



Effects of Trauma on Comorbidity and Emotion Recognition in Antisocial Adolescents

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Abstract

Previous research has shown that comorbidity and maltreatment history are related to emotion recognition in adolescents with externalizing problems. Nonetheless, the combined influence of these factors has rarely been investigated. Therefore, the present study examined the effect of trauma on the association between comorbid internalizing problems and emotion recognition in 61 adolescents, living in residential youth care facilities. The results showed that there was no difference in overall emotion recognition accuracy or latency between adolescents with externalizing disorders and a history of trauma, compared to those without a history of trauma. Furthermore, there was no interaction effect of trauma and comorbid internalizing disorders on overall emotion recognition accuracy or latency. However, when emotions were examined separately, it was found that adolescents with externalizing and internalizing disorders were significantly faster in recognizing anger than those with externalizing disorders only. Implications and suggestions for future research are discussed.

Effects of Trauma on Comorbidity and Emotion Recognition in Antisocial Adolescents

Emotion recognition, or the capability of identifying and interpreting expressions of emotion, is essential for successful human social interactions and interpersonal relationships (Fridlund, 1991; Izard et al., 2001). Emotion recognition typically refers to the recognition of facial expressions of emotions. Six facial expressions of emotions with particular facial muscular patterns are considered to be universal across cultures: happiness, sadness, anger, fear, disgust and surprise (Ekman & Friesen, 1971). Increasing evidence has indicated that various forms of psychopathology are characterized by specific biases or deficits in emotion recognition. For example, deficits in emotion recognition have been found for both externalizing (Collin, Bindra, Raju, Gillberg, & Minnis, 2013; Marsh & Blair, 2008) and internalizing problems (Demenescu, Kortekaas, den Boer, & Aleman, 2010). However, as for children and adolescents specifically, past studies frequently focused on facial emotion recognition in youth with autism (Collin et al., 2013).

Yet, at least half of all referrals to mental health agencies for youth are for externalizing problems (Granic, 2014). Externalizing problems refer to aggressive, antisocial and impulsive behaviors and disorders, such as oppositional defiant disorder (ODD), conduct disorder (CD), and attention deficit (hyperactivity) disorder (AD(H)D). Past research consistently showed a link between antisocial behavior and deficits in recognizing emotional expressions, yet conflicting results were found for specific deficits. One study showed that antisocial behavior was uniquely associated with improved fear recognition and impaired anger recognition in adolescence (Leist & Dadds, 2009), whereas another found a robust link between antisocial behavior and deficits in recognizing fearful expressions in children, adolescents and adults (Marsh & Blair, 2008).

As for behavioral disorders, ADHD specifically, a recent systematic review concluded that children and adolescents with ADHD tend to have difficulties with facial emotion

recognition compared to controls (Collin et al., 2013). However, since none of the included studies involved large numbers of children, the authors emphasized the importance of larger future studies to replicate these findings. Cadesky, Mota, and Schachar (2000) examined the ability to interpret emotional faces in children with comorbid ADHD and CD. Children were found to interpret all universal emotions less accurately, except for anger, and they tended to be biased towards sadness while interpreting other emotions. As regards CD specifically, the limited number of studies examining facial recognition in children and adolescents with CD yielded conflicting results concerning specific emotions (Collin et al., 2013). However, there seem to be more profound deficits in children and adolescents with early-onset CD than in those with adolescent-onset CD. Similar results have been found for children and adolescents with CD and high psychopathic traits, compared to those with CD and low psychopathic traits respectively (Fairchild, van Goozen, Calder, Stollery, & Goodyer, 2009). Overall, it seems that children and adolescents with externalizing behavioral problems have deficits in emotion recognition as well, yet the specifics of these difficulties vary for distinct disorders and emotions. A future study that combines different behavioral disorders and emotions might disentangle these past findings.

Within externalizing problems, comorbidity is often prevalent, such as co-occurring ADHD and other behavioral disorders like CD (Beauchaine, Hinshaw, & Pang, 2010). However, internalizing problems like depression and anxiety also frequently co-occur with externalizing problems (Granic, 2014; Nivard et al., 2017). As mentioned previously, difficulties with emotion recognition are not unique to externalizing problems only. Deficits in emotion recognition have been found for both anxiety disorders and major depressive disorder, although these seem to be more profound in depression (Demenescu et al., 2010). However, findings regarding specific deficits are inconclusive. A recent meta-analysis indicated impaired recognition of anger, disgust, fear, happiness, and surprise, but not sadness in depressive individuals (Dalili, Penton-Voak, Harmer, & Munafò, 2015), whereas

an earlier review concluded that there is limited evidence of reduced general or emotion-specific recognition accuracy in major depression (Bourke, Douglas, & Porter, 2010). Instead, the latter review found a negative response bias, increased vigilance, and selective attention towards sadness in individuals with major depression. In addition, emotional problems like nervousness and dejectedness were associated with better recognition of negative emotions like sadness and anger and with poorer recognition of neutral faces (Leist & Dadds, 2009).

The frequent co-occurrence of externalizing and internalizing problems might be explained by shared underlying factors, such as parental rejection (Akse, Hale, Engels, Raaijmakers, & Meeus, 2004; Hale, van der Valk, Engels, & Meeus, 2005), family stress (Keiley, Lofthouse, Bates, Dodge, & Pettit, 2003), or child abuse (Glaser, 2002; Norman et al., 2012). With regards to child abuse, past research has shown that physical abuse, as well as emotional abuse and neglect could lead to emotional, behavioral, and developmental difficulties (Glaser, 2002), such as depressive disorders, drug use, and suicide attempts (Norman et al., 2012). Additionally, a direct association between these kinds of trauma and emotion recognition has been suggested as well. Children and adolescents who were abused and neglected in their past performed worse on emotion recognition tasks than controls (Leist & Dadds, 2009; Pollak, Cicchetti, Hornung, & Reed, 2000; Pollak & Sinha, 2002). However, the type of maltreatment seems to influence the recognition of specific emotions. According to the study by Leist and Dadds (2009), maltreatment predicted better recognition of fear and sadness, with maltreatment being defined as a combination of emotional maltreatment, neglect, physical abuse, and sexual abuse. Conversely, another study reported better recognition of anger in physically abused children specifically (Pollak & Sinha, 2002). Yet, another study found that physically neglected children accurately recognized emotions less frequently than physically abused or nonmaltreated children do (Pollak et al., 2000). Physically neglected children also had a more liberal bias towards sadness (i.e., a tendency to

label emotional expressions as sad). Although these findings suggest distinct effects of specific trauma types on emotion recognition, these associations have not been comprehensively disentangled yet.

While several studies have investigated comorbidity, maltreatment history, and emotion recognition in adolescents with externalizing problems separately, very few have combined these concepts. One study that examined comorbid anxiety disorders and emotion recognition in adolescents with CD found that the sensitivity that accompanies anxiety disorders counteracts the deficits on emotion recognition in CD (Short, Sonuga-Barke, Adams, & Fairchild, 2016). However, this study did not take childhood trauma into account. Another study assessed the relationships between emotion recognition, antisocial behavior, emotional problems, callous-unemotional (CU) traits and early maltreatment (Leist & Dadds, 2009). As described above, this study found that (1) antisocial behavior was uniquely related to impairments in anger recognition but better recognition of fear, (2) emotional problems were associated with impaired recognition of neutral faces but better recognition of anger and sadness, (3) CU traits were uniquely associated with impaired fear recognition, and (4) past maltreatment was related to better recognition of fear and sadness. Nonetheless, this study did not explicitly examine comorbidity or the possible interaction between early maltreatment and different types of psychopathology, and had a small sample size.

To address these gaps, the present study is the first to examine the role of trauma in the association between (comorbid) psychopathology and emotion recognition. By examining emotion recognition for externalizing and internalizing problems in general, the findings of this study may clarify past findings from a broader perspective, and thus form a theoretical foundation for research on specific disorders. Furthermore, past research has shown that strengthening social skills, of which emotion recognition is an important part, is associated with a decrease in both externalizing and internalizing problems (Leist & Dadds, 2009). In order to determine whether different forms of psychopathology and trauma indeed relate to

adolescents' emotion recognition abilities, the present study aimed to answer the following questions: What is the moderating effect of trauma on the association between (1) externalizing disorders and emotion recognition and (2) comorbid internalizing and externalizing disorders and emotion recognition? It was expected that adolescents with externalizing disorders and a history of trauma would perform worse on an emotion recognition task than those without a history of trauma. Furthermore, given the inconclusive findings regarding internalizing problems and emotion recognition, it was explored whether comorbid internalizing problems add to these emotion recognition deficits.

Method

Participants

The participants were 61 male non-psychotic adolescents ($M_{\text{age}} = 16.36$, $SD_{\text{age}} = 0.95$) with externalizing problems and a normal intelligence, living in residential youth care facilities across the Netherlands. Adolescents are admitted to these facilities when their behavioral problems are so severe that they pose a danger to the adolescent himself or his environment when left untreated. The initial sample included 79 participants, but 18 participants were excluded because they had no externalizing disorder (as determined by the MINI-KID; Jonker, Bauhuis, Martens, Verdellen, & Verbraak, 2010).

In the final sample of 61 participants, most participants were Dutch (80.33%), some were Polish (6.56%), and most of the remaining participants had one Dutch parent and one non-Dutch parent. The highest levels of education (Dutch abbreviations in brackets) completed by participants were lower secondary education (VMBO; 95.08%) and higher secondary education (HAVO; 4.92%). As regards their family situation before they were admitted to youth care facilities, most participants' parents were separated (39.34%), some were together (24.59%), and some came from a single-parent family (21.31%). A few participants indicated that their father passed away (4.92%) and the remaining participants indicated another family situation (e.g., they were adopted, lived in foster care; 9.84%).

The total sample was divided in two subgroups, namely an externalizing only group, which consisted of adolescents with ADHD, ODD, and CD ($n = 28$), and a group with both externalizing and internalizing problems, which consisted of adolescents with (one or more of the) abovementioned externalizing problems *and* an anxiety or major depressive disorder ($n = 33$).

Procedure

Data collection took place in three sessions of approximately one hour each. In the first screening session, participants' intelligence, psychopathology, and trauma were assessed, using the RAVEN intelligence task (Raven, 1938), a structured interview (MINI-KID; Jonker et al., 2010), and a self-report questionnaire (CTQ; Bernstein et al., 1994; Bernstein et al., 2003), respectively. In both the second session and third session, three and ten days after the first session, participants completed an emotion recognition task on the computer. At the end of the third session, participants received a financial compensation of 20 euros for their participation. Active informed consent was obtained from participants when they are aged 16 or over, for 15-year-olds active informed consent from parents was required as well. This study was part of a larger project that has been approved by the Central Committee on Research Involving Human Subjects and the Ministry of Health.

Materials

Psychopathology. Using the Dutch version of the Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID; Jonker et al., 2010), psychiatric disorders were assessed. The questions of the MINI-KID are designed to ask for specific diagnostic criteria and taken together generate reliable and valid psychiatric diagnoses for children and adolescents (Sheehan et al., 2010), and is valid and reliable in both general and clinical samples (Duncan et al., 2017). The interview takes approximately 45 minutes to administer and screens for 24 DSM-IV and ICD-10 psychiatric disorders, as well as suicidality. All its questions are in binary "yes/no" format.

Childhood trauma. History of abuse and neglect were measured using the Dutch version of the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994; Bernstein et al., 2003), which has strong psychometric properties in both clinical and community samples (Scher, Stein, Asmundson, McCreary, & Forde, 2001). The CTQ is a 25-item questionnaire with five questions for each of its five clinical scales, namely (1) physical abuse (e.g., “I got hit so hard by someone in my family that I had to see a doctor or go to the hospital”), (2) sexual abuse (e.g., “Someone tried to touch me in a sexual way, or tried to make me touch them”), (3) emotional abuse (e.g., “People in my family said hurtful or insulting things to me”), (4) physical neglect (e.g., “I didn’t have enough to eat”) and (5) emotional neglect (e.g., “There was someone in my family who helped me feel that I was important or special” (reversed)). Items are rated on a Likert scale with response options ranging from 1 (“never true”) to 5 (“very often true”). A sum score was calculated for the combination of these five subscales, where a higher score represents more (severe) traumatic experiences. In the present sample, the internal consistency of the entire scale was excellent ($\alpha = .93$).

Emotion recognition. Using the Dynamic Affect Recognition and Evaluation task (DARE; Porges, Cohn, Bal, & Lamb, 2007; Porges, Cohn, Bal, Lamb, & Lewis, 2016), emotion recognition was assessed. The DARE is a standardized computer tool with video sequences of facial expressions changing from neutral to emotional expressions, which has shown good concordance in cross-validation tests (Shenk, Putnam, & Noll, 2013). The software includes stimuli from the Cohn-Kanade Facial Expression Database (Cohn, Zlochower, Lien, & Kanade, 1999; Kanade, Cohn, & Trian, 2000). Herein, six target emotions are used: happiness, sadness, anger, fear, surprise, and disgust. The DARE measures both emotion recognition accuracy and response time (latency). In this study, mean accuracy and latency were calculated using only the baseline conditions from the larger project, which contained 40 video sequences of emotional expressions. Therefore, each

participant in this study contributed accuracy and latency scores for 20 to 22 videos of emotional expressions, with two to four expressions for each of the six emotions.

Analyses

The data was analyzed using a linear mixed-effects model approach with emotion recognition accuracy and latency as dependent variables. Accuracy refers to the percentage of emotions that were recognized correctly, whereas latency refers to the time it takes participants to correctly recognize the presented emotions. Here, both low accuracy and high latency are indicative of emotion recognition impairments. To ensure reliability, latency scores under 2 seconds were excluded prior to the analyses, as well were scores that were more than 2 seconds longer than the video sequence of the emotional expression. Since the 40 video sequences that were included in this study differed in length, percentage scores (raw latency score divided by the length of the corresponding video sequence) were calculated and used for the latency scores on each video sequence.

The predictor variables were trauma, comorbidity, and an interaction between these two variables. The trauma variable consisted of a sum score of the total scores on the five subscales of the CTQ, ranging from 25 to 125, and comorbidity was coded as a dichotomous variable (*0 = externalizing problems, 1 = comorbid externalizing and internalizing problems*). To account for possible variation in emotion recognition due to age differences, age was also included as a predictor variable in both analyses. The trauma and age variables were centered prior to the analyses.

For both analyses, Barr, Levy, Scheepers, and Tily's (2013) advice to use a maximal random effects structure was followed: the repeated-measures nature of the data was accordingly modeled by including a random intercept for video and participant, as well as random slopes for each of the fixed slopes (including the interaction term). Additionally, all possible random correlation terms among the random effects were included. When convergence warnings were encountered, the models were simplified by excluding these

random effects in a stepwise manner. To determine p values, the function mixed from the package afex was used (Singmann, Bolker, Westfall, & Aust, 2018; version 0.20.2), using Type 3 tests and the parametric bootstrap method (with 500 simulations), which in turn calls the function PBmodcomp from the package pbrtest (Halekoh, & Højsgaard, 2014; version 0.4.7).

Results

Descriptives

Prior to the analyses, the normality of distributions of the included variables was assessed using visual inspections and Shapiro-Wilk tests. The distribution of the accuracy percentage scores was normal for both groups (externalizing disorders only, $W(28) = .96, p = .308$; internalizing and externalizing disorders, $W(33) = .96, p = .314$), as was the distribution of the latency percentage scores (externalizing disorders only, $W(28) = .98, p = .706$; internalizing and externalizing disorders, $W(33) = .96, p = .275$). Trauma on the other hand was non-normally distributed in both groups (externalizing disorders only, $W(28) = .87, p = .003$; internalizing and externalizing disorders, $W(33) = .89, p = .004$). Further inspection showed that trauma was moderately positively skewed (skewness = 0.99, $SE = .31$). Since this was expected as a high score on this variable indicates severe trauma, and to maintain feasible interpretation, no data transformation was used. Table 1 presents the means and standard deviations of all the study variables.

Table 1

Descriptives of Included Study Variables

	Total sample		EXT		EXT and INT	
	(N = 61)		(n = 28)		(n = 33)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age (years)	16.38	0.95	16.22	0.89	16.52	1.00
Trauma ^a	45.56	17.20	41.86	14.63	48.70	18.77
Accuracy ^b	72.61	13.55	69.76	12.33	75.02	14.24
Latency ^c	46.69	9.45	46.85	9.95	46.55	9.17

Note. EXT = externalizing disorders; INT = internalizing disorders.

^aThe sum score of the CTQ, ranging from 25 to 125. ^bThe percentage of the accurate responses. ^cThe latency percentage for correct responses.

Accuracy

First, it was examined whether there was an effect of comorbidity and trauma on emotion recognition accuracy. The data were analyzed with a linear mixed-effects model approach, using the `glmer` function of the `lme4` package (version 1.1.17; Bates, Maechler, Bolker, & Walker, 2015) in R (R Core Team, 2018). The model included a fixed intercept, a fixed slope for the factor Comorbidity (coded using sum-to-zero contrasts, with Externalizing and Internalizing Disorders coded as -1 in all factor contrasts), fixed slopes for the continuous variables Trauma and Age (these were centered prior to inclusion), and a fixed slope for the interaction between Comorbidity and Trauma. To obtain convergence for this model, it was necessary to standardize the Trauma and Age variables, and exclude the random correlation terms for video, as well as the random slopes for the fixed effect of the interaction term and the fixed effect for Comorbidity. Before investigating the significance of the included effects, diagnostic plots were generated and percentages of scaled residuals were inspected to check

model assumptions and thus test the accuracy of the model described above. These indicated that the model adhered to assumptions and provided no reasons for concern regarding the reliability of the found results.

With respect to the research question, no significant main or interaction effects were observed. The direct effect of comorbidity on accuracy was not significant ($b = -0.19$, $SE = 0.11$, $\chi^2 = 2.82$, $p = .123$), indicating no differences in emotion recognition accuracy between adolescents with or without a comorbid internalizing disorder. There also was no significant main effect of trauma on accuracy ($b = 0.05$, $SE = 0.11$, $\chi^2 = 0.17$, $p = .727$), suggesting that there were no significant differences in emotion recognition accuracy between adolescents with a higher level of trauma compared to those with a lower level of trauma. Most importantly, the interaction effect of comorbidity and trauma on accuracy was not significant ($b = 0.07$, $SE = 0.12$, $\chi^2 = 0.35$, $p = .605$). Put differently, there was no difference in emotion recognition accuracy for adolescents with different combinations of comorbidity and trauma. Last, as regards the control variable, there was no significant main effect of age on emotion recognition accuracy ($b = -0.05$, $SE = 0.11$, $\chi^2 = 0.18$, $p = .714$), indicating no difference in emotion recognition accuracy between younger and older participants.

Since past research has regularly shown differences in emotion recognition between distinct emotions, the means of the accuracy percentages were examined for each of the six emotions. An overview of these descriptive statistics is found in Table 2. To investigate whether these means were significantly different between the two subsamples, a MANOVA was conducted in SPSS with the overall accuracy percentages for each of the six emotions as dependent variables, comorbidity as a fixed effect, and trauma as well as the Trauma x Comorbidity interaction as covariates. Assumptions of multivariate normality and homogeneity of covariance matrices were checked and met. Using Pillai's trace statistic, there was no significant effect of comorbidity on emotion recognition accuracy, $V = 0.17$,

$F(6, 51) = 1.72, p = .136$, or trauma, $V = 0.04, F(6, 51) = 0.35, p = .909$, or the interaction between comorbidity and trauma on emotion recognition accuracy, $V = 0.14, F(6, 51) = 1.42, p = .225$.

Table 2

Descriptive statistics of recognition accuracy for each emotion

Emotion	Total sample		EXT		EXT and INT	
	<i>N</i>	<i>M (SD)</i>	<i>N</i>	<i>M (SD)</i>	<i>N</i>	<i>M (SD)</i>
Anger	61	75.27 (29.46)	28	71.43 (29.70)	33	78.54 (29.32)
Disgust	61	64.48 (31.66)	28	53.57 (32.98)	33	73.74 (27.73)
Fear	61	45.36 (33.18)	28	44.35 (31.27)	33	46.21 (35.18)
Happiness	61	92.90 (15.20)	28	94.35 (14.71)	33	91.67 (15.73)
Sadness	61	76.78 (24.87)	28	79.46 (23.18)	33	74.49 (26.35)
Surprise	60	81.53 (27.32)	28	79.76 (29.70)	32	83.07 (25.44)

Note. Accuracy = the percentage of the accurate responses; EXT = externalizing disorders; INT = internalizing disorders.

Latency

Second, it was examined whether there was an effect of comorbidity and trauma on emotion recognition latency for correct responses. This was analyzed with a linear mixed-effects model approach as well, using the `lmer` function of the `lme4` package (version 1.1.17; Bates, Maechler, Bolker, & Walker, 2015) in R (R Core Team, 2018). The model setup for this analysis was identical to that of the abovementioned accuracy model. No convergence warnings were encountered for this model, and therefore all possible random effects could be included. Before investigating the significance of the included effects, to check model assumptions and thus test the accuracy of the model, diagnostic plots were generated and

percentages of scaled residuals were inspected. As regards the latter, 1.09 percent of the scaled residuals had a value above 3. To confirm that the present findings were robust, p values were computed for an identical model using a data frame that excluded the cases with scaled residuals above 3. These recalculated p values showed that compared to the full data frame, excluding these cases had no influence on the significance of the included effects. For this reason, these cases were included in the analysis. The diagnostic plots indicated that the model adhered to other assumptions and did not provide reasons for concern regarding the interpretation of the results.

With respect to the research question, no significant main or interaction effects were observed. The direct effect of comorbidity on latency was not significant ($b = 0.30$, $SE = 1.30$, $\chi^2 = 0.06$, $p = .823$), suggesting that there were no differences in emotion recognition latency between adolescents with and without a comorbid internalizing disorder. There also was no significant main effect of trauma on latency ($b = -0.07$, $SE = 0.08$, $\chi^2 = 0.87$, $p = .366$). Put differently, there were no significant differences in emotion recognition latency between adolescents with a higher level of trauma compared to those with a lower level of trauma. Most importantly, the interaction effect of comorbidity and trauma was not significant ($b = -0.04$, $SE = 0.08$, $\chi^2 = 0.28$, $p = .635$), indicating no difference in emotion recognition latency for adolescents with different combinations of comorbidity and trauma. Last, as regards the control variable, there was no significant main effect of age on emotion recognition latency ($b = -0.11$, $SE = 1.39$, $\chi^2 = 0.01$, $p = .958$), indicating no difference in emotion recognition latency between younger and older participants.

To explore differences in emotion recognition between the six emotions, the means of the latency percentages for correct responses were examined for each of the six emotions. An overview of these descriptive statistics is found in Table 3. To investigate whether these means were significantly different between the two subsamples, a MANOVA was conducted

in SPSS with an identical setup as that for accuracy, using the overall latency percentages for each of the six emotions as dependent variables. Assumptions of multivariate normality and homogeneity of covariance matrices were checked and met. Since latency percentages were calculated for correct responses, only the 38 participants who had latency scores for all emotions were included (i.e., the participants that labeled at least one expression per emotion correctly). Using Pillai's trace statistic, there was a significant effect of comorbidity on emotion recognition latency, $V = 0.34$, $F(6, 29) = 2.49$, $p = .046$, $\eta_p^2 = .34$, but not of trauma, $V = 0.29$, $F(6, 29) = 1.94$, $p = .108$, nor the interaction between comorbidity and trauma on emotion recognition latency, $V = 0.30$, $F(6, 29) = 2.11$, $p = .083$.

Table 3

Descriptive statistics of latency for each emotion

	Total sample		EXT		EXT and INT	
	<i>N</i>	<i>M (SD)</i>	<i>N</i>	<i>M (SD)</i>	<i>N</i>	<i>M (SD)</i>
Anger	58	46.34 (12.72)	27	50.20 (13.70)	31	42.97 (10.94)
Disgust	56	57.52 (15.89)	23	55.54 (17.20)	33	58.89 (15.02)
Fear	47	53.58 (11.67)	22	51.46 (9.52)	25	55.45 (13.18)
Happiness	61	42.55 (11.49)	28	43.05 (11.90)	33	42.12 (11.30)
Sadness	60	42.89 (12.69)	28	40.72 (11.87)	32	44.75 (13.26)
Surprise	57	43.01 (11.40)	26	44.26 (12.39)	31	41.96 (10.59)

Note. Latency = the latency percentage for correct responses; EXT = externalizing disorders; INT = internalizing disorders.

Follow-up univariate ANOVAs with comorbidity as grouping factor and emotion recognition latency were conducted to explore specific differences. A significant effect of comorbidity on emotion recognition latency for anger was found, $F(1, 34) = 5.50$, $p = .025$, d

= .58. Adolescents with externalizing and internalizing disorders were significantly faster in recognizing angry facial expressions ($M = 44.09$, $SD = 9.16$) than those with externalizing disorders only ($M = 48.92$, $SD = 13.79$). There were no significant effects of comorbidity on emotion recognition latency for the other emotions, namely disgust, $F(1, 34) = 0.26$, $p = .611$, fear, $F(1, 34) = 0.25$, $p = .618$, happiness, $F(1, 34) = 0.25$, $p = .622$, sadness, $F(1, 34) = 0.22$, $p = .643$, and surprise, $F(1, 34) = 0.40$, $p = .532$.

Discussion

The present study was the first to examine the role of trauma in the association between (comorbid) psychopathology and emotion recognition. Unexpectedly, there was no difference found in overall emotion recognition accuracy or latency between adolescents with externalizing disorders and a history of trauma, compared to those without a history of trauma. These findings differ from those of previous studies, in which children and adolescents who were abused and neglected in their past performed worse on emotion recognition tasks than controls (Leist & Dadds, 2009; Pollak et al., 2000; Pollak & Sinha, 2002).

It might truly be the case that there are no differences in emotion recognition abilities for this specific group. Perhaps trauma does not play a role in emotion recognition for adolescents who have externalizing disorders, because the overall prevalence of trauma is higher in this population compared to community samples (e.g., Jennings, Piquero, & Reingle, 2012; Wilson et al., 2013), that are most often used in the existing literature on the consequences of childhood trauma. For instance, in the present sample, the majority of participants (73.77%) indicated that they experienced something really bad in their past, such as a fire, a dangerous accident, or an attack by someone (as indicated on the MINI-KID; Jonker et al., 2010). A comparison with a large community sample of male adults between 18 and 24 years old ($n = 460$; Scher et al., 2001) shows that the present sample had higher and more varied overall trauma scores (regardless of comorbidity) than the community sample.

More specifically, the present sample had higher mean scores for all subscales of the CTQ than the community sample, especially for the subscale Emotional Neglect. However, note that it is unknown whether these are significant differences and that there is an age difference between the two groups. Therefore, because of high levels of both childhood trauma and externalizing problems in the present population, it seems difficult to distinguish the possible differences in emotion recognition due to either trauma or externalizing disorders.

Nonetheless, the type of maltreatment seems to influence the ability to recognize specific emotions as well. Whereas physical abuse is associated with better recognition of anger, physical neglect is associated with difficulties in discriminating between emotional expressions (Pollak et al., 2000; Pollak & Sinha, 2002). It is possible that those types of maltreatment have counteracting effects, as appeared to be the case for the combination of specific disorders, namely conduct disorder and anxiety disorders, in the study by Short et al. (2016). Potentially, these differences and counteracting effects exist for different types of trauma as well, but could not be revealed due to the aggregation of the different trauma types. Future research could investigate these specific effects for distinct trauma types and emotions in a similar population and elucidate the present findings.

Furthermore, there was no influence of comorbid internalizing disorders on the relationship between trauma and overall emotion recognition accuracy or latency in adolescents with externalizing disorders. In other words, adolescents with externalizing disorders and a history of trauma who also suffered from a comorbid internalizing disorder performed similarly on an emotion recognition task as those who did not suffer from a comorbid internalizing disorder. Given the inconclusive findings regarding internalizing problems and emotion recognition, no specific hypothesis had been formulated for this research question.

The present results provide partial support for the findings of the review by Bourke et al. (2010), in which it was concluded that there is limited evidence of reduced general or

emotion-specific recognition accuracy in major depression. However, a later meta-analysis of emotion recognition in depression by Dalili et al. (2015) showed an impairment in the recognition of all basic emotions except for sadness. As regards anxiety disorders, a recent systematic review described that some authors have found that children and adolescents with anxiety disorders are more likely to make errors in recognizing emotional facial expressions, whereas others have found that these children and adolescents have a greater attentional bias towards fearful or angry expressions (Collin et al., 2013). Thus, the association between internalizing problems and emotion recognition remains elusive because of the previous conflicting findings. The present outcomes add to the earlier results by showing no evidence of general emotion recognition deficits in adolescents with comorbid internalizing problems and externalizing problems, compared to those with externalizing problems only, even when trauma is taken into account as well. Future studies might disentangle these inconclusive findings by examining specific combinations of externalizing and internalizing disorders for distinct emotions.

As for those specific emotions, only significant results regarding the recognition of anger were discovered in the present study. It was found that adolescents with externalizing and internalizing disorders were significantly faster in correctly recognizing facial expressions of anger, compared to adolescents with externalizing disorders only. This result is partly in line with what was found by Leist and Dadds (2009), namely that emotional problems were associated with better recognition of specifically sadness and anger, whereas antisocial behavior was related to better recognition of fearful facial expressions. However, Leist and Dadds (2009) examined emotion recognition accuracy, whereas the present finding was based on emotion recognition latency. Furthermore, adolescents with antisocial behavior and emotional problems (excluding those that pose as serious risk of harm to self or others) were compared with a community sample in their study, whereas the present study specifically compared adolescents with externalizing disorders and those with comorbid

internalizing disorders (both admitted to residential youth care facilities for behavioral problems). Therefore, the present results show that the distinct association between emotional problems and enhanced recognition of anger is also found in adolescents with externalizing disorders, even though that only seems to apply to recognition speed in this population.

This finding is also partly in agreement with a previous study showing a negative and aggressive attentional bias in adolescents with antisocial behavior (Cima, Vancleef, Lobbestael, Meesters, & Korebrits, 2014). According to Crick and Dodge (1994), aggressive behavior emerges from a tendency to interpret other people's intentions as negative, aggressive and hostile. This tendency could explain why adolescents with externalizing disorders outperform those without behavioral problems in the fast and accurate recognition of angry facial expressions. However, since a negative interpretation bias is associated with CU traits, especially in delinquent adolescents (Cima et al., 2014), one would expect this to hold true in adolescents with externalizing disorders particularly, as opposed to those with comorbid internalizing problems. Future studies should examine whether comorbid internalizing problems are related to a negative attentional bias in adolescents with externalizing problems to clarify the present findings.

The present study has several strengths and limitations. A notable strength of the study is the reliability and validity of the used instruments. Both the MINI-KID, used to assess psychopathology, and the CTQ, used to measure childhood trauma, have strong psychometric properties in both clinical and community samples (Duncan et al., 2017; Scher et al., 2001). The DARE, used to assess emotion recognition, has shown good concordance in cross-validation tests in the past (Shenk et al., 2013). Thus, the present findings are based on a methodologically sound foundation. Furthermore, the use of both accuracy and latency scores to assess emotion recognition skills made it possible to describe the speed with which emotions were correctly recognized, whereas most previous studies solely described the emotion recognition accuracy. Real-life emotion recognition should occur at high speed,

since some emotional expressions appear and disappear quickly (micro expressions; Ekman, 2003). Thus, including latency scores provided a more comprehensive picture of emotion recognition skills in adolescents with externalizing disorders. Last, the sample that was included in the present study is unique within the research on this topic. The use of this clinical sample, with high levels of externalizing problems, was suitable to answer the research questions that were central to this study.

An important limitation of this study is the use of aggregated scores for trauma and comorbidity. Since previous research has emphasized that emotion recognition abilities differ depending on the type of emotion, trauma, and disorder, it is possible that specific differences in adolescents' emotion recognition abilities are not revealed in the present study due to this aggregation. However, the sample size and consequently, the power of the present study was not sufficient to conduct the amount of analyses necessary to examine the specific types of childhood trauma. Future studies could further disentangle the present findings by exploring interactions between specific types of emotions, trauma, and disorders on emotion recognition abilities in a larger sample of adolescents. Moreover, the current study lacked a control group. Therefore, no statements can be made about significant differences between the present clinical population, adolescents with externalizing disorders living in residential youth care, and the general population. Whether emotion recognition abilities significantly differ between these two groups when childhood trauma and comorbidity is taken into account, remains to be investigated by future studies. Lastly, only boys were included in this study. Although externalizing symptoms are more prevalent in boys than girls (Keiley et al., 2003), generalization of the present findings to adolescent girls with externalizing disorders is inadvisable, since past research found gender differences in emotion recognition abilities (Hall & Matsumoto, 2004). To overcome this limitation, future research should include both genders when investigating comorbidity, trauma, and emotion recognition abilities in adolescents.

Irrespective of these limitations, this study has several implications. The present study is the first to examine the role of different types of trauma in the association between (comorbid) psychopathology and emotion recognition. By examining emotion recognition for externalizing and internalizing problems in general, the findings of this study clarify past findings from a broader perspective, and could thus provide a theoretical foundation for research on specific disorders. Furthermore, by further demonstrating the complexity and inconsistencies in the existing literature, the need for future research on specific trauma types and their interaction with specific disorders on emotion recognition abilities of adolescents is illustrated. Since past research has shown that strengthening social skills, of which emotion recognition is an important part, is associated with a decrease in both externalizing and internalizing problems (Leist & Dadds, 2009), providing a scientific foundation for future interventions for those who are in need of them, is an important matter.

In conclusion, the present study found no difference in overall emotion recognition accuracy or latency between adolescents with externalizing disorders and a history of trauma, compared to those without a history of trauma. Furthermore, there was no influence of comorbid internalizing disorders on the relationship between trauma and overall emotion recognition accuracy or latency in adolescents with externalizing disorders. As for specific emotions, it was found that adolescents with externalizing and internalizing disorders were significantly faster in correctly recognizing facial expressions of anger, compared to adolescents with externalizing disorders only, therewith partly replicating previous findings on the distinct association between emotional problems and enhanced recognition of anger. The present study could form a theoretical foundation for research on specific disorders and trauma types by describing emotion recognition for externalizing and internalizing problems, as well as childhood maltreatment in general. Therefore, the findings of this study clarify past findings from a broader perspective. However, these also illustrate the need for future

research on specific trauma types and their interaction with specific disorders on emotion recognition abilities of adolescents.

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