Exploring Links between Neuroticism and Psychoticism Personality Traits, Attentional Biases to Threat and Friendship Quality in 9-11-year-olds

Katerina Pavlou[1], Valerie Benson[2] and Julie A. Hadwin[1*]

[1]Developmental Brain-Behaviour Laboratory

[2]Centre for Vision and Cognition

Department of Psychology

University of Southampton

Southampton

SO17 1BJ

*Corresponding author: jah7@soton.ac.uk

1

Abstract

The current study used an eye-movement paradigm to explore associations between personality traits (neuroticism and psychoticism) attention to threat, and self-reported friendship quality in children aged 9-11 years. To explore attention, we asked children to look at and identify a target presented on a computer display in the presence or absence of a central, parafoveal or peripheral visual distractor (an angry, happy or neutral face). The results showed that symptoms of neuroticism were associated with hypervigilance for threat (i.e., slower latencies to initiate eye movements to the target in the presence of angry versus happy or neutral faces). They indicated that this relationship was most evident in children who reported lower levels of attentional control. Psychoticism traits were associated with increased selective attention to all face distractors (as measured by directional errors) and to child reported lower friendship quality. Moreover, the negative relationship between psychoticism and friendship characteristics associated with companionship was mediated via attentional capture of threat (i.e., a greater proportion of directional errors to angry distractors). The findings have potential to inform the development of translational research to reduce symptoms of psychopathology and address attentional biases to threat to improve peer relationships in late childhood.

Keywords: anxiety; personality; attention biases; friendship quality

Exploring Links between Neuroticism and Psychoticism Personality Traits, Attentional

Biases to Threat and Friendship Quality in 9-11-year-olds

Temperament reflects biologically based and relatively stable individual differences

in reactivity and regulation in behaviour, emotion and attention (Rothbart, 2011, p.10). For

example, behavioural inhibition (BI) is a temperamental trait characterised by low levels of

effortful control (associated with a reduced ability to focus attention to complete tasks and to

inhibit attention to irrelevant events), and increased negative arousal and fearfulness in the

context of novelty (Kagan & Fox, 2006; Rettew, 2008). BI is suggested to be a precursor for

later personality traits linked to elevated negative affect and neuroticism (Lonigan, Phillips,

Wilson & Allan, 2011). Neuroticism is a personality dimension associated with individuals

who experience increased levels of negative emotional states and sensitivity to environmental

stress, that sits alongside psychoticism (that describes individuals with low levels of empathy

and altruism and increased aggression) and extraversion (associated with traits linked to

being outgoing and friendly; see Eysenck, 1982). While increased neuroticism traits are

considered to place individuals at increased risk for the developmental of anxiety in

development (Lonigan et al., 2011, Paulus, Vanwoerden, Norton & Sharp, 2016),

psychoticism traits have been associated with the emergence of externalizing behaviours

(e.g., elevated symptoms of aggression, arguing, school absence; Center, Jackson & Kemp,

2005).

Children with elevated neuroticism and associated internalising traits have been

characterised as have a smaller numbers of reciprocal friendships and fewer opportunities to

receive help and guidance from friends (Erath, Flanagan, & Bierman, 2007; Fanti,

Brookmeyer, Henrich,& Kuperrminc, 2009;. review by Hay, Payne & Chadwick, 2004).

Further research has found that anxiety-related traits are also linked to increased social

wariness (Schneider, 1999) and hypersensitivity to peer rejection (Kujawa, Arfer, Klein &

Proudfit, 2014). Consistently, extreme levels of inhibited behaviour early in childhood were found to predict a distinct developmental pathway leading to delays in forming romantic relationships and partnerships in emerging adulthood (Asendorpf, Denissen & van Aken 2008). Similarly, increased aggression associated with psychoticism traits and externalising behaviors have also been related to social adjustment difficulties in development, such as increased levels of bullying (Farmer et al., 2015), peer rejection, isolation and loneliness, and with violence and adult crime in later life (review by Liu, 2004). The association between vulnerable personality traits and developmental psychopathology with social adjustment in childhood and adolescence is likely to be reciprocal. Cascade models have shown, for example, that young children who fail to show social competence are at risk for the development of internalising and externalising behaviour later in development (Bornstein, Hahn & Haynes, 2010).

Increasingly researchers have explored associations between anxiety with attentional control, including selective attention to environmental threat, and developmental outcome (review by Dudeney, Sharpe, & Hunt, 2015). Rueda, Checa and Rothbart (2010) proposed a theoretical framework which suggests that temperamental traits characterised by negative affect and poor effortful control to regulate attentional networks impact social adjustment across development. In support, Simonds and colleagues found that children aged 7 - 10 years of age who showed increased attentional control to inhibit irrelevant information to complete a computer task were also able to more mask feelings of disappointment when they were given a gift they had previously rated as one they would like least from the choice available (Simonds, Kieras, Rueda & Rothbart, 2007). Checa, Rodriguez-Bailon and Reuda (2008) also found that effortful control mediated a positive association between social status in school (i.e., positive responses from peers to questions about whether they were a nice classmate and paid attention/ listened to others) with achievement. With respect to attention

4

to threat, Pérez-Edgar and colleagues (2010, 2011) found that anxiety-related temperament early in development was related to later social withdrawal at 5 years of age and with parent reported social isolation in adolescence and where these associations were most evident for individuals who showed an attentional bias towards threatening stimuli. Related research suggests that good attentional control in childhood and adolescence (Lonigan & Vasey, 2009; Susa, Pitica, Benga, and Miclea, 2012), as well as in adulthood (Derryberry and Reed, 2002), works to minimise the interference of threat stimuli on achieving task goals.

Dodge (2006) similarly developed a psychological model that aimed to understand the emergence of aggression in children and adolescents via the development of selective attention biases to environmental threat. This model builds on early research which has shown that a predisposition to interpret ambiguous or benign social situations as hostile is associated with increased aggression early in development (Gouze, 1987) and predicts aggressive behaviours over time (e.g., Dodge, Pettit & Valente, 1995). Dodge (2006) suggested that the emergence of biases are underpinned by personality traits and develop via socialisation processes (see Piekarska, 2012 for support).

A recent theoretical framework utilized eye movement methodology to build on earlier models of anxiety (e.g., Eysenck, 1987) that differentiate selective attention processes towards threat in anxiety (i.e., the notion of attentional capture), from hypervigilance (i.e., a broadening of attention that facilitates the detection of environmental threat (Richards, Benson, Donnelly & Hadwin, 2014). Richards, Benson and Hadwin (2012) used the remote distractor paradigm (RDP) to explore selective attention and hypervigilance for threat with self-reported trait anxiety in adults. The RDP asks participants to identify the shape of a target stimulus presented in central, parafoveal or peripheral vision. In this study, distractors were presented alongside a threatening (angry faces) or non-threatening (neutral or happy faces) stimulus presented centrally or in the contralateral hemifield to the target. The results

showed that symptoms of anxiety were linked to increased latencies to initiate a first saccade towards a target in the presence of angry (and not happy or neutral) distractor faces located in all regions of the visual field. They also indicated that anxiety was not associated with erroneous eye movements towards threat distractors. The authors argued that that the results indicate that elevated anxious affect is associated with covert processing of parafoveal and peripheral and difficulties disengaging attention from centrally presented threatening stimuli, that interferes with task goals.

The current study utilised the RDP and eye movement measures to consider attentional control and threat processing in primary school aged children who reported individual differences in neuroticism and psychoticism personality traits. Following Richards et al., (2012), we anticipated that neuroticism would be associated with delayed saccade latencies towards the target in the presence of angry faces and would support the notion that hypervigilance for threat emerges in childhood. The attentional focus on hostility highlighted in previous research (review by Dodge, 2006) suggests that increased psychoticism traits would be linked to a selective attention bias for threat (i.e., directional errors towards angry faces). The study extended current research to explore the potential of a moderating role of attentional control in understanding the emergence of cognitive biases in development, specifically linked to anxiety related constructs (see e.g., Susa et al., 2012). In addition, following Rueda et al., (2010), it considered the relationship between attention processes and friendship quality in childhood. We anticipated that temperamental risk would be related to poor quality friendships (Fanti et al., 2009) and we investigated the proposition that attentional processes would be important in understanding this association (e.g., Pérez-Edgar et al., 2010; 2011).

Method

Participants

We invited 55 children to take part in the study and obtained parental consent for $N =$ 42 (75%; mean age = 10.40 years, SD = .54, age range = 9-11 years; 25 male). Children provided their written assent to take part in the study on the day of testing. Participants were given a £5 voucher for their participation on the completion of the study. Ethical permission for the study was obtained from the Psychology Ethics' Committee and University Research Governance.

Stimuli and apparatus

Participants completed three experimental blocks each with 144 trials; one for each facial expression (angry, happy, neutral)[1]. Each block included 48 single target trials (used as a measure of baseline performance) and 96 emotion face distractor trials presented in central parafoveal or peripheral locations. On each experimental trial we asked participants to identify a target stimulus, a white diamond or square. The size of the target stimuli was 59 x 59 pixels (1.5° x 1.5° of visual angle) at a viewing distance of 70 cm. In the single-target trials, the target appeared in a parafoveal (4° eccentricity) or peripheral (8° eccentricity) location on the right or left of central fixation with equal frequency. In trials containing parafoveal or peripheral distractors the targets appeared in the mirror position of the distractor. If a distractor was presented in the center, then the target appeared either in a parafoveal or peripheral position.

Sixteen models (8 males and 8 females) from the NimStim face set (Tottenham et al., 2009) were used as distractor stimuli and these included emotional (angry and happy) and non-emotional (neutral) faces. Four additional models were used for practice blocks. Faces were 165 x 256 pixels in size or 4.2° horizontally and 6.5° vertically at 70 cm viewing distance. Response buttons and experimental blocks were counterbalanced. Stimuli were presented on a black background. We used the Eyelink 1000 (1000 sampler per second)

---

[1] A fourth experimental block used white circles as distractor stimuli; this data is not reported in the current paper.

Desk Mount eye-tracking system (SR Research Ltd.) to record participants' right-eye vertical

and horizontal eye-movements.

Materials[2]

Neuroticism and psychoticism. These two personality traits were measured with the

Junior Eysenck Personality Inventory (Eysenck, & Eysenck, 1975) which consists of 81 items.

For each item children are asked to respond yes or no depending on whether they think the

item describes them. In the current study we used the neuroticism (n = 20 items, total score

0-20, e.g., "Do you worry about awful things that might happen?", "Do you find it hard to

sleep at night because you are worrying about things?") and psychoticism (n = 14 items,

score range = 0-14, e.g., "Do you seem to get into a lot of fights?", "Are you in more trouble

at school than most children?") subscales. Twenty four percent of the sample reported levels

of neuroticism and psychoticism that were above published norms (Eysenck, & Eysenck,

1975). Previous research has found that the scale has good reliability and validity (e.g.,

Scholte & De Bruyn, 2001). In the current study α = .80 and α = .60 for the neuroticism and

psychoticism scales respectively[3].

Attentional control. We assessed attentional control with the child version of the

Attentional Control Scale (ACS; Derryberry & Reed, 2002). The scale consists of 20 items

to assess children's ability to focus and switch attention. For each item participants are asked

to judge whether they "almost never" (score 1), "sometimes", "often" or "always" (score 4)

show a particular behaviour, making a possible score range from 20 to 80, where higher

scores indicate poorer attentional control. Previous research has found that the ACS-C is

reliable and valid (e.g., e.g., Muris, 2006; and *α* = .85 in the current study).

---

[2] Participants also completed measures of state and trait anxiety; these data are not reported in the current paper.

[3] Note that reliability for the Psychoticism scale is low, but for this age range the score is comparable with the internal consistency as reported in the original reports of its psychometric properties (αs = .65, .73 and .65 for 9-, 10-, and 11-year-olds; see Eysenck & Eysenck, 1975.)

Friendship quality. We assessed quality of friendships with the Friendship Quality

Scale (FQS, Bukowski, Hoza & Boivin, 1994). This scale consists of 23 items and for each

children are asked to indicate "strongly agree" (score = 1), "agree", "neither agree nor

disagree", "disagree" or strongly disagree (score = 5). The original scale is made up five

subscales reflecting companionship (4 items), help (5 items), closeness (5 items), security (5

items) and conflict (4 items). The total score range on this questionnaire is 23 to 115 and

higher scores indicate poorer quality friendships. While the current study focused on the total

score, exploratory analysis also considered associations between the subscale scores with key

variables. Previous research has reported good psychometric properties for the FQS

(Bukowski et al., 1994; and $\alpha = .79$ in the current paper).

Procedure

The aim of the study was explained to each child prior to completing the eye

movement task, and children were given the opportunity to ask questions before signing an

assent form. The task response and equipment use was explained to each child before

starting. A nine-point-calibration routine was performed prior to each experimental block to

measure the position of the eye at different locations on the display screen, and a small one-

point-calibration was used between trials within each block to correct for drifts before each

trial. Each trial began with a centrally-located fixation cross, presented on a black

background, which participants had to fixate. The fixation cross was presented for a

minimum duration of 1000 milliseconds (ms) and participants had to look within 1.5 degree

of the centre of the cross for at least 200ms. The fixation cross was then replaced with a trial

display that contained either a single target or a target and a distractor. The trial display was

presented for 1500 ms or until a key-press response was made (see Figure 1). Participants

were instructed to direct their eyes towards and identify a target (a square or a diamond) as

quickly and accurately as possible. The questionnaire measures were completed in groups of four children within a week following completion of the eye-tracking task.

Data Analysis

The eye movement measures of interest were the percentage of directional errors (i.e. first saccades towards the distractor of any type or eccentricity with an amplitude greater than 2°) and the latency of accurate first saccades (i.e. first saccades directed towards the target with an amplitude greater than 2°). Trials were excluded from the eye movement analysis if the fixation point at the beginning of the trial was greater than 1° away from the center of the screen, if a blink occurred or if an anticipatory eye movement was executed (first saccades with latencies less than 80 ms (Wenban-Smith & Findlay, 1991) 4). In addition, we removed trials where the latency of the first saccade was more than 3 standard deviations away from the participant's mean first saccade latency. First saccades with amplitude less than 1° were also replaced with second saccades.

Data analysis considered the basic effects related to the RDP (i.e., time taken to make an eye movement to the target in distractor versus single target trials). Repeated measures ANOVAs were conducted to assess the effects of distractor condition (i.e. present or absent), distractor type (i.e. angry, happy and neutral faces) and distractor eccentricity (central, parafoveal, peripheral) on behavioural reaction time (RT) and eye movement measures across participants. Correlations and regression analysis considered links between individual difference measures (i.e. neuroticism, psychoticism, and attentional control) with eye movement measures and friendship quality. The eye movement measures were initially collapsed across eccentricities for each distractor condition separately and any significant findings were followed up with further analyses to see whether effects were evident across the different eccentricities. Models were tested to explore whether any positive association between neuroticism and task performance was moderated by attentional control. In addition,

mediation analysis aimed to test the proposition that temperamental risk was related to poor

quality friendships and that attentional processing of threat is important in understanding

these basic associations. Moderating and mediating effects were tested using a process that

applies bootstrapping techniques (Hayes, 2013).

Results

Eye movement measures

      Saccade latencies and the remote distractor effect (RDE). For each distractor

condition and eccentricity the latencies of first saccades to the target in the distractor trials

were compared with the saccade latencies towards the target in the single-target trials from

the same experimental block (e.g. angry central distractor trials were compared with single

target trials embedded within the angry block etc.). First saccade latencies were found to be

shorter in the single-target trials compared with the distractor trials (i.e. a remote distractor

effect occurred; see Walker et al., 1995), and this was evident across all distractor conditions

and eccentricities (all ts > 8, all ps < .001). Thus, first saccade latencies to the target were

delayed by the presence of distractors regardless as to whether the distractor was located in

the central, parafoveal or peripheral vision[4].

      Saccade latencies to the target. A repeated measures ANOVA for 3 distractor

expression (angry, happy, neutral) x 3 distractor eccentricity (central, parafoveal, peripheral)

was conducted on the latency of accurate first saccades to the target (means for each emotion

and eccentricity are shown in Table 1). The results revealed a significant main effect of

eccentricity (F (2, 66) = 18.92, η_p^2 = .36, p < .001). Pairwise comparisons showed that first

saccade latencies to the target were significantly longer in central distractor trials (M =

---

[4] A one-way ANOVA (with single target trials only) was also conducted to assess whether any distractor effects
were carried over in the single-target trials embedded within each experimental block. The results revealed that
first saccade latencies to the target did not differ significantly attween the single-target trials in each
experimental block (Angry M = 161.17 ms, SD = 24.84 ; Happy M = 166.75 ms, SD = 29.88 ; Neutral M =
168.51, SD = 32.10).

232.14 ms, SD = 32.36) compared with parafoveal distractor trials (M = 220.91 ms, SD =31.02) and peripheral distractor trials (M =214.93 ms, SD = 28.92), suggesting that distractors located in foveal vision interfered more with performance, compared with distractors located in peripheral regions of the visual field. In addition, saccade latencies to the target were significantly longer in parafoveal trials compared to peripheral distractor trials. The main effect of emotion and the interaction between emotion and eccentricity was not significant (Fs < 2 and ps > .1).

Directional errors. The mean proportion of directional errors made to the distractor stimuli for each emotion and in each eccentricity (parafoveal and peripheral) is shown in Table 1. Consideration of the data distribution revealed that that error rates were negatively skewed in all distractor conditions, therefore non-parametric tests were used to assess whether distractor type and eccentricity influenced directional error rates. The Wilcoxon signed ranks test showed significant error rate differences between the parafoveal and the peripheral distractor trials in all distractor conditions (in parafoveal angry, happy and neutral trials Mdns were 27.59%, 19.35% and 17.24% respectively; and in peripheral angry, happy and neutral Mdns were 40%, 31.25% and 32.26%). A Friedman's ANOVA was used to assess whether the emotion of the face distractor (angry, happy or neutral face) influenced directional error rates (for parafoveal and peripheral trials separately).

The results revealed that error rates differed significantly between distractor conditions in parafoveal distractor trials (χ^2 (2) = 33.24, p < .001) and peripheral distractor trials (χ^2 (2) = 20.30, p < .001). In parafoveal trials, non-parametric post-hoc tests showed that the error rate was significantly greater in angry distractor trials compared with neutral distractor trials (χ^2 (2) = 4.57, p = .03). Differences in error rates for angry versus happy and happy versus neutral distractor trials were not significant (χ^2 (2) < 3, ps > .05). In peripheral trials, the error rate was marginally significantly higher in the angry distractor condition

12

compared with the happy distractor condition (χ^2 (2) = 3.67, p = .05) and the neutral

distractor condition (χ^2 (2) = 4.00, p = .05). The difference between the error rate for the

happy versus the neutral distractor condition was not significant (χ^2 (2) = .26, p = .61).

Reaction time data. A repeated measures ANOVA was conducted to explore

whether distractor emotion or eccentricity influenced the total time taken to identify the target,

and the results showed a main effect of eccentricity (F (2, 80) =9.98, p < .001). Pairwise

comparisons showed that RTs were significantly longer in peripheral distractor trials (M =

876.18 ms, SD = 159.95) compared with parafoveal distractor trials (M = 848.26 ms, SD =

162.16). In addition, RTs were marginally significantly longer in central distractor trials (M

= 859.21 ms, SD = 162.16) compared with parafoveal distractor trials. The main effect of

emotion and the interaction between emotion and eccentricity were not significant (F < 1.5,

ns. See Table 1)[5].

Task performance and individual differences[6]

Saccade onset latencies. The mean score (and SD) for each questionnaire measure is

shown in Table 2. Table 2 also shows correlations between each questionnaire with both of

the key eye movement measures (directional errors and saccade onset latencies for angry,

happy and neutral distractors). It highlights that self-reported symptoms of neuroticism was

positively associated with saccade onset latencies for angry and neutral faces and this

association was significant at all distractor eccentricities. We further considered whether the

relationship between neuroticism and saccade onset to angry faces (for four models collapsed

across distractor location and for each location separately) was moderated via attentional

control (complete data was available for N = 33 participants).

---

[5] In order to assess whether the presence of a distractor influenced the total time taken to make a response in single target trials within each block. Comparing RTs in distractor trials (for each distractor condition and eccentricity separately) with those in the single target trials distractor block) showed that these were significantly longer in angry peripheral trials compared with single target trials (t = 3.24, p = .002). There were no other significant differences (*ts* < 2, *ns*).

[6] Reaction time data was not significantly associated with any individual difference measure (in all cases p >.1) and is therefore not reported further in this section.

The models that explored the moderating effect of attentional control on the relationship between neuroticism traits and increased saccade onset latencies to the target showed non-significant interaction effects for parafoveal and peripheral distractor locations, as well as for all locations combined (in all cases $p > .1$). The interaction effect between neuroticism and attentional control for centrally presented angry faces was marginally significant ($b = .65$, 95% CI [-.012 – 1.31], t = 2.00, $p = .054$). Because of this borderline effect and the theoretical significance of this result we examined simple slopes. This analysis highlighted that at lower levels of attentional control, there was a significant positive association between saccade onset latencies with neuroticism ($b = 3.28$, 95% CI [0.734 – 5.82], t = 2.63, $p = .013$ and $b = 6.09$, 95% CI [1.91 – 10.28], t = 2.97, $p = .006$). In contrast the model for this relationship and when attentional control was high was not significant ($t < 1$ and $p > .1$); see Figure 2. This analysis provides preliminary evidence for a moderating role of attentional control in understanding associations between anxiety related personality traits and difficulties disengaging from threat stimuli to meet task goals.

Directional errors. With respect to directional errors, Table 2 shows that the personality trait psychoticism was positively associated with directional error to all face distractor stimuli. In addition, the table highlights that directional errors to angry faces was associated with reports of lower quality friendships ($r = .39$, $p = .018$). Further analysis showed that psychoticism was also significantly associated with lower quality friendships ($r = .47$, $p < .01$). Moreover, the relationship between psychoticism traits and friendship was evident for the help, security and conflict subscales (rs > .35, ps < .05) and was marginally linked to companionship ($r = .28$, p = .08) (closeness ns). Similarly, directional errors to angry faces was linked to the companionship and security subscales (rs > .3 and ps <.05).

Friendship quality was associated with both directional errors to angry faces and to psychoticism traits (to poorer quality friendship, as well as to subscales linked to

14

companionship and security), we therefore tested the possibility across three models that selective attention to threat mediated the association between personality and friendship quality (for total scores, as well as those associated with companionship and security). In all models friendship quality (total score, companionship and security subscale scores) was entered as the outcome variable. Considering the indirect effect of psychoticism on friendship quality (via directional errors), the analysis showed a significant effect only for the companionship subscale (b = .15, CI [.004 - .484]; see Figure 3. This analysis highlighted that the association between self-reported psychoticism traits and lower levels of companionship was mediated via directional errors to angry faces presented in parafoveal and peripheral vision.

Discussion

The RDP requires participants to ignore distractor stimuli to identify a target stimulus presented in parafoveal or peripheral vision (review by Richards et al., 2014). We utilised threat and non-threat distractor stimuli to explore the relationship between attentional processes and friendship quality with individual differences in neuroticism and psychoticism personality traits. The results showed basic RDP effects in children aged 9-11 years, and further indicated that angry faces presented in peripheral vision increased directional errors to these stimuli and reaction times to make decisions about the target identity. With respect to individual differences, increased neuroticism traits were linked to hypervigilance for threat; children showed a delay in making a saccade to move their eyes towards a target stimulus in the presence of angry faces and across all distractor eccentricities. In addition, this association was most evident for children with low levels of attentional control (children's self-reported ability to focus and shift attention between tasks) in trials that required the disengagement of attention from centrally presented angry faces towards the target. The results also showed that psychoticism traits were positively linked to distractibility; more eye

movements towards emotional and non-emotional face distractors. Furthermore, psychoticism (and not neuroticism) traits were associated with self-reported poor quality friendships, reflecting increased conflict and lower levels of feeling secure, and being able to rely on friends for help and companionship (see Bukowski et al., 1991). Moreover, the negative association between psychoticism and companionship was mediated by increased selective attention (i.e., directional errors) to threat stimuli.

These results are consistent with previous findings with adults to highlight that eye movement methods can more reliably identify associations between individual differences and cognitive processes in childhood (Richards et al., 2012). They also replicate Richards et al.'s findings that anxious affect is linked to hypervigilance for threat (i.e., increased saccade latencies to move eyes towards targets in the context of an angry face; see also Eysenck, 1997) and extend these findings to show that disengaging from threat is most difficult for children who reported increased neuroticism symptoms and low levels of attention control. They fit with a growing body of research with children and adolescents has found that elevated trait and clinical levels of anxiety have been linked to attentional biases towards threat stimuli that interfere with task relevant goals (Hadwin, Donnelly, Richards, French & Patel, 2009; Waters, Mogg, Bradley & Pine, 2011; review by Dudeney, 2015).

Difficulties disengaging attention away from angry faces in children who reported increased neuroticism traits in the current study also links to research with adults using behavioural indices and eye movement methodologies which has found, for example, that elevated anxiety was associated with increased saccade latencies to shift attention away from angry faces (e.g., Fox, Russo & Dutton, 2001; Reinholdt-Dunne et al., 2012). The current study extends this evidence base to highlight that increased time to disengage attention from threat stimuli was only evident for children who reported lower levels of attentional control (for similar moderating effects of attentional control on anxiety and threat processing see also

Lonigan & Phillips, 2009; Susa et al., 2012). This finding is important in the development of translational research that aims to impact poor developmental outcome in children with elevated anxious affect. It suggests that interventions that focus on improving attentional control could attenuate the impact of threat processing on individuals' abilities to meet task goals (see Hadwin & Richards, 2016).

Broadening of attention for the detection of threat was specific in the current study to neuroticism traits. Self-reported psychoticism traits were unrelated to delays in making a saccade towards the target; however, they were positively linked to directional errors to distractors across all emotional stimuli and in parafoveal and peripheral vision, suggesting a general difficulty in supressing exogenous (reflexive) saccades towards both threatening and non-threatening distractors. The study further showed that psychoticism traits were associated with poor quality friendships and that directional errors to threat stimuli were important in understanding this association. Early research used models of social information processing have found biases to hostile social cues in children with aggressive and conduct problems (e.g., Cadesky, Mota & Schachar, 2000) and have argued that this processing style underpins increased aggression across development(Dodge, 2006). In support, the current study highlighted that selective attention to angry faces was important in understanding links positive between psychoticism traits and poor quality friendships as reflected in lowered reports of companionship (e.g., spending time with friends in their spare time). The results fit with previous research which has found that attentional biases to threat are linked to difficulties with social interaction over time (Pérez-Edgar et al., 2010). And they are consistent with theoretical frameworks that focus on attentional processes to understand academic and social outcomes in children and adolescents (Rueda et al., 2010). The findings suggest that children who show early emerging psychoticism traits and attentional biases to threat are at increased risk of reduced opportunities for social development with peers. The

highlight that in this case children might benefit from attention bias modification interventions to improve peer relationships that focus on to training attention away from angry/ hostile cues (review by Lowther & Newman 2014).

In summary, the results from the current study indicate differential attentional processes in late childhood for self-reported neuroticism and psychoticism personality traits that have important implications for the development of prevention and intervention methods in development and psychopathology. Hypervigilance for threat in neuroticism and the moderating effect of attentional control to shift attention away from threat suggest that young people with elevated anxious affect might benefit from attentional training to allow them to effectively meet task goals. In contrast, the significance of selective attention to threat in children with elevated self-reported psychoticism traits in understanding lower quality friendships indicates that interventions aimed to attenuate attentional capture may be important in the development of effective peer relationships. Future research should aim to replicate these findings using more naturalistic measure of peer interactions and to understand the impact of attention on the emergence of anxiety and behavioural difficulties over time.

References

Asendorpf, J.B., Jaap, J.A., Denissen & van Aken, M.A.G. (2008). Inhibited and Aggressive Preschool Children at 23 Years of Age: Personality and Social Transitions into Adulthood. *Developmental Psychology, 44*, 997–1011. DOI: 10.1037/0012-1649.44.4.997.

Bornstein, M. H., Hahn, C., & Haynes, O. M. (2010). Social competence, externalizing and internalizing behavioral adjustment from early childhood through early adolescence: Developmental cascades. *Development and Psychopathology, 22*, 717–735. DOI: 10.1017/S0954579410000416.

Bukowski, W. M., Hoza, B., & Boivin, M. (1991). Measuring friendship quality during pre and early adolescence: the development and psychometric properties of the friendship quality scale. *Journal of Social and Personal Relationships, 11*, 471-484. DOI: 10.1177/0265407594113011.

Cadesky, E. B., Mota, V. L. & Schachar, R. J. (2000). Beyond words: how do children with ADHD and/or conduct problems process nonverbal information about affect? Journal of the *American Academy of Child and Adolescent Psychiatry, 39*, 1160-1167. DOI:10.1097/00004583-200009000-00016

Center, D.B., Jackson, N., Kemp, D. (2005). A test of Eysenck's antisocial behavior hypothesis employing 11–15-year-old students' dichotomous for PEN and L. *Personality and Individual Differences, 38*, 395-402.

Checa, P., Rodriguez-Bailon, R., & Rueda, M. R. (2008). Neurocognitive and temperamental systems of self-regulation and early adolescents' school competence. *Mind, Brain and Education*, 2, 177–187. DOI:0.1111/j.1751-228X.2008.00052.x.

Derryberry D., & Reed M.A. (2002). Anxiety related attentional biases and their regulation by attentional control , *Journal of abnormal psychology*, 111, 225-236. DOI: 10.1037//0021-843X.111.2.225. 225.

Dodge, K.A. (2006). Translational science in action: Hostile attributional style and the development of aggressive behaviour problems. *Developmental Psychopathology, 18*, 3, 791-814. DOI: 10.1017/S0954579406060391.

Dodge, K.A., Pettit, G.S., Bates, J.E. & Valente, E. (1995). Social information-processing patterns partially mediate the effect of early physical abuse on later conduct problems. *Journal of Abnormal Psychology, 104*, 632–643. DOI: 10.1037/0021-43X.104.4.632.

Dudeney, J., Sharpe, L., Hunt, C. (2015). Attentional bias towards threatening stimuli in children with anxiety: A meta-analysis Clinical Psychology Review, 40, 66-75. Doi:10.1016/j.cpr.2015.05.007.

Erath, S. A., Flanagan, K. S., Bierman, K. L. (2007). Social anxiety and peer relations in early adolescence: Behavioural and cognitive factors. *Journal of Abnormal Child Psychology,* 35, 405-416. DOI: 10.1007/s10802-007-9099-2.

Eysenck, H.J. (1982). *Personality, genetics, and behavior: selected papers*. New York: Praeger.

Eysenck H. J. and Eysenck S. B. G. (1975). Manual of the Eysenck Personality Questionnaire. Hodder & Stoughton, London.

Fanti, K.A., Brookmeyer, K.A., Henrich, C.C., and Kuperrminc, G.P. (2009). Aggressive behavior and quality of friendships. *Journal of Early Adolescence*, 29, 826-838. DOI: 10.1177/0272431609332819.

Fox, E., Russo, R., Bowles, R. & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology General, 130*, 681–700. DOI: 10.1037/0096-3445.130.4.681.

Gouze, K.R. (1987). Attention and social problem solving as correlates of aggression in preschool males. *Journal of Abnormal Child Psychology*, 15, 181-197. DOI: 10.1007/BF00916348.

Hadwin, J.A. & Richards, H.J. (2016). Working memory training and CBT reduces anxiety symptoms and attentional biases to threat: A preliminary study. *Front.Psychol.7*:47. DOI: 10.3389/fpsyg.2016.00047.

Hayes, A.F. (2013). *Introduction to mediation, moderation, and conditional process analysis*. The Guilford Press, New York.

Hay, D.F., Payne, A., & Chadwick, A. (2004). Peer relations in childhood. *Journal of Child Psychology and Psychiatry, 45*, 84–108. DOI: 10.1046/j.0021-9630.2003.00308.x.

Kagan, J.; Fox, N.A. (2006). Biology, culture, and temperamental biases. In W. Damon & N. Eisenberg (Eds). *Handbook of child psychology: Social, emotional, and personality development*. New York: Wiley.

Kujawa, A., Arfer, K.B., Klein, D.N. & Proudfit, G.H. (2014). Electrocortical reactivity to social feedback in youth: A pilot study of the Island Getaway task. *Developmental Cognitive Neuroscience, 10*, 140-147. DOI:10.1016/j.dcn.2014.08.008.

Liu, J. (2004). Concept analysis: Aggression. *Issues in Mental Health Nursing, 25*, 693–714. DOI:10.1080/01612840490486755.

Lonigan, C. J., Phillips, B. M., Wilson, S. B., & Allan, N. P. (2011). Temperament and Anxiety in Children and Adolescents. In W. Silverman and A. Field (Eds.). Anxiety Disorders in Children and Adolescents: Research, Assessment, and Intervention. Cambridge: Cambridge University Press.

Lonigan, C.J., & Vasey, M.W. (2009). Negative affectivity, effortful control, and attention to threat-relevant stimuli. Journal of Abnormal Child Psychology, 37, 387-399. DOI: 10.1007/s10802-008-9284-y.

Lowther, H. & Newman,E. (2014). Attention bias modification (ABM) as a treatment for

child and adolescent anxiety: a systematic review. *Journal of Affective Disorders, 168*,

125–135. DOI:10.1016/j.jad.2014.06.051.

Muris, P. (2006). Relation between attention control and school performance in normal

children. *Perceptual and Motor Skills, 102*, 78–80. DOI: 10.2466.PMS.102.1.78-80.

Paulus, D. J., Vanwoerden, S., Norton, P. J., & Sharp, C. (2016). Emotion dysregulation,

psychological inflexibility, and shame as explanatory factors between neuroticism and

depression. *Journal of Affective Disorders, 190*, 376-385.

DOI:10.1016/j.jad.2015.10.014.

Pérez-Edgar, K., Bar-Haim, Y., McDermott, J. M., Chronis-Tuscano, A., Pine, D. S., & Fox,

N. A. (2010). Attention biases to threat and behavioral inhibition in early childhood

shape adolescent social withdrawal. *Emotion*, 10, 349–357. DOI: 10.1037/a0018486.

Pérez-Edgar, K., Reeb-Sutherland, B.C., McDermott, J.M., White, L.K., Henderson, H.A.,

Degnan, K.A., Hane A.A., Pine, D.S. & Fox, N.A. (2011). Attention biases to threat

link behavioral inhibition to social withdrawal over time in very young children.

Journal of Abnormal Child Psychology, 39, 885–895. DOI: 10.1007/s10802-011-

9495-5.

Piekarska, J. (2012). Perceived parental reactions to child's problems and successes and

Eysenckian psychoticism in adolescence. *Personality and Individual Differences, 53*,

523-527. DOI: 10.1016/j.paid.2012.04.028.

Reinholdt-Dunne, M.L., Mogg, K., Benson, V., Bradley, B.P., Hardin, M.G., Liversedge,

S.P., Pine, D.S. & Ernst, M. (2012). Anxiety and Selective Attention to Angry Faces :

An Anti-saccade Study. *European Journal of Cognitive Psychology, 24*, 54-65. DOI:

10.1080/20445911.2011.560111.

Rettew, D.C. (2008). Temperament and child psychopathology. In J.J. Hudziak (Ed).

Developmental psychopathology and wellness. Washington DC and London:

American psychiatric Publishing.

Richards, H. J., Benson, V., & Hadwin, J. A. (2012). The attentional processes underlying

impaired inhibition of threat in anxiety: The remote distractor effect. *Cognition and*

Emotion, 26, 934–942. DOI: 10.1080/02699931.2011.630990

Richards, H.J., Benson, V., Donnelly, N., & Hadwin, J. (2014). Exploring the function of

selective attention and hypervigilance for threat in anxiety. *Clinical Psychology*

Review, 34, 1-23. DOI: 10.1016/j.cpr.2013.10.006.

Rothbart, M.K. (2011). *Becoming who we are*. New York and London: The Guildford Press.

Rueda, M.R., Checa, P., & Rothbart, M.K. (2010). Contributions of attentional control to

socioemotional and academic development. *Early Education and Development*, 21,

744-764. DOI:10.1080/10409289.2010.510055.

Schneider, B. H. (1999). A multimethod exploration of the friendships of children considered

socially withdrawn by their school peers. *Journal of Abnormal Child Psychology*, 27,

115–123. DOI: 10.1023/A:1021959430698.

Scholte, R.H.J. & De Bruyn, E.E.J. (2001). The Revised Junior Eysenck Personality

Questionnaire (JEPQ-R): Dutch replications of the full-length, short, and abbreviated

forms. *Personality and Individual Differences, 31*. 615-625. DOI: 10.1016/S0191-

8869(00)00166-5.

Simonds, J., Kieras, J. E., Rueda, M., & Rothbart, M. K. (2007). Effortful control, executive

attention, and emotional regulation in 7–10-year-old children. *Cognitive Development*,

22, 474–488. DOI: 10.1016/j.cogdev.2007.08.009.

Susa, G., Pitica, I.,Benga, O. & Miclea, M. (2012). The self regulatory effect of attentional

control in modulating the relationship between attentional biases toward threat and

anxiety symptoms in children. *Cognition and Emotion, 26*, 1069–1083. DOI: 10.1080/02699931.2011.638910.

Tottenham, N., Tanaka, J. W., Leon, A. C., McCarry, T., Nurse, M., Hare, T. A. et al. (2009). The NimStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research*, 168, 242-249. DOI: 10.1016/j.psychres.2008.05.006.

Wenban-Smith, M.G, & Findlay, J. M. (1991). Express saccades: Is there a separate population in humans? *Experimental Brain Research*, 87, 218-222. DOI: 10.1007/BF00228523.

Table 1

Mean reaction times (RTs) (SD) and saccade onset latencies (milliseconds) to identify target stimuli and proportion of directional errors to

distractor stimuli to the target stimuli with angry, happy and neutral face distractors and where the target was presented centrally (0°), or in the

parafovea, (4°) or periphery (8°).

Dependent variables	Angry			Happy			Neutral		
	0°	4°	8°	0°	4°	8°	0°	4°	8°
Saccade onset (N = 34)	239.19	221.36	214.72	233.65	223.31	217.84	226.57	218.33	212.77
	(34.19)	(33.82)	(29.14)	(42.31)	(36.78)	(37.01)	(32.74)	(31.37)	(29.77)
Errors (N = 37)	N/A	30.65	39.54	N/A	25.37	34.46	N/A	21.80	32.36
		(21.55)	(23.20)		(20.58)	(21.46)		(19.88)	(22.03)
RTs (N = 40)	878.04	880.21	915.64	855.88	833.66	866.07	841.27	825.76	846.49
	(192.07)	(205.32)	(184.13)	(180.59)	(176.07)	(191.37)	(173.27)	(159.55)	(154.58)

Table note. Directional errors to faces are not relevant to experimental conditions where the distractor is presented centrally.

25

Table 2

Descriptive statistics (mean, standard deviation, range) for neuroticism and psychoticism personality traits, attentional control and friendship

quality and correlations with global eye movement measurements (directional errors to distractor faces and saccade onset latencies to targets)

collapsed across distractor condition.

Questionnaire measures	Descriptive statistics		Directional errors			Saccade onset latency		
	Mean (SD)	Range	Angry	Happy	Neutral	Angry	Happy	Neutral
Neuroticism	9.57 (5.12)	1-20	.11	.06	.00.	.62**	.27	.36*
Psychoticism	3.15 (2.26)	0-8	.34*	.39*	.40*	-.03	-.01	.11
Attentional Control	50.76 (4.22)	42-59	.37*	.18	.22	.018	.052	.012
Friendship Quality	45.37 (9.36)	28-97	.39*	.24	.23	-.09	-.01	.09

Table note. Directional errors are collapsed across parafoveal and peripheral distractor conditions and saccade onset latency is collapsed across centrally presented, parafoveal and peripheral distractor conditions.

26

Figure 1. An example of trial sequence in the Remote Distractor Paradigm (RDP) showing an

angry distractor face and where the target and distractor is presented in the parafovea.
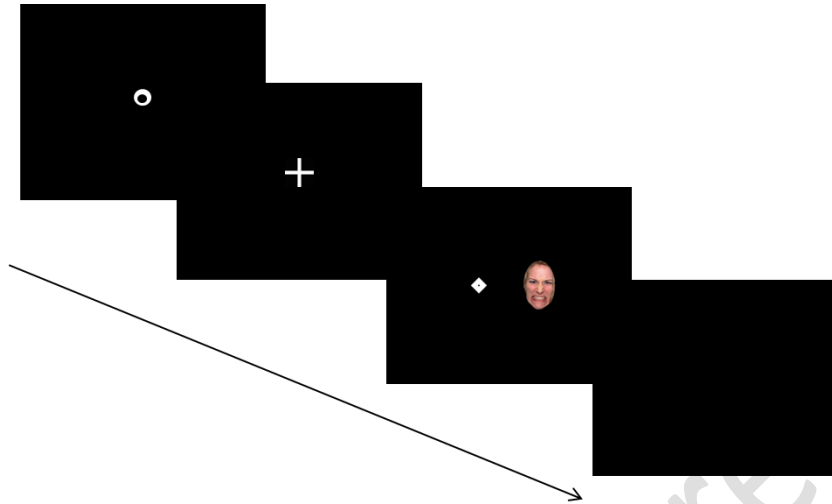
Figure 2. The moderating effect of attentional control (high, medium and low) on the relationship between neuroticism traits and saccade onset latency to the targets presented in the parafoveal or peripheral vision in the context of centrally presented angry faces.
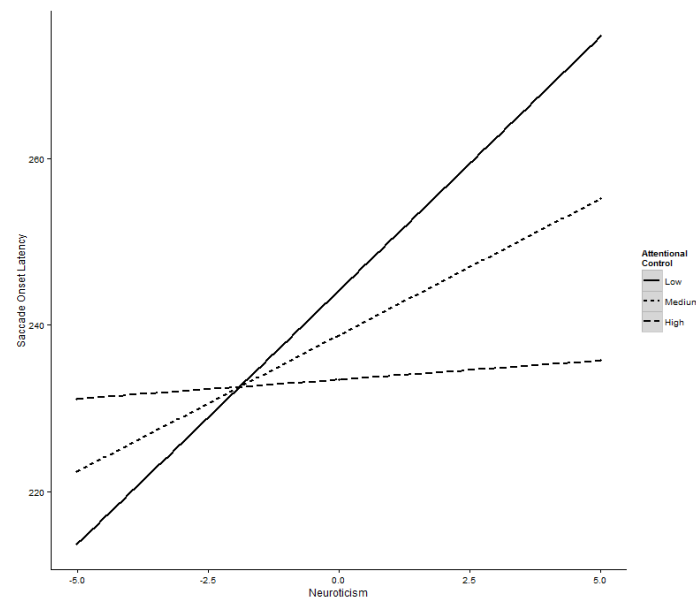
Figure 3

Mediation model demonstrating links between psychoticism personality traits and friendship

quality (companionship) via directional errors towards angry faces.

b = 2.10 , p = .04

$b = 0.07$, $p = .01$

Psychoticism traits

Directional errors towards angry faces

Friendship Quality: Companionship

Direct effect: $b = 0.18$, $p = .33$
Indirect effect: $b = 0.15$, 95 % CI [0.005, 0.407]