Emotional intelligence and attentional bias for threat-related emotion under stress

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Abstract

Emotional intelligence (EI) can buffer potentially harmful effects of situational and chronic stressors to safeguard psychological wellbeing (e.g., Mikolajczak, Petrides, Coumans, & Luminet, 2009), yet understanding how and when EI operates to promote adaptation remains a research priority. We explored whether EI (both trait and ability) modulated early attentional processing of threat-related emotion under conditions of stress. Using a dot probe paradigm, eye movement (fixation to emotive facial stimuli, relative to neutral) and manual reaction time data were collected from 161 adults aged 18–57 years (mean age = 25.24; *SD* = 8.81) exposed to either a stressful (failure task) or non-stressful (control) situation. Whilst emotion management ability and trait wellbeing corresponded to *avoidance* of negative emotion (angry and sad respectively), high trait sociability and emotionality related to a bias *for* negative emotions. With most effects not restricted to stressful conditions, it is unclear whether EI underscores 'adaptive' processing, which carries implications for school-based social and emotional learning programmes.

Keywords: *emotional intelligence; stress; attentional bias; threat; eye movement*

Emotional intelligence (EI) captures individual differences in perceiving, regulating and understanding emotions in others and oneself (Zeidner, Matthews, & Roberts, 2009). EI can be considered a lower-order emotion-related trait (TEI), allied to broadband personality dimensions and measured via self-report (Petrides, Pita, & Kokkinaki, 2007), or an IQ-type ability (AEI) indexed via maximal performance (Mayer, Roberts, & Barsade, 2008). Both TEI/AEI have been linked to adaptive outcomes, particularly psychological adjustment (Martins, Ramalho, & Morin, 2010). However, in order to better understand the 'adaptive' nature of the construct it remains to be established *how* and *when* EI contributes to wellbeing. Commentators have suggested that those with high EI may be better able buffer the effects of stress to safeguard mental health (Zeidner et al., 2009). For TEI, experimental studies of psychological and physiological reactivity to stressors have supported this notion; higher levels relate to minimal mood deterioration, heart rate variation and cortisol release (Laborde, Brüll, Weber, & Anders, 2011; Mikolajczak, Roy, Luminet, Fillée, & de Timary, 2007). The situation is less clear for AEI. Whilst Schneider, Lyons and Khazon (2013) found emotionally skilled individuals better able to maintain their mood, demonstrating 'challenge' vs. 'threat' physiology (increased cardiac activity) throughout a stressful lab session, higher AEI has also been related to an *increase* in post-task distress (Matthews et al., 2006) and slower recovery post social-stressor (cortisol secretion) (Bechtoldt & Schneider, 2016). Thus, whilst differences in stress reactivity as a function of EI are manifest, it is clear that the nature of effects differs according to type of EI.

Differences in stress reactivity could be attributed to early attentional biases for emotional information, moderated by EI. According to theory, biased allocation of attentional resources to emotional content should be a key hallmark of high EI and result in advantageous processing performance e.g., detection and recognition of briefly presented and/or subtle emotional cues (Fiori, 2009). Empirically, AEI has been associated with rapid discrimination of negative emotional faces vs. neutral (Farrelly & Austin, 2007) and with faster decoding of mismatched non-verbal and verbal cues (Jacob et al., 2012), although not selective attention in an affective priming task (Fiori & Antonakis, 2012). TEI relates to faster identification of morphed facial expressions (Petrides & Furnham, 2003) but not efficiency of visual search for emotional faces or identification of micro-expressions (Matthews et al., 2015). Comparison of findings is complicated by variations in task paradigms and attentional processes tapped (e.g., filtering; search etc), and it remains unclear whether EI underscores 'adaptive' attentional processing *in context* i.e., where patterns of processing are expected to vary with environmental demands/stressors leading to 'typical' vs. 'atypical' trends (see e.g., Pessoa, 2009). This is necessary to understand the protective function of EI and why there are differences in stressor reactivity as a function of TEI/AEI.

Attentional selection under stress

Attentional selection of emotion under stressful conditions has been almost exclusively studied in clinical and sub-clinical (i.e., high-level trait vulnerability) populations, commonly employing orienting paradigms (e.g., dot probe task) (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). Key cognitive-level individual difference theories make competing predictions about 'adaptive' attentional selection under conditions of stress. Williams, Watts, MacLeod & Mathews (1988, 1997) argue that those with *low* trait anxiety should show a tendency to divert attention *away* from danger-related information to minimise increases in negative affect. The opposite is predicted for anxiety-prone individuals. These tendencies should become further pronounced with increasing stress. Corroborating studies have found threat-vigilance under conditions of chronic stress in individuals with underlying vulnerability, yet threat-avoidance in those with low trait anxiety (MacLeod & Matthews, 1988; Mogg, Bradley, & Hallowell, 1994). However, Mogg, Mathews, Bird and Macgregor-Morris (1990) found that underlying vulnerability made no difference to preference for threat under situational stress; both high and low trait anxious groups showed a vigilance bias.

Mogg and Bradley (1998) suggest that these patterns of selection can be qualified by the level of threat (state or stimuli). Under lower levels of stress (i.e., mildly stressful environments or aversive stimuli), those with low levels of vulnerability should orient away from threat-related emotion, whilst those with higher vulnerability should orient towards threat. However, with increasing levels of stress, both high and low trait vulnerable individuals should similarly orient *towards* danger-relevant material. This 'graded' attentional selection allows for greater flexibility in adaptive responding, screening out less relevant, low-level emotional information and protecting the appraisal system from switching to the 'hyper-vigilant' state associated with clinical disorders. As the theoretical model that has received most empirical support to date (Koster, Crombez, Verschuere, & De Houwer, 2006; Mogg, McNamara, et al., 2000; Wilson & MacLeod, 2003; Yiend & Mathews, 2001), it has been suggested that adaptive avoidance of danger at lower threat levels, yet vigilance at more severe levels of threat, would represent a 'healthy' selection pattern and could characterize a protective cognitive marker that might be targeted for bias modification work (Yiend, 2009).

EI and attentional selection under stress: The current study

With control for known indicators of vulnerability (i.e., trait neuroticism; anxiety and depression), high scorers on measures of EI (a latent level resource) should represent a 'low-vulnerable' population, permitting researchers to ascertain the relative contribution of EI as a protective resource in early attentional selection. To date, only one study has examined this. Using a dot probe task, Mikolajczak, Roy, Verstrynge and Luminet (2009) found adults with high trait EI (self-control) showed a bias for emotionally valenced words under stressful vs. non-stressful conditions, whilst the reverse was true for those with lower levels of trait EI, suggesting that low trait EI underpins an atypical pattern of attentional selection. Conclusions are however speculative, as a result of methodological shortcomings (e.g., measured response to arbitrary symbols vs. biologically salient faces using a composite 'emotion' index vs. negative or positive words). Additionally, dot probe reaction time data can only provide an indication of attentional deployment *at the time* of probe presentation (i.e., post-stimuli presentation) and with target stimuli typically presented for 500ms, multiple attentional shifts may take place prior to the onset of the probe (Yiend, 2009). One way to address this limitation is to measure eye movements (initial orientation) with the onset of target stimuli. Eye tracker devices offer a fast, reliable and more direct measure of attention through continuous sampling of data, than indirect motor behaviour (i.e., reaction time key press) (Armstrong & Olatunji, 2009).

The current study seeks to extend extant literature by utilizing a facial dot probe paradigm and multiple measures of attentional bias (eye movement and reaction time data) to explore whether EI (trait; ability) moderates early attentional processing for threat-related emotion under situational stress. To recap, the current consensus suggests ‘typical’ or low vulnerable individuals should orient *away* from threatening (angry) at low levels of stress (i.e., control conditions), yet orient *towards* threat at higher levels of stress (i.e., induced situational stress). As EI is touted as an adaptive latent level trait, this study will explore whether those with *high* EI follow this ‘protective’ pattern of orienting to danger contingent on threat level. It is hypothesized that there will be differences in reaction times and direction of initial fixations to threatening faces, relative to neutral, between those with high and low levels of A/TEI as a function of group (‘control’ or ‘stress’ manipulation condition). To generate sufficiently ‘stressful’ conditions, stimuli depicting emotional expressions of strong intensity will be used in tandem with induced transient stress (failure experience). Responses to positive (happy) and other negative (sad) emotion will be examined for comparison. Finally, given known associations between attentional biases and mood disorders (i.e., depression and anxiety) (Bar-Haim et al., 2007), and the overlap between EI (particularly TEI) and broadband personality traits (Petrides et al., 2007), the latter will be controlled to facilitate a ‘clean’ assessment of the role of EI in attentional selection.

Methodology

Participants

161 adults (121 females; 40 males) aged 18–57 years (Mean age = 25.24; *SD* = 8.81) were recruited via opportunity sampling from a University campus located in the West Midlands, UK. Only adults with normal levels of visual acuity were eligible to participate. Participants were randomly assigned to a control (*n* = 83) or experimental condition (*n* = 78).

Procedures

Participants completed psychometric measures (i.e., TEI, AEI, internalizing disorders, personality) online up to three weeks prior to completing the lab-based experimental session. At the lab, participants provided a baseline index of negative affective state (PANAS) and were randomly assigned to the experimental (stressful) or control (neutral) condition. In line with recommendations for affect induction (Nummenmaa & Niemi, 2004), a failure task paradigm ('bogus IQ' test) was used to manipulate mood in the experimental group. Participants were informed that they were to be tested on a measure designed to predict career success and were expected to have an 83% success rate (i.e., from 12 items, 10 or more completed correctly within a time limit of 6 minutes). Test stimuli were drawn from the most challenging items within Raven's Advanced Matrices (Raven, 1976) and impossible to complete successfully within the allotted time. Participants completed the items alone in a test cubicle. After 6 minutes, answer sheets were collected and the PANAS administered again to index any change in negative affect post-manipulation. Those allocated to the control condition read an emotionally neutral magazine article (confirmed through piloting) and rated the content for readability. No time constraints were imposed. Participants were then invited to complete the dot probe task whilst eye movements were recorded. On completion of the task, participants were debriefed and thanked for their contribution.

Measures

Ability EI was indexed using the Situational Test of Emotional Understanding (STEU) and the Situational Test of Emotion Management (STEM) (MacCann & Roberts, 2008). The 42-item STEU requires participants to choose the most plausible emotion arising from a particular scenario from a choice of five, e.g., "*Something unpleasant is happening. Neither the person involved, nor anyone else can make it stop. The person involved is most likely to feel? (a) Guilty (b) Distressed (c) Sad (d) Scared (e) Angry*". Items describe context-free (above), personal or workplace scenarios, testing knowledge relating to 14 different emotions. In line with Roseman's (2001) appraisal-based emotion theory, items are scored as correct/incorrect (e.g., option [b] above) generating a total score. The STEM requires participants to choose the most effective course of action for managing emotion (anger, sadness, fear) across 44 personal or workplace scenarios (e.g., *"Lee's workmate fails to deliver an important piece of information on time, causing Lee to fall behind schedule also. What action would be the most effective for Lee?").* Four options are presented for each item and scored using expert weights, yielding a total score. STEM, STEU and MSCIET scores are significantly associated (Austin, 2010) and demonstrate acceptable levels of internal consistency and test-retest reliability (Libbrecht & Lievens, 2012; MacCann & Roberts, 2008).

Trait EI indexed via the Trait Emotional Intelligence Questionnaire-Short Form (TEIQue-SF: Petrides, 2009) consists of 30 statements (e.g., "*Many times, I can't figure out which emotion I'm feeling*") tapping four factors: *Sociability* (competencies necessary for developing strong personal relationships), *Emotionality* (e.g., perceived skills in negotiation, networking), *Self-control* (capability in controlling internal urges and external pressure/stress) and *Wellbeing* (degree of satisfaction with life). Participants respond using a seven-point scale: strongly disagree (1) to strongly agree (7). The TEIQue-SF has robust psychometric properties (including item discrimination) with full-scale alpha typically in the range of α = .87; factors: α = .64 (Cooper & Petrides, 2010; Petrides et al., 2010).

Internalising disorders were assessed using the Hospital Anxiety And Depression Scale (HADS: Zigmond & Snaith, 1983). Participants rate how often each of the 14 statements (e.g., *"I feel tense or wound up"; "I can see the funny side of things"*) has been true for them recently using a 4-point scale: never (0) through to most of the time (3). The HADS has been comprehensively validated in clinical and typically-functioning populations (Bjelland, Dahl, Haug, & Neckelmann, 2002).

Personality was measured using the Big Five Inventory (BFI-44; John, Donahue, & Kentle, 1991). 44 statements tap thoughts, feelings and behaviours central to the 'Big Five' traits of Neuroticism (N); Extraversion (E); Openness (O); Agreeableness (A) and Conscientiousness (C) (see John & Srivastava, 1999 for review). Participants indicate the extent of their agreement with each statement (e.g., "*I see myself as someone who is outgoing, sociable*" [E]) by means of a five-point scale: strongly disagree (1) to strongly agree (5). Dimensional scores are derived from summed item averages (1-5). Srivastava, John, Gosling and Potter (2003) reported adequate levels of internal consistency and factorial validity in data drawn from 132,515 adults aged 21-60 years old.

Negative affect (NA) was indicated via the 10-item subscale of the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988). Participants rate the extent to which they are experiencing ten negative emotional states at the time of completion (e.g., distressed, irritable, nervous) using a 5-point scale: very slightly/not at all (1) to extremely (5). The PANAS has excellent psychometric properties (Crawford & Henry, 2004) with the NA subscale demonstrating construct validity with measures of general distress and state anxiety (Watson et al., 1988).

Attentional bias was assessed using a visual dot probe paradigm presented using Eprime 2.0 (Psychology Software Tools, USA), configured in line with previous research (Mogg, Garner, & Bradley, 2007; Mogg, Millar, & Bradley, 2000). 104 pairs of faces were constructed using stimuli from the NimStim repository (http://www.macbrain.org/resources.htm) - a repository of 43 ethnically diverse actors modeling 8 different facial emotions of high intensity that have good levels of inter-rater reliability and validity (Tottenham et al., 2009). 32 face pairs depicting angry-neutral expressions, 32 happy-neutral, 32 sad-neutral, and 16 neutral–neutral pairs (for use as filler/practice trials) were constructed. Each pairing used expressions from the same actor, with equal numbers of males and females drawn from a range of ethnicities. Images measured 90mm x 110mm and spaced 215mm apart, set against a white background. Stimuli were presented twice across two blocks, yielding 224 experimental trials. Trials began with presentation of a central fixation cross (500ms), followed by a face pair (500ms). With offset of the pair, a probe stimulus (triangle) appeared in the location previously occupied by one of the faces (neutral or emotional face) for 1100ms or until key press response. The probe replaced the emotional (congruent) or neutral face (incongruent) with equal frequency across trials, and positioning of emotional vs. neutral faces (left or right side) was randomized. Participants were instructed to focus on the central fixation cross and then press one of two response keys as quickly as possible to indicate the location of the probe ('a' for left or 'l' for right). Standardised instructions and 6 practice trials were presented at the beginning to aid familiarization. Manual reaction times were recorded for the interval between onset of the probe and key press response. Faster reaction times to probes replacing emotionally valenced (e.g., happy, sad, angry) vs. neutral faces reflect an attentional bias for that particular emotion type. Eye movements (direction of gaze post-offset of the central fixation cross) were recorded for each trial using an ASL MobileEye XG eye tracking system (Applied Science Laboratories, Bedford, MA), at a temporal resolution of 30Hz and an accuracy of .5-1.0 degree visual angle. Regions of interest (either left or right facial stimuli) were applied to the data post collection using ASL Results^{+} software. Eye movements occurring before 100ms after presentation of the fixation cross were filtered from the data set, as these 'anticipatory' eye movements are not considered dependent on emotional stimuli (Mogg, Philippot, & Bradley, 2004). Prior to each experimental block, the eye tracking equipment was calibrated using a 9-point visual display. The task took 10 minutes to complete.

Results

Table 1 displays descriptive statistics and inter-correlations for the questionnaire variables. TEI scores shared robust associations with mood disorders and four of the Big 5 personality dimensions (significant *r* range = .23-.76) yet were unrelated to AEI measures, consistent with previous literature (e.g., Austin, 2010; Brackett & Mayer, 2003). AEI emotion management and understanding were moderately related ($r = .38$, $p < .001$) but not significantly associated with personality, as expected (MacCann & Roberts, 2008). There was a negligible, inverse association between emotion understanding and depression. Consequently, the influence of the Big Five, depression and anxiety were controlled in subsequent analyses.

A 2 (time: pre-manipulation vs. post) x 2 (group: experimental vs. control) repeated measures ANOVA was performed on negative affect scores to verify that the stress manipulation had been successful. There was a significant effect of time (F (1, 159) = 43.70, $p < .001$, partial $\eta^2 = .22$), group (F (1, 159) = 41.93, $p < .001$, partial $\eta^2 = .21$) and a time x group interaction (F (1, 159) = 106.82, $p < .001$, partial $\eta^2 = .40$), such that those in the experimental condition had significantly higher levels of negative affect post-manipulation (M = 17.14, SD = 5.55) compared to those in the control condition (M = 11.22, SD = 1.84) and pre-manipulation scores (M = 12.37, SD = 2.83) as anticipated.

Manual reaction time (RT) data preparation

In line with attentional bias research (e.g., Mogg et al., 2007; Mogg et al., 2004), the complete data set of 32,200 experimental trials was initially screened for incorrect responses (direction of the probe) and outliers (RTs +/- 2 SD from the mean RT: 386.77 ms). For each measure of EI, participants were dichotomized into high or low groups using mean scores (Mikolajczak, Roy, et al., 2009). Groups (level of EI or condition) did not differ in error rate (3.27%) or in outliers (7.96%). Table 2 displays mean RTs for each condition across types of EI. Attentional bias scores for each emotion type (angry, sad, happy) were computed as an index of vigilance for/avoidance of emotional faces using a standard methodology (Bradley, Mogg, Falla, & Hamilton, 1998). The mean RT to congruent stimuli (probe and emotional face appear in same position) was subtracted from the mean RT to incongruent stimuli (probe and emotional face appear in different positions) for each participant per emotion type. Positive values indicate an attentional bias *for* the emotional relative to neutral face, whilst negative values suggest a bias *away* from the emotional face (0 = no bias). Kolmogorov-Smirnov tests indicated that angry, sad and happy bias scores did not significantly differ from a normal distribution (all $p > .20$).

Predicting attentional bias for emotional faces under stress: RT data

A series of 2 (group: experimental vs. control) x 2 (EI: high vs. low) ANCOVAs controlling for depression, anxiety and personality, were run to test for significant differences in attentional bias for each emotion type. This method of analysis was selected over an omnibus test to ensure sensitivity for discrete hypothesis testing within each group (Tabachnick & Fidell, 2007). There were no significant effects across groups in attentional bias for happy faces. For angry faces, there was a significant main effect of AEI management, such that those *lower* in AEI emotion management showed a bias *towards* threat-related emotion relative to neutral emotional expressions, whilst those *higher* in AEI management oriented *away* from threat towards neutral emotion (F (1, 154) = 4.03, p < .05, partial η^2 = .03). However, the AEI x condition interaction effect was non significant (F (1, 154) = 1.16, p > .05) indicating this preference was not contingent upon condition (stressful or control). For sad faces, those *higher* in TEI Emotionality showed a bias *towards* sad faces relative to neutral expressions, with the reverse true for those with lower TEI Emotionality (F (1, 153) = 5.56, p < .05, partial η^2 = .04). This was not contingent on condition (TEI emotionality x condition: F (1, 153) = .32, p > .05) and thus appeared to be a general orienting bias to sad faces *per se*. Analyses at the level of total TEI were all *ns*. AEI emotional understanding was not related to attentional bias for any type of emotional face.

Eye movement (EM) data preparation

Total sample N = 89. Two participants had more than 70% incomplete trial data (i.e., made very few EMs to faces) and their data were excluded from analyses to avoid distorting the calculation of bias scores (see below). This resulted in a final sample N ranging between 87-89 for EM analyses (see table 3 for n per group). Missing cases did not significantly differ in relation to TEI, AEI, mood disorders or personality (all t < (159) 1.96, p > .05). Trials were initially screened to filter responses that occurred before 100ms after the onset of a face pairing, as these ‘anticipatory’ EMs are thought to occur independently of the emotional stimuli (Mogg et al., 2004). Groups (level EI or experimental condition) did not differ in frequency of anticipatory EMs. Table 3 displays mean number of EMs for each condition across the three types of EI. Directional bias scores were computed for each participant for angry, sad and happy faces following Mogg, Miller & Bradley (2000). Analysis of bias scores is preferential to using count data, given the interdependency of EM measures (i.e., within stimuli pairs, EMs towards an emotional face cannot be considered independent of the number of EMs away from that particular face type). This index was derived by dividing the number of trials where the first fixation was directed towards the emotional face, by the total number of trials with fixations to emotion-neutral pairings of that emotion type (e.g., first fixations to happy faces divided by the total number of happy-neutral fixations). Scores > .5 indicate a preference to *look towards* the emotional instead of the neutral face, whilst values < .5 suggest a bias to *look away* from the emotional face and towards the neutral (.5 = no bias). Kolmogorov-Smirnov tests indicated that angry, sad and happy directional bias scores did not significantly differ from a normal distribution (all $p > .06$).

Predicting attentional bias for emotional faces under stress: EM data

Directional bias scores for first fixations to each emotion type were entered into a series of 2 (group: experimental vs. control) x 2 (EI: high vs. low) ANCOVAs controlling for depression, anxiety and personality. There were no significant effects across groups in directional bias for happy faces. For angry faces, there was a significant main effect of TEI Sociability, such that those *higher* in TEI Sociability showed a preference for looking first at angry rather than neutral faces, with the reverse true for those with *lower* TEI Sociability (F (1, 78) = 5.40, $p < .05$, partial $\eta^2 = .07$). However, the TEI x condition interaction was non-significant (F (1, 78) = .43, $p > .05$), indicating this preference was not context-dependent (stressful or control). There was a marginally significant main effect of AEI management, such that those *lower* in emotion management skills looked first at threat-related relative to neutral emotional expressions, whilst the reverse was true for those with *higher* skills (F (1, 78) = 3.42, p = .07, partial η^2 = .04). Again, a non-significant AEI x condition interaction effect (F (1, 78) = 1.13, p > .05) suggested this was a general orienting preference *per se*. For sad faces, there were no significant main effects of TEI Wellbeing (F (1, 76) = .036, p > .05) or condition (F (1, 76) = .04, p > .05) on eye direction bias. However, the TEI Wellbeing x condition interaction effect was significant (F (1, 76) = 6.94, p < .05, partial η^2 = .08). Under stress, those *higher* in TEI Wellbeing looked *away* from sad faces compared to neutral, whilst individuals with *lower* TEI wellbeing looked *towards* sad faces under stress. This pattern was reversed under non-stressful conditions (see Figure 1). Analyses at the level of total TEI were ns. AEI emotional understanding was not related to directional preference for any type of emotional face.

There were no significant correlations between RT bias scores and EM directional bias scores (e.g., angry directional bias and angry RT bias: r = -.02, p = .86) confirming that EM and RT data provide discrete measures of early attentional orienting bias (Mogg et al., 2000).

Discussion

This study is the first to examine whether EI moderates attentional processing of threat-related emotion under situational stress using multiple measures of attentional bias (eye movement; reaction time data). A complex pattern of preliminary findings emerged. EI was found to relate to attentional selection, beyond the effects of broadband personality dimensions, suggesting this is an important dimension of individual difference to consider in mental health trajectories. Specifically, differences in the *early* detection of salient, negatively valenced stimuli were found (a 'vigilance' or 'facilitation' bias). This contrasts with previous studies reporting non-significant findings for more *deliberate* processing at extended stimulus exposures using alternative paradigms (e.g., Matthews et al 2015; Fiori 2012). However, effects varied according to type of EI (trait/ability) and type of facial emotion (sad/angry), with patterns generally not contingent on stress context, leaving open the question as to whether EI is truly 'adaptive'.

Ability EI and attentional bias under stress

Manual data (500ms presentation time) demonstrated that participants who were highly skilled in emotion management looked away from threatening faces (orienting to neutral), compared to lower-skilled individuals who were drawn to threat. This trend was corroborated via a marginally significant effect of first fixation eye movements to angry versus neutral faces (>100ms). Effects were restricted to skills in emotion management (not understanding) and to selection of angry faces (not sad or happy), yet represented a *general orienting preference*, operating across both benign and stressful conditions. Findings appear consistent with the notion that low AEI represents a latent vulnerability for mental health problems (Martins et al., 2010), akin to subclinical anxiety, whereby pronounced bias for threat is evident under both stressful and neutral conditions, intensifying unmanageable levels of negative affect and precipitating disordered symptomatology (MacLeod & Matthews, 1988; Williams et al., 1988, 1997). However, it is inconsistent with recent consensus in the literature which suggests that a ‘protective’, interactive pattern of orienting to danger, contingent on threat level, should be observed (i.e., avoidance at low, not high levels of stress) (Bar-Haim et al., 2007; Mogg & Bradley, 1998; Yiend, 2009). Clearly, it is not always advantageous to ignore biologically salient cues that may signal impending threat. As such, it is difficult to establish the adaptive worth of this pattern of attentional selection.

Given this study successfully stimulated ‘acute’ transient stress through manipulation of negative affect and used high intensity facial emotions, two possible explanations are apparent; either emotionally intelligent individuals did not perceive the level of stress engendered (state or stimuli) to be acutely threatening, or, their patterns of attentional selection were characterised by additional features not captured by the current measures. To ascertain which of these explanations is plausible it will be necessary for future research to manipulate procedural variables. Differences in threat perception thresholds can be examined by varying the stress context (i.e., chronically stressful conditions as well as acute) and by utilising stimuli of ‘graded’ intensities. Studies point to discrepancies in the observation of vigilance bias as a function of prolonged (chronic) or transient (acute) stress (e.g., Mogg et al., 1994) and threat values of stimuli, e.g., a human scream (Massar, Mol, Kenemans, & Baas, 2011), distressing visual scenes (e.g., Koster, Crombez, Verschuere, & De Houwer, 2004). EI may relate to *sensitivity* in detecting and discriminating emotive cues (e.g., Jacob et al., 2012; Knyazev, Mitrofanova, & Bocharov, 2013) – not all of which show ‘benefits’ for high EI scorers (Baker, ten Brinke, & Porter, 2013). Within the facial dot probe paradigm, future studies could also, therefore, vary stimuli intensity to establish whether selection biases are due to threat perception differences.

Recent literature also argues against the notion that attentional selection is a unitary, stimulus-driven process and that a combination of processes (*vigilance, disengagement, avoidance*) work in tandem to guide early selection (Cisler & Koster, 2010). The current data indicate that those low in AEI were initially drawn to threat (>100ms) but then may have experienced difficulty *disengaging* from the target location to shift towards neutral stimuli (still engaged with threat at 500ms). It is also possible that those high in AEI were initially drawn to neutral stimuli (>100ms), and then rapidly engaged with threat before seeking out safety signals and re-directing back to neutral stimuli, thus *avoiding* threat (at 500ms). In order to clarify whether disengagement (maladaptive) and avoidance (adaptive) distinguish between low and high-skilled individuals, varied presentation times for stimuli alongside dwell time data for first fixation eye movements are required. These two attentional features are considered to reflect more controlled, strategic processing, best captured at later stimulus onset asynchronies in comparison with the more automatic, rapidly occurring stimulus-driven vigilance biases (Cisler & Koster, 2010). For instance, disengagement difficulties have been observed between 100ms and 500ms (Fox, Russo, Bowles, & Dutton, 2001; Koster et al., 2004, 2006; Massar et al., 2011; Sagliano, Trojano, Amoriello, Migliozzi, & D'Olimpio, 2014), whilst avoidance can manifest from 200ms onwards (e.g., Bradley et al., 1998; Koster et al., 2006; Onnis, Dadds, & Bryant, 2011), with specificity according to level of trait and state anxiety. It is possible therefore, that EI modulates these later elaborative processes as well as early vigilance, particularly given skill in emotion management taps high-order, ‘strategic’ rather than ‘experiential’ elements of EI (i.e., use and perception of emotion). It will be important to now replicate these findings with extended testing of the full AEI domain.

Trait EI and attentional bias under stress

Effects for TEI diverged significantly from the AEI pattern, once again emphasizing the distinctiveness of the two (Petrides, 2011). There were no significant effects of TEI on attentional bias at the global level. This is not unexpected given heterogeneous, global TEI shares much overlap with broadband personality traits (controlled for in the current analysis) (Petrides et al., 2007), with analysis of remaining facet-level variance permitting a nuanced insight into the TEI-attentional processing relationship (Matthews et al., 2015). Only components encompassing *experiential* emotional experience (*emotionality*: emotion perception/expression/empathy; *sociability:* management of others/social awareness; *wellbeing:* self-esteem/optimism) related to attentional biases. Two general orienting patterns (operating irrespective of context) were found. Individuals with higher emotionality showed vigilance for sad faces (manual data), whilst those with higher sociability looked first at angry faces (eye movement data), suggesting higher self-rated competency relates to a *generalised* preference for negative (vs. neutral) affect-related stimuli. As per discussion of AEI effects, it is difficult to ascertain whether this reflects ‘adaptive’ processing. Additionally, an interactive effect was found for *wellbeing*; under stress, those with higher levels looked away from sad faces, compared to their lower scoring counterparts, for whom a sad vigilance bias was observed. This pattern was reversed under non-stressful conditions.

In line with theory and evidence, high TEI (low vulnerability) should only relate to a preference for threat-related emotion under conditions of moderate to high stress (Bar-Haim et al., 2007; Mogg & Bradley, 1998; Yiend, 2009). The 'hypervigilance' for negative emotional content detected in the current data would more closely correspond with the pattern expected for clinical groups. It is unclear why vigilance biases were detected in benign conditions for those with high self-perceived emotional understanding and awareness. In each case, the lack of synchrony between measurement methods (i.e., first fixation and later key press) suggests the data may not have captured multiple attentional shifts occurring over the time course. For example, those high in trait sociability may be initially vigilant then avoidant after 100ms, whilst a difficulty disengaging may explain the high trait emotionality effect, as reported elsewhere in low vulnerable individuals (e.g., Sagliano et al., 2014). Variable stimulus presentation times (100ms to 1250ms), in concert with dwell time data, would illuminate these issues, and also allow researchers to ascertain whether the more 'strategic' trait *self-control* (perceived ability to manage self-relevant emotion) relates to effortful attentional control at later stages of processing. Indeed, using EEG, Fisher and colleagues (2010) detected a link between high trait emotional clarity (strategic understanding) and reduced *extended* processing of negative stimuli (348-768 ms), in contrast to an early attentional bias for negative stimuli (88-148 ms) for those with high levels of emotional awareness (experiential TEI).

Clearly, aspects of TEI which capture general wellbeing (self-esteem, optimism, happiness) operate differentially to those predominantly concerned with socio-emotional processing, contrasting markedly with theoretical predictions. Higher levels related to a bias *away* from sad faces (versus neutral) in *stressful* but not benign conditions, with the reverse true for those with lower levels. Positive self-system beliefs, notably self-esteem, are traditionally associated with better psychological and interpersonal adjustment (Zeigler-Hill et al., 2016) and there is evidence to suggest that high levels buffer individuals from the physiological and subjective effects of stress (e.g., Greenberg et al., 1992). Differences in attentional biases may underlie this effect; individuals with high self worth can inhibit attention to interpersonally relevant 'rejection' cues, whilst those with low self-esteem are drawn to this material (e.g., Li, Zeigler-Hill, Luo, Yang, & Zhang, 2012). Thus, those with high self-esteem are able to defend their positive self-perceptions and guard against potential threats to wellbeing and social value. Avoidance of negative emotional content under acutely stressful conditions may, therefore, allow high trait wellbeing individuals to prevent self-esteem decline and fortify a positive world-view.

It is also worth noting that TEI appears to relate to early attentional processing of negative affect *per se* (i.e., sad *and* angry faces) in contrast to the threat-specific effects found for AEI. As no baseline differences were found in subjective mood state, this could be a result of the type of stress manipulation employed. It is possible that the 'Bogus IQ' task also engendered feelings of sadness captured by the measure of general negative affect used here. This would indicate that TEI is a more domain-general facilitator of mood-congruent processing (borne out by non-significant effects for happy emotion), consistent with literature examining broadband personality markers. For instance, Neuroticism has underlies an array of clinical disorders and relates to a generalized difficulty disengaging from valence-free information (Bredemeier, Berenbaum, Most, & Simons, 2011; Malouff, Thorsteinsson, & Schutte, 2005). Future studies might consider using a more stress-sensitive indicator of subjective state (e.g., Speilberger Sate-Trait Inventory; Spielberger, 1989) and/or an experimental manipulation which may more closely replicate real-life social and emotional stress (e.g., Trier Social Stress Test; Kirschbaum, Pirke, & Hellhammer, 1993) to gain a more nuanced understanding of this effect.

Limitations and conclusions

This study offers preliminary data to suggest that high levels of ability and trait EI relate differentially to attentional selection. It is as yet unclear whether this corresponds with 'adaptive' processing under stressful circumstances. Using the current findings as a foundation, researchers must now extend investigation to examine the full time-course of attentional selection with eye movement data. Examination of EI and attentional processing should be investigated using alternative attentional paradigms (attentional blink; visual search) to address issues of reliability and validity leveled at the dot probe task (Schmukle, 2005). Whilst this study sought to maximize the explanatory power of the findings by incorporating measures of both trait and ability EI, future studies will need to index experiential AEI and a more comprehensive measure of TEI (the short form version of the TEIQue yielded a relatively low estimate of internal consistency for TEI Sociability). It may also be the case that those reporting high levels of TEI possess (or choose to report) inaccurate perceptions of their abilities – indeed measurement of TEI can be prone to faking (Tett, Freund, Christiansen, Fox, & Coaster, 2012). Whilst this is informative in itself (Petrides, 2011), it would aid interpretation to have an indication of the relative accuracy of self-report to ascertain how best to characterize attentional patterns (e.g., emotionally skilled vs. hubristic or image conscious individuals). Finally, whilst no significant sex differences were detected across measures of attentional bias in the current data, the imbalance of males and females should also be addressed going forward to allow further differentiation of effects in line with recent research in the field (Sass et al., 2010).

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Table 1: Correlations and descriptive statistics for questionnaire measures (*N* = 161)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. TEI Total	-														
2. TEI Wellbeing	.83**	-													
3. TEI Self control	.70**	.51**	-												
4. TEI Emotionality	.74**	.49**	.26**	-											
5. TEI Sociability	.67**	.40**	.37**	.39**	-										
6. AEI Management	.05	.08	.02	.12	-.10	-									
7. AEI Understanding	.10	.08	.15	.08	.01	.38**	-								
8. Depression	-.59**	-.57**	-.50**	-.37**	-.33**	-.12	-.20*	-							
9. Anxiety	-.56**	-.48**	-.66**	-.23**	-.32**	-.03	-.15	.57**	-						
10. Neuroticism	-.57**	-.51**	-.76**	-.12	-.31**	.07	-.08	.42**	.61**	-					
11. Extraversion	.60**	.54**	.27**	.38**	.54**	.00	-.06	-.37**	-.26**	-.39**	-				
12. Conscientiousness	.48**	.36**	.37**	.34**	.23**	.04	.10	-.25**	-.26**	-.31**	.19*	-			
13. Openness	.08	.07	-.01	.09	.14	-.06	.06	.10	.04	.02	.10	-.02	-		
14. Agreeableness	.37**	.32**	.25**	.39**	.05	.10	-.10	-.23**	-.21**	-.27**	.17*	.37**	.02	-	
15. Age	-.02	.02	.05	.01	-.15	.12	.19*	.12	-.11	-.02	-.10	.02	.34*	.07	-

													*		
Alpha (α)	.89	.84	.68	.72	.32	.80	.63	.75	.83	.83	.87	.77	.70	.75	-
Mean (*SD*)	146.89 (22.78)	5.25 (1.14)	4.27 (1.04)	5.07 (.99)	4.82 (.92)	197.63 (9.38)	25.83 (4.36)	3.68 (3.13)	7.31 (4.09)	3.18 (.81)	3.34 (.82)	3.66 (.63)	3.58 (.54)	3.84 (.61)	25.24 (8.81)

Note: TEI = trait emotional intelligence; AEI = ability emotional intelligence

* $p < .05$; ** $p < .001$

Table 2: Manual reaction times to face stimuli as a function of experimental condition and group (N= 161)

Condition	Group	Congruent stimuli			Incongruent stimuli		
		Angry *M (SD)*	Sad *M (SD*	Happy *M (SD)*	Angry *M (SD)*	Sad *M (SD)*	Happy *M (SD)*
	TEI Wellbeing						
Experimental	Low (*n* =32)	384.45 (53.33)	389.98 (55.36)	389.02 (52.72)	386.63 (54.28)	394.47 (55.17)	389.30 (53.97)
	High (*n* = 46)	380.48 (46.65)	383.24 (46.95)	379.30 (48.73)	380.37 (45.65)	384.87 (48.11)	382.71 (47.55)
Control	Low (*n* =33)	375.07 (41.20)	378.04 (42.06)	378.42 (43.26)	382.91 (44.06)	381.43 (37.86)	381.53 (46.27)
	High (*n* = 50)	374.15 (48.40)	370.18 (45.02)	373.03 (41.86)	374.02 (46.74)	371.20 (43.81)	374.43 (43.89)
	TEI Self Control						
Experimental	Low (*n* = 39)	376.93 (44.68)	378.30 (46.10)	382.28 (46.49)	380.69 (43.54)	386.21 (45.72)	380.69 (48.00)
	High (*n* = 39)	387.27	393.71	384.30	385.18 (54.63)	391.41 (56.27)	390.15 (52.20)

		(53.43)	(53.71)	(54.44)			
Control	Low (*n* =32)	377.90	389.30	382.50	386.12 (45.49)	385.91 (33.38)	384.31 (43.77)
		(42.19)	(40.45)	(41.03)			
	High (*n* =51)	372.39	363.28	370.57	372.18 (45.33)	368.59 (45.07)	372.83 (45.15)
		(47.61)	(43.15)	(42.74)			
	TEI Emotionality						
Experimental	Low (*n* = 36)	383.65	389.02	385.52	387.39 (51.89)	388.99 (54.30)	388.93 (53.58)
		(49.15)	(55.66)	(57.18)			
	High (*n* = 42)	380.78	383.43	381.38	379.12 (46.92)	388.65 (48.65)	382.41 (47.25)
		(49.80)	(45.80)	(44.18)			
Control	Low (*n* =33)	387.55	392.69	388.77	393.08 (45.82)	388.61 (38.10)	392.16 (44.77)
		(41.92)	(40.74)	(43.84)			
	High (*n* = 50)	365.91	360.52	366.19	367.30 (42.94	366.46 (41.84)	367.41 (42.28)
		(45.97)	(41.28)	(39.04)			
	TEI Sociability						
Experimental	Low (*n* = 42)	387.89	390.13	388.59	388.23 (49.85)	394.40 (52.08)	390.11 (52.94)
		(47.90)	(53.58)	(53.97)			

	High (*n* = 36)	375.36 (50.51)	381.20 (46.53)	377.10 (45.62)	376.76 (48.23)	388.59 (53.97)	379.94 (46.58)
Control	Low (*n* = 40)	388.34 (47.45)	390.48 (39.97)	387.35 (39.74)	389.40 (45.05)	390.55 (38.64)	392.15 (45.71)
	High (*n* = 43)	361.65 (39.80)	357.34 (41.42)	363.84 (41.77)	366.53 (43.85)	361.05 (39.56)	363.39 (39.42)
	AEI Management						
Experimental	Low (*n* = 28)	393.73 (60.34)	407.15 (62.38)	400.88 (65.07)	400.55 (63.13)	406.81 (62.22)	401.45 (60.76)
	High (*n* = 50)	375.60 (40.96)	374.17 (37.92)	373.44 (36.97)	373.03 (36.33)	378.73 (40.80)	376.43 (40.88)
Control	Low (*n* = 38)	376.70 (41.10)	376.40 (41.01)	378.41 (38.54)	380.37 (44.61)	377.68 (35.94)	381.16 (42.71)
	High (*n* = 45)	372.66 (49.15)	370.70 (46.28)	372.44 (45.38)	375.17 (46.84)	373.23 (46.17)	373.95 (46.55)
	AEI Understanding						
Experimental	Low (*n* = 35)	383.10	390.34	387.31	385.65 (44.15)	391.92 (46.96)	390.61 (47.36)

		(43.39)	(47.98)	(48.29)			
	High (n = 43)	381.29	382.09	380.02	380.73 (53.25)	386.27 (54.48)	381.19 (52.30)
		(53.97)	(52.39)	(52.21)			
Control	Low (n = 42)	380.80	377.68	379.75	381.53 (47.16)	379.58 (38.81)	382.91 (45.18)
		(47.38)	(44.25)	(40.72)			
	High (n = 41)	368.08	368.84	370.48	373.48 (44.22)	370.85 (44.34)	371.45 (44.02)
		(42.93)	(43.38)	(43.74)			

Note: TEI = trait emotional intelligence; AEI = ability emotional intelligence; Experimental = stress condition; Control = neutral task condition; Congruent stimuli = probe and emotional face in same position; Incongruent stimuli = probe and emotional face in different positions.

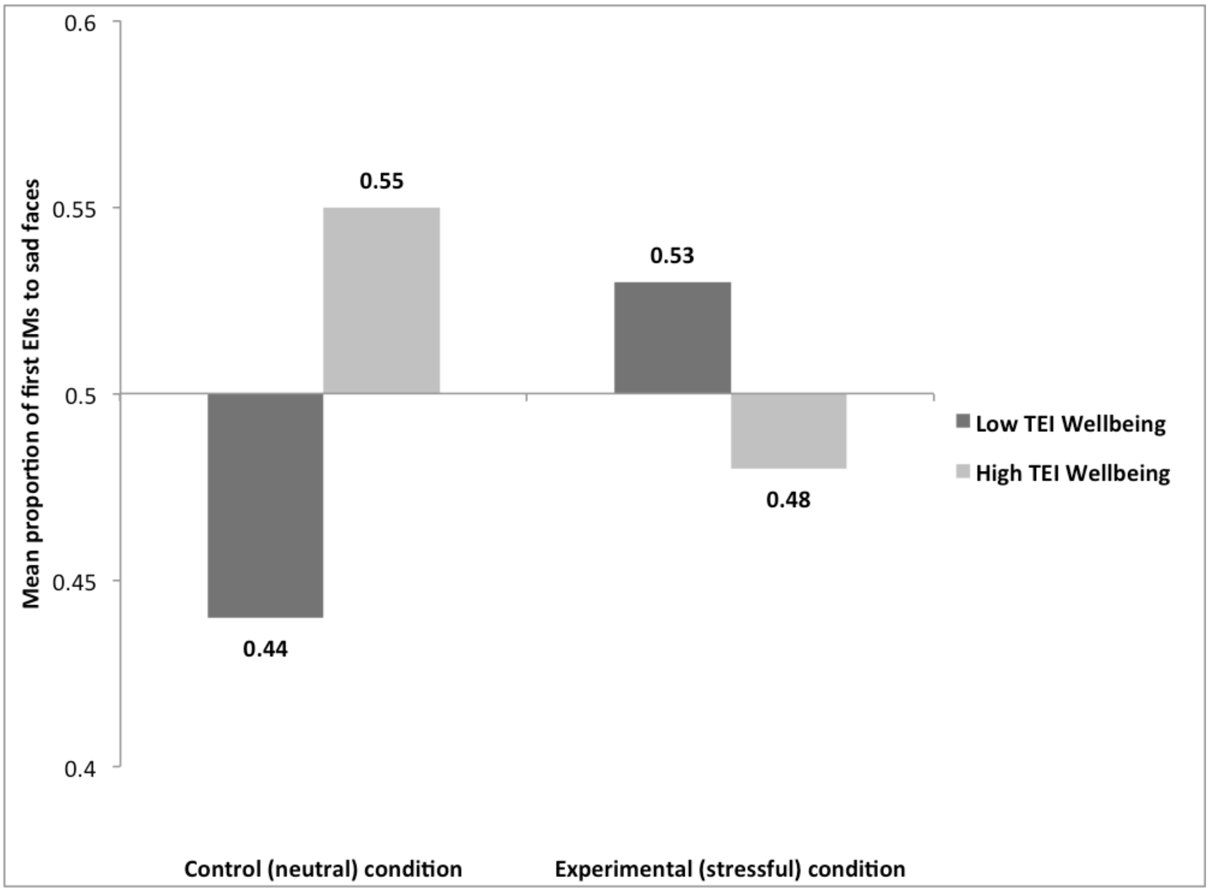
Table 3: Mean number of initial eye movements (first fixations) to face stimuli as a function of experimental condition and group

Condition	Group	Gaze direction: Towards			Gaze direction: Away		
		Angry	Sad	Happy	Angry	Sad	Happy
	TEI Wellbeing						
Experimental	Low (*n* =19-20)	8.85 (6.66)	10.37 (6.95)	8.11 (5.95)	10.35 (6.79)	9.00 (5.34)	9.89 (6.94)
	High (*n* = 25-26)	8.42 (5.63)	8.54 (6.24)	9.32 (6.49)	7.77 (5.09)	8.73 (5.59)	9.00 (5.39)
Control	Low (*n* =21)	7.52 (4.58)	7.71 (5.17)	8.33 (5.48)	8.81 (4.59)	8.67 (4.90)	8.87 (5.71)
	High (*n* = 21-22)	9.27 (6.60)	11.00 (7.09)	9.41 (6.16)	8.91 (6.38)	8.86 (5.52)	9.55 (7.33)
	TEI Self Control						
Experimental	Low (*n* = 23-24)	9.25 (6.56)	10.54 (7.00)	9.74 (6.46)	10.29 (6.46)	9.33 (5.70)	10.35 (6.83)
	High (*n* = 21-22)	7.91 (5.47)	7.91 (5.81)	7.76 (5.92)	7.36 (5.07)	8.29 (5.23)	8.33 (5.00)
Control	Low (*n* =18)	7.56 (4.93)	8.78 (5.57)	7.83 (5.45)	8.22 (4.98)	7.89 (4.85)	8.17 (5.29)
	High (*n* =24-25)	9.04 (6.23)	9.79 (6.96)	9.64 (6.03)	9.32 (5.92)	9.42 (5.38)	9.80 (7.31)
	TEI Emotionality						
Experimental	Low (*n* = 21)	9.25 (6.34)	9.05 (6.34)	8.52 (6.38)	9.05 (5.77)	9.38 (5.42)	9.48 (5.72)
	High (*n* = 23-25)	7.84 (5.78)	9.54 (6.83)	9.04 (6.20)	8.76 (6.23)	8.38 (5.51)	9.30 (6.46)
Control	Low (*n* =20-21)	7.90 (5.96)	8.65 (6.09)	8.00 (5.55)	8.33 (5.37)	8.20 (5.01)	8.70 (5.95)

	High (*n* = 22-23)	8.91 (5.55)	10.00 (6.65)	8.96 (6.12)	9.36 (5.72)	9.27 (5.35)	9.48 (7.10)
	TEI Sociability						
Experimental	Low (*n* = 23-24)	9.00 (5.70)	9.71 (5.88)	9.57 (6.33)	10.33 (5.61)	7.02 (5.79)	10.13 (5.75)
	High (*n* = 21-22)	8.18 (6.49)	8.86 (5.34)	7.95 (6.13)	7.32 (6.06)	8.62 (6.20)	8.57 (6.40)
Control	Low (*n* = 23)	9.23 (5.68)	9.61 (6.60)	8.91 (5.25)	9.78 (5.22)	8.61 (4.30)	9.78 (6.41)
	High (*n* = 19-20)	7.50 (5.74)	9.05 (6.19)	8.85 (6.51)	7.80 (5.77)	8.95 (6.15)	8.35 (6.74)
	AEI Management						
Experimental	Low (*n* = 17-19)	9.53 (5.89)	10.56 (7.38)	10.35 (6.51)	9.84 (6.85)	10.89 (5.50)	11.47 (6.56)
	High (*n* = 27)	7.96 (6.15)	8.48 (5.91)	7.81 (5.94)	8.22 (5.28)	7.48 (5.03)	8.07 (5.42)
Control	Low (*n* = 16-17)	8.53 (5.91)	9.38 (6.37)	8.94 (6.74)	8.23 (5.57)	9.50 (5.27)	9.35 (6.19)
	High (*n* = 26)	8.35 (5.67)	9.35 (6.46)	8.85 (5.23)	9.27 (5.54)	8.31 (5.14)	8.96 (6.85)
	AEI Understanding						
Experimental	Low (*n* = 22-23)	8.78 (5.77)	9.96 (7.35)	9.55 (6.31)	9.65 (6.22)	9.61 (5.72)	10.36 (6.81)
	High (*n* = 22-23)	8.43 (6.41)	8.63 (5.66)	8.05 (6.18)	8.13 (5.72)	8.05 (5.12)	8.41 (5.15)
Control	Low (*n* = 26-27)	9.35 (5.12)	9.58 (4.88)	9.59 (5.73)	10.04 (5.08)	9.85 (6.02)	10.00 (6.70)
	High (*n* = 16-17)	7.00 (6.39)	7.44 (5.46)	7.69 (5.88)	7.06 (5.80)	8.56 (6.97)	7.62 (6.14)

Note: TEI = trait emotional intelligence; AEI = ability emotional intelligence; Experimental = stress condition; Control = neutral task condition. N.B. *n* per group reflects the range of sample *n* per face type (e.g., in the experimental condition, 20 participants were classified as low TEI Wellbeing in analysis of first fixations to angry faces; 19 in analyses of data for sad and happy faces).

Figure 1: Mean proportion of initial eye movements (EMs) toward sad faces on trials with sad-neutral face pairs, as a function of group and experimental condition



Note: Mean proportional scores > .5 indicate a bias to look first at the sad face rather than the neutral, whilst scores < .5 suggest a bias to look away from the sad face towards the neutral stimuli (.5 = no bias).