., Bearman, S. K., Daleiden, E. L., Ugueto, A. M., Ho, A., Martin, J., Gray, J., Alleyne, A., Langer, D. A., Southam-Gerow, M. A., Gibbons, R. D., Glisson, C., Green, E. P., Hoagwood, K. E., Kelleher, K., … Mayberg, S. (2012). Testing standard and modular designs for psychotherapy treating depression, anxiety, and conduct problems in youth: A randomized effectiveness trial. *Archives of General Psychiatry*, *69*(3), 274–282. https://doi.org/10.1001/archgenpsychiatry.2011.147

Zoccolillo, M. D. (1992). Co-occurrence of conduct disorder and its adult outcomes with depressive and anxiety disorders: A review. *Journal of the American Academy of Child and Adolescent Psychiatry*, *31*(3), 547–556. https://doi.org/10.1097/00004583-199205000-00024

Zoccolillo, M. D., Tremblay, R., & Vitaro, F. (1996). DSM-III-R and DSM-III criteria for conduct disorder in preadolescent girls: Specific but insensitive. *Journal of the American Academy of Child and Adolescent Psychiatry*, *35*(4), 461–470. https://doi.org/10.1097/00004583-199604000-00012

APPENDIX A

As earlier research showed high overlap in reactive and proactive aggression scores measured by instruments such as the REPRO (Polman et al., 2007), we aimed to account for this by repeating the Study 1 analyses on reactive and proactive aggression, this time controlling for the other type of aggression. Specifically, we added proactive aggression as predictor for reactive aggression to the model and vice versa. Findings for reactive aggression, which was first significantly predicted by hostile interpretation, became nonsignificant as a consequence.

In the reactive aggression model, results showed that hostile interpretation was a significant predictor of anxiety, $\beta = .28$, $B = 1.75$, $SE = 0.69$, $p = .011$, $R^2 = .08$, but—in contrast to our main analyses—not for reactive aggression, $\beta = .13$, $B = 0.14$, $SE = 0.09$, $p = .097$, $R^2 = .01$, when we controlled for proactive aggression, $\beta = .67$, $B = 0.69$, $SE = 0.08$, $p < .001$, $R^2 = .50$. As in our main analyses, we found a small and nonsignificant reduction from $r = .09$ to $r = .07$ when hostile interpretation was added, $\chi^2(1) = 0.07$, $p = .789$.

For proactive aggression, results were the same as for our main analyses. We found that hostile interpretation was a significant predictor of anxiety, $\beta = .28$, $B = 1.75$, $SE = 0.69$, $p = .011$, $R^2 = .08$, but not for proactive aggression, $\beta = .05$, $B = 0.05$, $SE = 0.09$, $p = .558$, $R^2 < .01$, when we controlled for reactive aggression, $\beta = .69$, $B = 0.68$, $SE = 0.08$, $p < .001$, $R^2 = .50$. We found no change in the correlation between anxiety and aggression problems, which remained $r = .16$ when hostile interpretation was added, $\chi^2(1) = 0.01$, $p = .926$.

APPENDIX B

Previous studies showed stronger associations between hostile interpretation and problem behavior in samples with both typically developing children and clinically-referred children (Verhoef et al., 2019). As our Study 1 included such as sample, but Study 2 included a restricted range of only clinically-referred boys, we were wondering whether this difference could explain our contrasting study findings. To explore whether using a clinical-only sample indeed reduced variance in aggression and anxiety, we reanalyzed our Study 1 data. We therefore excluded boys recruited in primary education ($n = 30$) and analyzed the subset of boys recruited from special education and clinical centers ($n = 54$). In the original analyses with all boys ($n = 84$), hostile interpretation was significantly associated with aggression ($r = .34$,

p = .004) and anxiety (*r* = .26, *p* = .023). For the clinical-only sample, correlations decreased and hostile interpretation was no longer associated with aggression (*r* = .12, *p* = .428) and anxiety (*r* = .12, *p* = .421). This provides support to our hypothesis that hostile interpretation is more strongly related to problem behavior in samples with both typically developing and clinically-referred boys than within a clinical sample with a restricted range.