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# Recognition of facial emotion and affective prosody in children at high risk of criminal behaviour

Lisette van Zonneveld <sup>1,2</sup>, Leo de Sonneville <sup>1,2</sup>, Stephanie van Goozen <sup>1,3</sup>, and Hanna Swaab <sup>1,2</sup>

<sup>1</sup> Clinical Neurodevelopmental Sciences, Leiden University, the Netherlands

<sup>2</sup> Leiden Institute for Brain and Cognition, Leiden, the Netherlands

<sup>3</sup> School of Psychology, Cardiff University, Cardiff, United Kingdom

## Correspondence

Lisette van Zonneveld

Faculty of Social and Behavioural Sciences

PO Box 9555

2300 RB Leiden, the Netherlands

Phone: 0031715276043

Fax: n/a

E-mail: e.m.van.zonneveld@fsw.leidenuniv.nl

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### **Abstract**

**Objective:** Emotion recognition is an important aspect of emotion processing which is needed for appropriate social behaviour and normal socialization. Previous studies in adults with Antisocial Personality Disorder or psychopathy, in those convicted of criminal behaviour, or in children with Conduct Disorder show impairments in negative emotion recognition. The present study investigated affective facial and prosody recognition in a sample of children at high risk of developing future criminal behaviour. **Methods:** Participants were 8- to 12-year-old children at high risk of developing criminal behaviour ( $N=219$ , 83.1% boys) and typically developing controls ( $N=43$ , 72.1% boys). The high-risk children were recruited through an ongoing early intervention project of the city of Amsterdam, that focuses on the underage siblings or children of delinquents, and those failing to attend school. Facial and vocal recognition of happy, sad, angry and fear were measured with the Facial Emotion Recognition (FER) test and the Prosody test of the Amsterdam Neuropsychological Tasks (ANT), respectively. **Results:** The high-risk group was significantly worse in facial affect recognition, and had particular problems with fear and sadness recognition. No hostile attribution bias was found. The high-risk group did not differ from controls in affective prosody recognition, but needed significantly more time to recognize emotions. **Conclusions:** The emotion-specific deficits found in forensic and clinical populations are already present in a sample of children at high risk of developing future criminal behaviour. These findings help to understand a possible underlying mechanism of antisocial behaviour that could provide directions for tailored interventions.

**Keywords;** criminality, antisocial behaviour, emotion recognition, facial affect, affective prosody, high-risk

## **Introduction**

Large cities such as Amsterdam in the Netherlands are confronted by serious criminal problems caused by groups of severe and persistent juvenile offenders, who come from families, which frequently operate off the radar from health, educational and social services. While these children might have behavioural problems, they often have no diagnosis because they have not seen a mental health professional, nor do their families actively seek help from social services or clinicians, which substantially increases the risk of an unfavourable social developmental trajectory (Farrington, Piquero, & Jennings, 2013; Loeber & Stouthamer-Loeber, 1998). The Preventive Intervention Trajectory (PIT) is a project of the municipality of the city of Amsterdam that targets young children who are at risk of future criminal behaviour (for details, see Van Zonneveld, Platje, de Sonnevile, van Goozen, & Swaab, 2017). The motivation behind the project is to get this group on the radar to obtain insight into their socio-emotional functioning in order to prevent antisocial development in an effort to take a generation out of crime.

To understand socio-emotional functioning it is crucial to investigate how social stimuli are processed (Corden, Critchley, Skuse, & Dolan, 2006). In a recent study with the same population of high risk children evidence was found for impaired affective empathy but intact social attention and cognitive empathy (Van Zonneveld et al., 2017). Emotion recognition is another important aspect of emotion processing. Evidence has been found that impairments in emotion processing contribute to behavioural and social problems in at-risk children (Izard et al., 2001). Emotion recognition is particularly crucial when it comes to engaging in social behaviour: it is fundamental for normal social interaction and socialization (Blair, Colledge, Murray, & Mitchell, 2001; Montagne et al., 2005). The aim of the present study was to examine the role of emotion recognition in children at high risk of developing future criminal behaviour, which may serve as an underlying mechanism of antisocial behaviour. It is proposed that aggression or antisocial behaviour is the result of an inability to be led by the social cues of others (Blair, 2003; Montagne et al., 2005). This assumption is supported by the Integrated Emotion System (IES) model of Blair (2005). The IES model explains that aversive stimuli, such as expressions of fear and sadness, serve as social reinforcements and that individuals who do not recognize these cues cannot take advantage of these cues to adapt their behaviour in a socially

appropriate manner (Blair, 2005; Blair, 2003; Marsh & Blair, 2008). Adequate recognition of fear and sadness evokes empathy and inhibits aggressive and/or antisocial behaviour (Marsh, Adams Jr, & Kleck, 2005; Marsh & Blair, 2008), whereas someone will continue with behaviour that causes distress when that individual is unable to recognize distress in others (Hubble, Bowen, Moore, & van Goozen, 2015). One of the best-replicated findings is the inability to recognize fear and sadness in facial expressions across populations of children and (early) adolescents presenting with behavioural problems (Blair & Coles, 2000; Schwenck et al., 2014; Walker & Leister, 1994), Conduct Disorder (CD) (Fairchild, Stobbe, van Goozen, Calder, & Goodyer, 2010; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009; Martin-Key, Graf, Adams, & Fairchild; Sully, Sonuga-Barke, & Fairchild, 2015), psychopathic tendencies (Blair et al., 2001; Montagne et al., 2005; Stevens, Charman, & Blair, 2001), young offenders (Bowen, Morgan, Moore, & van Goozen, 2014; Carr & Lutjemeier, 2005; Hubble et al., 2015), or callous/ unemotional (CU) traits (Dadds et al., 2006; Leist & Dadds, 2009; Woodworth & Waschbusch, 2008). Székely et al. (2014) found that preschoolers with externalizing problem behaviour were generally less skilled in emotion recognition, but did not find any emotion-specific deficits. The current study extends the current literature by investigating facial affect recognition in a non-clinical sample of children who are at risk of future antisocial or criminal behaviour.

Another phenomenon, with respect to facial affect recognition is the hostile attribution bias which has been linked to aggression and antisocial behaviour (De Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). Individuals who have a hostile attribution bias attribute hostile intent to others when the stimulus or situation is actually neutral or ambiguous (De Castro et al., 2002; Dodge, 2006; Schönenberg & Jusyte, 2014). Research into this phenomenon in children is scarce (see review, Mellentin, Dervisevic, Stenager, Pilegaard, & Kirk, 2015). The result of a study which used ambiguous stimuli showed that antisocial children were less skilled in interpreting neutral faces and often misinterpret them as anger (Dadds et al., 2006). In the current study the existence of a hostile attribution bias was investigated using neutral faces to find out whether at-risk children interpret these faces in a negative way.

In contrast to facial affect recognition, affective prosody recognition is an understudied area of research in antisocial or aggressive populations, and research seems to be limited to the study of children or adults with psychopathic tendencies. From a meta-analysis by Dawel, O’Kearney, McKone, and Palermo (2012) it appears that affective prosody recognition in psychopathic individuals is impaired in positive as well as negative emotions. However, in one of these studies in boys with psychopathic tendencies impairments in sadness recognition were observed (Stevens et al., 2001), whereas another of these studies found impairments in fear recognition (Blair, Budhani, Colledge, & Scott, 2005).

The main aim of the present study was to investigate facial affect and affective prosody recognition in children at high risk of developing future criminal behaviour. In line with previous research (Bowen et al., 2014; Dawel et al., 2012; Marsh & Blair, 2008), we predicted that high-risk children would have impaired facial affect and prosody recognition, and show specific impairments in fear and sadness recognition. We also predicted a hostile attribution bias in response to neutral faces compared to typical control children (Mellentin et al., 2015).

## **Methods**

### **Participants**

Data were gathered from children recruited through the Preventive Intervention Trajectory. This is a large ongoing project of the municipality of the city of Amsterdam, the Netherlands. Participants were the underage siblings of young offenders, children of delinquent parents ( $N=45$ , familial high-risk) or children who fail at school due to severe unauthorized absenteeism (e.g. truancy) or because of extreme antisocial behaviour ( $N=174$ , school high-risk). The total sample consisted of 262 participants (213 boys and 49 girls) with a mean age of 10.46 years ( $SD=1.34$ ). The high-risk group consisted of 219 participants (182 boys and 37 girls) with a mean age of 10.49 years ( $SD=1.35$ ). The control group ( $N=43$ ; 31 boys and 12 girls; mean age of 10.27 years [ $SD=1.29$ ]) was recruited through the same schools that were attended by the participants in the high-risk group which make them a representative group. The Dutch version of the Teacher Report Form (TRF; Achenbach & Rescorla, 2001; Verhulst, Van der Ende, & Koot, 1997) was used to confirm risk status of the participants and to include children into the study; all participants in the high-risk group scored in the borderline or clinical range on the aggression and/or

rule breaking behaviour scales ( $t$ -score $\geq 65$ ); and their average internalizing problem behaviour score was in the normal range. All participants in the control group scored on average within the normal range on all problem scales ( $t$ -score $< 65$ ). The Dutch version of the Child Behaviour Checklist (CBCL; Achenbach & Rescorla, 2001; Verhulst, Van der Ende, & Koot, 1996) was used to identify the problem behaviour reported by the parents of the high-risk group.

Children were eligible to participate if they were between 8 and 13 years old and spoke and understood the Dutch language. No exclusion criteria were used. Written informed consent was obtained from the parents and from the children if they were 12 years or older. Ethical approval for this study was obtained from Leiden University's Education and Child Studies Ethics Committee.

### **Procedure**

Following informed consent, an appointment was made at school, where the tests were administered following a standard protocol. All participants were individually assessed in a quiet room. The assessors were two trained graduate students under supervision of a clinical investigator (LvZ).

### **Instruments**

**Facial emotion recognition.** Facial emotion recognition was assessed with the Facial Emotion Recognition (FER) test (for details, see Bowen et al., 2014). This computerized task consists of 108 slides presented on a laptop, displaying facial expressions. Six target faces, three male and three female, were used. Each target displayed a neutral expression or one of six basic emotions (happy, sad, anger, fear, disgust or surprise). The intensity of the emotional expression varies between 25%, 50%, 75% or 100%, because they are morphed with their corresponding neutral expression (0% intensity). The question "What emotion is this person showing?" accompanies the target face, along with numbered and labelled options. Percentage correct recognition scores (accuracy) was calculated for each emotion at every intensity.

**Affective prosody recognition.** Affective prosody recognition was assessed with the subtest "Prosody" of the computerized test battery Amsterdam Neuropsychological Tasks (ANT; De Sonneville, 1999, 2014; Oerlemans et al., 2014). This test consists of 48 sentences of neutral content

(12 for each basic emotion: happy, sad, anger, fear; 6 spoken by a male and 6 spoken by a female), and presented through a headphone. The original material, used in previous studies (Van Rijn et al., 2007; Van Rijn et al., 2005), consisted of 24 sentences which are presented twice in random order to obtain more observations. Sentences were spoken with a happy, sad, angry or frightened intonation. The participants were asked to verbally (into a microphone) identify the emotion expressed in the sentence spoken. Reaction times of the correct responses were recorded using a voice-key response. The mean reaction time (speed) and percentage correct recognition scores (accuracy) were calculated for each emotion.

**Intellectual functioning.** Intellectual functioning was assessed with the Dutch version of the Wechsler Intelligence Scale for Children (WISC-III; Kort et al., 2005). Two subtests, Block Design (perceptual organization skills) and Vocabulary (verbal skills), were used to estimate full scale IQ (FSIQ; Campbell, 1998).

### **Statistical analyses**

There were no outliers or violations of statistical assumptions. Facial emotion recognition data were not available for five participants (high-risk group) and affective prosody recognition data were not available for two participants (high-risk group) due to time restrictions. For another 11 participants (high-risk group) one or more of the mean reaction times on the prosody test could not be calculated because they did all 12 trials of one emotion wrong. For these 11 participants, the accuracy data were available. A priori, the high-risk group and control groups were compared on age, sex, estimated FSIQ, Vocabulary, Block Design and the different TRF scales. Since estimated FSIQ was significantly different between the groups, correlations with affective facial and prosody recognition were computed, resulting in three significant but small correlations ( $.19 < r < .26$ ) out of 12. Repeating the analyses with estimated FSIQ as covariate resulted in two non-significant effects of the covariate and one significant effect but in this case the outcome did not change. These results and based on arguments by Dennis et al. (2009) we decided not to include estimated FSIQ as covariate in subsequent analyses. We have examined whether there was a differential relationship between estimates of verbal and nonverbal ability



(Vocabulary and Block Design) between groups as well as whether the nonverbal measure related to the facial and prosody scores. Furthermore, preliminary analyses revealed that the 25% intensity recognition and the emotions disgust and surprise of FER were too difficult for this age group and we decided to exclude these from our analyses. Because we were interested in specific emotion recognition and not in emotion specific intensity recognition, we calculated a mean emotion recognition score for each of the four emotions across the three intensities (50%, 75% and 100%). Next, we performed three two-way repeated measures analyses of variance (RM-ANOVAs) to investigate differences between groups in facial affect and affective prosody recognition. Mean reaction times and percentage correct were calculated for Emotion (happiness, sadness, fear, anger) as within-subjects' factors and Group as between-subjects' factor. Post hoc group differences by emotions were examined in case of a significant interaction effect. Two RM-ANOVAs were performed to examine the distribution of the selected emotions in case the target emotion was not recognized, for facial as well as vocal affect recognition. Emotion (target emotion) and Confusion type as within-subjects' factors and Group as between-subjects factor were used. The existence of a hostile attribution bias was examined with a t-test by using the responses when neutral was the target emotion. Because antisocial behaviour is notoriously heterogeneous post hoc analyses were performed to compare control participants, familial high-risk and school high-risk participants. Effect sizes were calculated using partial eta squared ( $\eta_p^2$ ) with  $\eta_p^2 \sim .03$  representing a small effect,  $\eta_p^2 \sim .06$  representing a moderate effect, and  $\eta_p^2 \sim .14$  a large effect (Cohen, 1992).

## Results

### Descriptive statistics

Descriptive data for sex, age, estimated FSIQ, and the different scales of the TRF are shown in Table 1. The high-risk and control groups did not differ in age or sex. However, the high-risk group had a significantly lower estimated FSIQ and scored lower on Vocabulary and Block Design but group differences were independent of subtest. Furthermore, the nonverbal measure was not significantly correlated to the facial and prosody scores. Lastly, the high-risk group scored significantly higher on the different TRF scales (Table 1). As expected, parents of the high-risk group reported less problem

behaviour on the CBCL ( $M_{\text{aggression}}=59.31, SD=8.53; M_{\text{rule-breaking}}=58.19, SD=7.05$ ) compared to teachers for aggression ( $t(1,215)=18.47, p<.001, d=1.7$ ) and rule-breaking behaviour ( $t(1,215)=19.74, p<.001, d=1.7$ ).

[INSERT TABLE 1 HERE]

### Facial emotion recognition

The results showed a significant main effect of Group ( $F(1,255)=9.37, p=.002, \eta_p^2=.035$ ), of Emotion ( $F(3,765)=187.32, p<.001, \eta_p^2=.423$ ), and a significant Emotion by Group interaction ( $F(3,765)=2.82, p=.038, \eta_p^2=.011$ ). As shown in Figure 1, Panel A, the results indicate that the high-risk group generally performed less accurate compared to the control group, that there were clear differences between the emotions in recognition rates, and that the high-risk group performed particularly worse compared to the control group with respect to sadness and fear (significant interaction, confirmed by post hoc analyses,  $p\leq.003$ ). In case the target emotion was not recognized, the groups did not differ in distribution of the errors across the non-target emotions ( $p=.484$ ).

### Hostile attribution bias

No group difference in neutral recognition was found; the high-risk and control group also did not differ in the number of times they misattributed a neutral face for another emotion, see Table 2.

[INSERT TABLE 2 HERE]

### Affective prosody recognition

Regarding accuracy, no Group effect ( $p=.124$ ) was found. The results show a significant main effect of Emotion ( $F(3,774)=234.84, p<.001, \eta_p^2=.477$ ), indicating that both groups were less accurate in sadness and especially fear recognition (see Figure 1, Panel B). There was no Emotion by Group interaction ( $p=.536$ ). In case the target emotion was not recognized, the groups did not differ in the distribution of errors across the non-target emotions ( $p=.364$ ). In terms of speed, a significant effect of Group ( $F(1,247)=4.43, p=.036, \eta_p^2=.018$ ) and Emotion ( $F(3,741)=50.84, p<.001, \eta_p^2=.171$ ) was found, but

there was no Emotion by Group interaction ( $p=.117$ ). These results indicate that the high-risk group responded significantly slower across emotions compared to the control group, see Figure 1, Panel C.

[INSERT FIGURE 1 HERE]

The comparisons between the control participants, familial high-risk and school high-risk participants are shown in Table 3. The results indicate that the school group and the familial group do not differ from each other on both tasks. In case the familial and school group differ from the control group, effect sizes were comparable. On Prosody (speed) the school group differed from the control participants, while the familial group versus the control group did not differ ( $p=.176$ ), although effect sizes were of similar magnitude.

[INSERT TABLE 3]

### **Discussion**

The aim of the present study was to examine evidence for weaknesses in facial and vocal emotion recognition in a sample of children at high risk of future criminal behaviour. Emotion recognition is an important underlying mechanism of emotion processing and related to social interaction and socialization (Blair et al., 2001; Montagne et al., 2005). The present study is embedded within the PIT project that targets children with behavioural problems who often have no diagnosis or whose families do not actively seek help. It is of great importance to examine emotion recognition in these children, because their behaviour is characterized by inappropriate social behaviour, including problems with social interaction. Early intervention may prevent these children from developing in an antisocial way and protect society from its detrimental effects (Van Goozen, 2015). The results of the study indicate that the high-risk group performed less accurately in facial affect recognition, in particular fear and sadness recognition, while they performed equally accurate in affective prosody recognition, although they needed significantly more time than controls to correctly identify these emotions. No hostile attribution bias was found.

The present findings are consistent with previous research showing impaired fear and sadness recognition in populations of children and (early) adolescents with CD, high levels of psychopathic tendencies, and young offenders (e.g., Blair & Coles, 2000; Dadds et al., 2006; Fairchild et al., 2009; Hubble et al., 2015). The results of the present study strongly suggest that children who are at high risk of developing criminal behaviour because they are the underage siblings or children of delinquents and those failing primary school, exhibit emotion-specific deficits in facial emotion recognition that could impair their prosocial development leading to future antisocial behaviour. Recognition of others' emotions is learned through experience and based on the gradual refinement with age of children's production and recognition of emotional signals (van Goozen, 2015). Caregivers play a substantial role in developing their child's emotion recognition proficiency. The influence of parenting on the development of emotion recognition may help to explain why children who show aggressive and antisocial behaviour have emotion recognition impairments (Bowen et al., 2014). Poor parenting is a known risk factor in the development of aggressive behaviour, affecting - among others - emotional appraisal processes and predisposing children to attribute hostile intent (Dishion, French, & Patterson, 1995; Nelson & Coyne, 2009). These results underpin the importance of early detection of at-risk children in order to provide tailored interventions to prevent them from drifting towards a criminal career (Van Goozen & Fairchild, 2008).

In the literature, explanations for the emotion-specific impairments can be found in the IES model of Blair (2005). Fear and sadness should serve as social reinforcements leading to appropriate social behaviour and evoking empathy (Marsh et al., 2005; Marsh & Blair, 2008). The current findings, together with the earlier reported impairments in affective empathy (Van Zonneveld et al., 2017), help to explain problems in socio-emotional functioning in these children. The high-risk group appears to have problems with empathizing and experiencing others' negative emotions, but they are also less able to recognize the distress-related emotions in others. When a child does not empathize and recognize the distress of another caused by their behaviour it is likely that they will not be able to adapt their behaviour (Marsh & Blair, 2008).

In contrast to our hypothesis, the results showed no hostile attribution bias. The high-risk group and the control group did not differ in the number of times they misinterpret a neutral face as angry. Although the literature on this phenomenon in children is scarce, previous studies have linked this bias to aggression and antisocial behaviour (De Castro et al., 2002). A plausible explanation for the absence of a hostile attribution bias might be ascribed to the different methods used across studies. For example, some studies used videos, others vignettes, or morphed faces from one emotion to another (De Castro et al., 2002). In our study, we used neutral faces and emotions were morphed with their corresponding neutral face. Because of this method we were able to differentiate between neutral faces and emotional ones. Another possible explanation is the existence of a publication bias, since non-significant results happen to be underreported in the literature. Future studies in this area need to examine this issue further in a range of high-risk groups.

To the authors' knowledge, this is the first study that examined affective prosody recognition in a group at high risk of future criminal behaviour. Although in previous studies impairments in sadness and fear recognition were found in populations of children with psychopathic tendencies (Blair et al., 2005; Stevens et al., 2001), the present study found that both the high-risk group and control group showed significant difficulties in the vocal recognition of sadness and fear, but only the high-risk group needed significantly more time to accurately recognize emotions in voices. Social situations are complex in nature; they often involve implicit information and are dynamic, fast and expire under time pressure. Since social communication often develops in a time frame, the delay in emotion recognition might compromise the possibility of these children to effectively adjust their behaviour, which results in difficulties with social interaction.

This study has some limitations that should be addressed. It would have been worthwhile to differentiate within the high-risk group using a measure of CU-traits, and explore the effect of CU traits on affect recognition. We did not include a measure of CU-traits, or any other self-report measures, due to time limitations related to testing in schools, but future studies should aim to do this. Another limitation is the heterogeneity in our sample which makes it more difficult to generalize to the general population. For instance, the small amount of girls in our sample, especially in the control group, makes

it difficult to examine the possible influence of sex in our sample. Also, the participants are recruited in two ways, one group had also a familial risk factor. Nevertheless, a post-hoc analyses between the “familial” and “school” risk groups resulted in non-significant outcomes on the variables of interest.

For the clinical practice the results clearly indicate a need for early screening and a focus on training of emotion recognition skills. The current study adds to knowledge about the characteristics of antisocial behaviour by finding emotion-specific recognition impairments in children with externalizing behaviour problems at high risk of developing future criminal behaviour. Research challenges the notion that high-risk children *inevitably* mature into adult offenders, thereby raising the possibility that well-targeted treatments could create a turning-point in the development of antisocial behaviour in high-risk children. The period between childhood and early adolescence is a time when children are particularly receptive to social and emotional learning. This provides a natural opportunity to promote prosocial development in high-risk children and creates a window of opportunity for intervention. Emotion recognition training programs are beginning to show reductions in antisocial behaviour in samples of young offenders (Hubble et al., 2015).

### **Conclusion**

This study found emotion-specific impairments in facial emotion recognition, particularly fear and sadness recognition, but intact affective prosody recognition in a sample of children considered to be at high risk of future criminal behaviour, even though they needed significantly more time to recognize the vocal emotions, compared to control children. These findings may partly explain the problems they experience with social communication which is frequently reflected in the occurrence of inadequate behaviour. There are currently interventions available that target these impairments and strengthen emotion recognition skills. For now, more research is needed to investigate whether these well-targeted treatments can create a turning-point in the development of antisocial behaviour in high-risk juveniles.

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### References

- Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the ASEBA School-Age Forms & Profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, and Families.
- Blair, R. (2005). Applying a cognitive neuroscience perspective to the disorder of psychopathy. *Development and Psychopathology*, 17(3), 865-891. doi: 10.1017/S0954579405050418
- Blair, R. J. R. (2003). Neurobiological basis of psychopathy. *The British Journal of Psychiatry*, 182(1), 5-7. doi: 10.1192/bjp.182.1.5
- Blair, R. J. R., Budhani, S., Colledge, E., & Scott, S. (2005). Deafness to fear in boys with psychopathic tendencies. *Journal of Child Psychology and Psychiatry*, 46(3), 327-336. doi: 10.1111/j.1469-7610.2004.00356.x
- Blair, R. J. R., & Coles, M. (2000). Expression recognition and behavioural problems in early adolescence. *Cognitive Development*, 15(4), 421-434. doi: [https://doi.org/10.1016/S0885-2014\(01\)00039-9](https://doi.org/10.1016/S0885-2014(01)00039-9)
- Blair, R. J. R., Colledge, E., Murray, L., & Mitchell, D. G. V. (2001). A Selective Impairment in the Processing of Sad and Fearful Expressions in Children with Psychopathic Tendencies. *Journal of Abnormal Child Psychology*, 29(6), 491-498. doi: 10.1023/a:1012225108281

- Bowen, K. L., Morgan, J. E., Moore, S. C., & van Goozen, S. H. (2014). Young offenders' emotion recognition dysfunction across emotion intensities: explaining variation using psychopathic traits, conduct disorder and offense severity. *Journal of Psychopathology and Behavioral Assessment*, 36(1), 60-73.
- Campbell, J. M. (1998). Internal and external validity of seven Wechsler Intelligence Scale for Children - Third Edition short forms in a sample of inpatients. *Psychological Assessment*, 10, 431-434.
- Carr, M., & Lutjemeier, J. (2005). The relation of facial affect recognition and empathy to delinquency in youth offenders. *Adolescence*, 40(159).
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155.
- Corden, B., Critchley, H. D., Skuse, D., & Dolan, R. J. (2006). Fear Recognition Ability Predicts Differences in Social Cognitive and Neural Functioning in Men. *Journal of Cognitive Neuroscience*, 18(6), 889-897. doi: 10.1162/jocn.2006.18.6.889
- Dadds, M. R., Perry, Y., Hawes, D. J., Merz, S., Riddell, A. C., Haines, D. J., . . . Abeygunawardane, A. I. (2006). Attention to the eyes and fear-recognition deficits in child psychopathy. *The British Journal of Psychiatry*, 189(3), 280-281.
- Dawel, A., O'Kearney, R., McKone, E., & Palermo, R. (2012). Not just fear and sadness: Meta-analytic evidence of pervasive emotion recognition deficits for facial and vocal expressions in psychopathy. *Neuroscience & Biobehavioral Reviews*, 36(10), 2288-2304. doi: <https://doi.org/10.1016/j.neubiorev.2012.08.006>
- De Castro, B. O., Veerman, J. W., Koops, W., Bosch, J. D., & Monshouwer, H. J. (2002). Hostile Attribution of Intent and Aggressive Behavior: A Meta-Analysis. *Child Development*, 73(3), 916-934. doi: 10.1111/1467-8624.00447
- De Sonnevile, L. M. J. (1999). Amsterdam Neuropsychological Tasks: A computer-aided assessment program. *Computers in psychology*, 6, 187-203.
- De Sonnevile, L. M. J. (2014). *Handboek ANT: Amsterdamse Neuropsychologische Taken*. Amsterdam: Boom Test Uitgevers.



- Dennis, M., Francis, D. J., Cirino, P. T., Schachar, R., Barnes, M. A., & Fletcher, J. M. (2009). Why IQ is not a covariate in cognitive studies of neurodevelopmental disorders. *Journal of the International Neuropsychological Society*, 15(3), 331-343.
- Dishion, T. J., French, D. C., & Patterson, G. R. (1995). The development and ecology of antisocial behavior. In D. Cicchetti & D. J. Cohen (Eds.), *Wiley series on personality processes. Developmental psychopathology, Vol. 2. Risk, disorder, and adaptation* (pp. 421-471). Oxford, England: John Wiley.
- Dodge, K. A. (2006). Translational science in action: Hostile attributional style and the development of aggressive behavior problems. *Development and Psychopathology*, 18(3), 791-814. doi: 10.1017/S0954579406060391
- Fairchild, G., Stobbe, Y., van Goozen, S. H. M., Calder, A. J., & Goodyer, I. M. (2010). Facial Expression Recognition, Fear Conditioning, and Startle Modulation in Female Subjects with Conduct Disorder. *Biological Psychiatry*, 68(3), 272-279. doi: 10.1016/j.biopsych.2010.02.019
- Fairchild, G., Van Goozen, S. H. M., Calder, A. J., Stollery, S. J., & Goodyer, I. M. (2009). Deficits in facial expression recognition in male adolescents with early-onset or adolescence-onset conduct disorder. *Journal of Child Psychology and Psychiatry*, 50(5), 627-636. doi: 10.1111/j.1469-7610.2008.02020.x
- Farrington, D., Piquero, A. R., & Jennings, W. G. (2013). *Offending from childhood to late middle age: Recent results from the Cambridge study in delinquent development*. New York: Springer Science & Business Media.
- Hubble, K., Bowen, K. L., Moore, S. C., & van Goozen, S. H. M. (2015). Improving Negative Emotion Recognition in Young Offenders Reduces Subsequent Crime. *PLoS ONE*, 10(6), e0132035. doi: 10.1371/journal.pone.0132035
- Izard, C., Fine, S., Schultz, D., Mostow, A., Ackerman, B., & Youngstrom, E. (2001). Emotion Knowledge as a Predictor of Social Behavior and Academic Competence in Children at Risk. *Psychological Science*, 12(1), 18-23. doi: 10.1111/1467-9280.00304

- Kort, W., Schittekatte, M., Dekker, P. H., Verhaeghe, P., Compaan, E. L., Bosmans, M., & Vermeir, G. (2005). *Handleiding en verantwoording WISC-III<sup>NL</sup>*. London: Pearson Assessment.
- Leist, T., & Dadds, M. R. (2009). Adolescents' Ability to Read Different Emotional Faces Relates to their History of Maltreatment and Type of Psychopathology. *Clinical Child Psychology and Psychiatry*, 14(2), 237-250. doi: 10.1177/1359104508100887
- Loeber, R., & Stouthamer-Loeber, M. (1998). Development of juvenile aggression and violence - Some common misconceptions and controversies. *American Psychologist*, 53(2), 242-259. doi: 10.1037//0003-066x.53.2.242
- Marsh, A. A., Adams Jr, R. B., & Kleck, R. E. (2005). Why Do Fear and Anger Look the Way They Do? Form and Social Function in Facial Expressions. *Personality and Social Psychology Bulletin*, 31(1), 73-86. doi: 10.1177/0146167204271306
- Marsh, A. A., & Blair, R. J. R. (2008). Deficits in facial affect recognition among antisocial populations: a meta-analysis. *Neuroscience & Biobehavioral Reviews*, 32(3), 454-465.
- Martin-Key, N. A., Graf, E. W., Adams, W. J., & Fairchild, G. Facial emotion recognition and eye movement behaviour in conduct disorder. *Journal of Child Psychology and Psychiatry*, n/a-n/a. doi: 10.1111/jcpp.12795
- Mellentin, A. I., Dervisevic, A., Stenager, E., Pilegaard, M., & Kirk, U. (2015). Seeing enemies? A systematic review of anger bias in the perception of facial expressions among anger-prone and aggressive populations. *Aggression and Violent Behavior*, 25(Part B), 373-383. doi: <https://doi.org/10.1016/j.avb.2015.09.001>
- Montagne, B., van Honk, J., Kessels, R. P. C., Frigerio, E., Burt, M., van Zandvoort, M. J. E., . . . de Haan, E. H. F. (2005). Reduced efficiency in recognising fear in subjects scoring high on psychopathic personality characteristics. *Personality and Individual Differences*, 38(1), 5-11. doi: <https://doi.org/10.1016/j.paid.2004.02.008>
- Nelson, D. A., & Coyne, S. M. (2009). Children's intent attributions and feelings of distress: associations with maternal and paternal parenting practices. *Journal of Abnormal Child Psychology*, 37(2), 223-237. doi: 10.1007/s10802-008-9271-3

- Oerlemans, A. M., Van der Meer, J. M., Van Steijn, D. J., De Ruiter, S. W., De Bruijn, Y. G., De Sonnevile, L. M., . . . Rommelse, N. N. (2014). Recognition of facial emotion and affective prosody in children with ASD (+ ADHD) and their unaffected siblings. *European Child & Adolescent Psychiatry*, 23(5), 257-271.
- Schönenberg, M., & Jusyte, A. (2014). Investigation of the hostile attribution bias toward ambiguous facial cues in antisocial violent offenders. *European Archives of Psychiatry and Clinical Neuroscience*, 264(1), 61-69. doi: 10.1007/s00406-013-0440-1
- Schwenck, C., Gensthaler, A., Romanos, M., Freitag, C. M., Schneider, W., & Taurines, R. (2014). Emotion recognition in girls with conduct problems. *European Child & Adolescent Psychiatry*, 23(1), 13-22. doi: 10.1007/s00787-013-0416-8
- Stevens, D., Charman, T., & Blair, R. J. R. (2001). Recognition of Emotion in Facial Expressions and Vocal Tones in Children With Psychopathic Tendencies. *The Journal of Genetic Psychology*, 162(2), 201-211. doi: 10.1080/00221320109597961
- Sully, K., Sonuga-Barke, E. J. S., & Fairchild, G. (2015). The familial basis of facial emotion recognition deficits in adolescents with conduct disorder and their unaffected relatives. *Psychological Medicine*, 45(9), 1965-1975. doi: 10.1017/S0033291714003080
- Székely, E., Tiemeier, H., Jaddoe, V. W. V., Hofman, A., Verhulst, F. C., & Herba, C. M. (2014). Associations of Internalizing and Externalizing Problems with Facial Expression Recognition in Preschoolers: The Generation R Study. *Social Development*, 23(3), 611-630. doi: 10.1111/sode.12070
- Van Goozen, S. H., & Fairchild, G. (2008). How can the study of biological processes help design new interventions for children with severe antisocial behavior? *Development and Psychopathology*, 20(03), 941-973. doi: doi:10.1017/S095457940800045X
- Van Goozen, S. H. M. (2015). The Role of Early Emotion Impairments in the Development of Persistent Antisocial Behavior. *Child Development Perspectives*, 9(4), 206-210.
- Van Rijn, S., Aleman, A., Swaab, H., Krijn, T., Vingerhoets, G. U. Y., & Kahn, R. S. (2007). What it is said versus how it is said: Comprehension of affective prosody in men with Klinefelter

- (47,XXY) syndrome. *Journal of the International Neuropsychological Society*, 13(6), 1065-1070. doi: 10.1017/S1355617707071044
- Van Rijn, S., Aleman, A., Van Diessen, E., Berckmoes, C., Vingerhoets, G., & Kahn, R. S. (2005). What is said or how it is said makes a difference: role of the right fronto-parietal operculum in emotional prosody as revealed by repetitive TMS. *European Journal of Neuroscience*, 21(11), 3195-3200. doi: 10.1111/j.1460-9568.2005.04130.x
- Van Zonneveld, L., Platje, E., de Sonnevile, L., van Goozen, S., & Swaab, H. (2017). Affective empathy, cognitive empathy and social attention in children at high risk of criminal behaviour. *Journal of Child Psychology and Psychiatry*, 58(8), 913-921. doi: 10.1111/jcpp.12724
- Verhulst, F. C., Van der Ende, J., & Koot, H. M. (1996). *Handleiding voor de CBCL/ 4-18 [Manual for the Child Behavior Checklist]*. Rotterdam: Afdeling Kinder- en Jeugdpsychiatrie, Sophia Kinderziekenhuis, Erasmus MC.
- Verhulst, F. C., Van der Ende, J., & Koot, H. M. (1997). *Handleiding voor de Teachers' Report Form [Manual for the Teachers' Report Form]*. Rotterdam, The Netherlands: Afdeling Kinder- en Jeugdpsychiatrie, Sophia Kinderziekenhuis, Erasmus MC.
- Walker, D. W., & Leister, C. (1994). Recognition of Facial Affect Cues by Adolescents with Emotional and Behavioral Disorders. *Behavioral Disorders*, 19(4), 269-276. doi: 10.1177/019874299401900408
- Woodworth, M., & Waschbusch, D. (2008). Emotional processing in children with conduct problems and callous/unemotional traits. *Child: Care, Health and Development*, 34(2), 234-244. doi: 10.1111/j.1365-2214.2007.00792.x