Ability EI predicts recognition of dynamic facial emotions, but not beyond the effects of crystallized IQ

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Abstract

Extant evidence provides no consensus on whether individuals with higher emotional intelligence (EI) are better at recognising others' facial emotions, or whether EI independently contributes to this skill beyond related predictors (such as general cognitive ability). Methodological variations across studies complicate evaluations of the link between EI and emotion recognition skill (e.g., type of EI examined [trait/ability], use of static/posed photos of prototypical emotional expressions vs. 'real-life' dynamic video). Our study explored whether EI (trait *or* ability) was associated with accuracy in labelling subtle, dynamic displays of emotional expressions (happy, sad, angry, disgusted, fearful, surprised) akin to those typically encountered in social interactions. Data from 92 UK adults (79% females; Mean age = 27.80; *SD* = 11.57) showed that only a subset of ability EI (emotion understanding) was associated with the recognition of emotional expressions, but this did not surpass the predictive effect of crystallised intelligence. Our data suggest that broader cognitive abilities may account for the association between ability EI and facial emotion recognition skill, and that current EI measures lack sensitivity to represent differences in socially-relevant aspects of emotion recognition.

Keywords: emotional intelligence; facial emotion recognition; emotion perception; perceiving emotion, interpersonal sensitivity

1. Introduction

Emotional intelligence (EI) represents individual differences in perceiving, understanding, and managing emotions in oneself and others. EI is argued to confer an advantage in recognising emotional expressions in others, which facilitates effective social interactions (Malouff, Schutte, & Thorsteinsson, 2014; Mayer & Salovey, 1997). However, studies relating EI and emotion recognition ability (ERA) have returned mixed findings, raising questions about (1) whether current measures of EI are limited in the information they can provide about emotion recognition skills relevant to interpersonal interactions, and (2) whether EI can incrementally predict ERA beyond allied variables, such as general cognitive ability (DeBusk & Austin, 2011; MacCann, Pearce, & Roberts, 2011; Matthews et al., 2015; Petrides & Furnham, 2003). Differences in prior findings may be due to variations in study protocols, including the type of EI that is measured (e.g., trait vs. ability EI), or stimulus used to assess ERA (e.g., static/posed photos of faces vs. 'real-life' dynamic video, or high intensity [prototypical] vs. low-intensity [subtle] emotional faces). To better understand how EI relates to the processing of facial cues commonly encountered in social interactions, the current study examines the association between trait (TEI) and ability EI (AEI), and the recognition of graded, dynamic displays of facial emotion. We also investigate whether EI measures independently predict ERA beyond related individual differences (internalizing symptomatology; IQ).

1.1 Individual differences in ERA

The ability to recognise nonverbal emotional cues in others (ERA) is part of the broader construct of interpersonal sensitivity (Hall, Andrzejewski, & Yopchick, 2009). ERA comprises multiple, related skills for decoding non-verbal cues that may be predicted by individual differences (Schlegel, Boone, & Hall, 2017; Schlegel, Grandjean, & Scherer, 2012), such as

age and sex (Hall, Hutton, & Morgan, 2010; Kessels, Montagne, Hendriks, Perrett, & de Haan, 2014), personality traits, self-concept, formative life experiences (Hall et al., 2009), internalising disorders (Demenescu, Kortekaas, den Boer, & Aleman, 2010), and general cognitive ability (Murphy & Hall, 2011).

Less is known about how such individual differences influence the recognition of subtle (low-intensity) as opposed to 'full-blown' (high-intensity) levels of emotional expression. This nuance is important for understanding how ERA translates into effective processing of 'everyday' social interactions, which are typically characterised by emotional expressions of low-to moderate intensity (Motley & Camden, 1988). For instance, sex differences in ERA may be more prominent with subtle than with prototypical expressions (e.g., Hoffmann et al., (2010); c.f., Wingenbach et al. (2018). To better understand how EI contributes to adaptive social outcomes (e.g., Elfenbein, Marsh, & Ambady, 2002), the current study examined associations between EI and the recognition of low-intensity, dynamic facial cues of emotion.

1.2 The relationship between ERA and EI

Theoretically, ERA should be associated with EI, whether measured at the trait or ability level. Trait EI (TEI) taps self-reported emotional competency (e.g., perceived emotional control) and personal qualities (e.g., assertiveness); ability EI (AEI) indexes emotional skills (e.g., emotion perception, management etc.) through IQ-style testing. Both aspects are important for social adaptation, but relate to adjustment processes in qualitatively and quantitively different ways (e.g., Davis & Humphrey, 2014). The AEI perspective locates ERA at the core of a set of specialist, emotion-related cognitive skills, underpinning 'strategic' emotion understanding and management that are essential for effective social interaction (Elfenbein & MacCann, 2017; Mayer & Salovey, 1997). In contrast, TEI reflects confidence in emotional skills and emotion-related personality traits (Petrides, Pita, & Kokkinaki, 2007),

tapping known psychosocial correlates of ERA acquired through learned, social experiences (Hall, Andrzejewski, & Yopchick, 2009). However, despite theoretical links, research findings are equivocal: some studies report a moderate relationship between strategic AEI skills and ERA (Farrelly & Austin, 2007, study 2; MacCann et al., 2011; Roberts et al., 2006), while others find none (e.g., DeBusk & Austin, 2011; Farrelly & Austin, 2007, study 1). Data relating TEI to ERA are also inconsistent (e.g., Matthews et al., 2015; c.f. Petrides & Furnham, 2003). Together, such findings raise questions about whether existing measures of AEI and TEI are sensitive enough to represent individual differences in socially-relevant aspects of emotion recognition.

For instance, EI may not confer an advantage in recognizing the prototypical static facial expressions that are used in most studies (often reporting ceiling effects; MacCann et al., 2011). Instead, EI may be more predictive of performance on *challenging* tasks, such as those requiring the detection and recognition of briefly presented or subtle emotional cues (Fiori, 2009). Notably, studies that used such tasks have reported non-significant associations between EI and ERA (e.g., DeBusk & Austin, 2011; Matthews et al., 2015), suggesting that measures of EI may not capture the ability to recognize subtle nonverbal emotional cues (Castro, Cheng, Halberstadt, & Grühn, (2016).

Further, EI may not predict ERA beyond the influence of conceptually related correlates, such as information-processing ability (Murphy & Hall, 2011) and psychosocial factors (Hall, Andrzejewski, & Yopchick, 2009). Previous validation research argues that both TEI and AEI are sufficiently distinct from such associated constructs that they show unique predictive effects for emotion-related outcomes (Andrei, Siegling, Aloe, Baldaro, & Petrides, 2016; MacCann, Joseph, Newman, & Roberts, 2014). However, studies directly testing this assertion with broader emotion processing tasks have not supported that claim (Fiori &

Antonakis, 2012; Matthews et al., 2015). Determining the association between EI and ERA advances our understanding of cognitive mechanisms underpinning emotional processing (e.g., attentional processes, retrieval efficiency, etc.), but also has practical implications for the delivery and content of EI training programmes in schools and workplace settings (Hodzic, Scharfen, Ripoll, Holling, & Zenasni, 2017).

1.3 Aims and objectives

We aim to clarify ongoing debates about the association between EI and ERA by examining whether those high on A/TEI show an advantage in the detection of subtle vs. 'full-blown' dynamic displays of facial emotions (happiness, sadness, fear, anger, surprise, disgust), akin to expressions encountered in daily interpersonal interactions. We predict that higher T/AEI will be associated with more accurate recognition of both low- and high-intensity emotions. As a secondary objective, we examine whether predictive effects of EI persist after controlling for known covariates (cognitive ability and internalizing symptoms).

2. Method

2.1 Participants

92 adults (79% female) ages 18–64 years (Mean age = 27.80; *SD* = 11.57) were recruited from a University in the West Midlands, UK. Participants consented to complete a battery of online psychometric measures prior to a lab-based emotion recognition task. The project received University Research Ethics Board approval.

2.2 Measures

2.2.1 Emotional Intelligence (EI)

The 19-item Brief Situational Test of Emotional Understanding (STEU-B; Allen, Weissman, Hellwig, MacCann, & Roberts, 2014) and 18-item Brief Situational Test of Emotion Management (STEM-B; Allen et al., 2015) indicated strategic ability EI. STEU-B

items tap emotion knowledge, scored as correct or incorrect (max. score = 42; AEI-EU), 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*". STEM-B requires participants to choose the most effective strategy for managing own/others' emotions in 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 (scoring range: 90.60 – 219.40; AEI-EM). Both tests demonstrate good internal consistency and test-retest reliability (Allen et al., 2014; 2015). The 30-item Trait Emotional Intelligence Questionnaire-Short Form (Petrides, 2009) taps self-perceptions of Sociability, Emotionality, Self-control and Wellbeing (e.g., "*Many times, I can't figure out which emotion I'm feeling*"), using a seven-point scale ('strongly disagree (1)' to 'strongly agree (7)'). Total scores range from 30–210 (TEI). Expected estimates of internal consistency for each measure are presented in *Supplemental Table 2*.

2.2.2 Dynamic emotion recognition

The Emotion Recognition Task (Kessels et al., 2014; Montagne, Kessels, De Haan, & Perrett, 2007) is a 10-minute, computer-based paradigm displaying videos of 6 facial emotional expressions (happy, sad, angry, fearful, disgusted, surprised) modelled by Caucasian adult males and females. Across 4 blocks of 24 trials, participants watch video clips of increasing length depicting facial expressions morphing from neutral to emotional across variable levels of intensity (40%/subtle, 60%, 80%, 100%/full-blown). Expressions are matched to one of 6 emotion labels displayed on portable tablet screen. The ERT is sensitive to individual differences in ERA in normative and clinical groups (e.g., Kessels et al., 2014). Performance was indexed by the unbiased hit rate (H_u; Wagner, 1993), which corrects raw accuracy estimates by accounting for response biases. H_u was calculated for each emotion type and

intensity level, yielding 24 values of H_u for each participant. Following Wagner (1993), H_u values were arcsine-transformed prior to analyses.

2.2.3 Covariates: Cognitive ability and internalising symptoms

A 24-item Esoteric Analogies task (e.g., "*MANY is to FEW as OFTEN is to: FREQUENT/NEVER/ALWAYS/SELDOM*"), and a 15-item Letter Series task (e.g., "*Determine the next letter in a given sequence: A-B-C-D-E-F?*") were taken from the Quickie Test Battery (Stankov, 1997) to indicate Crystallized and Fluid IQ respectively (Roberts & Stankov, 1999). Items were scored as correct or incorrect, and totalled to create Gc/Gf summed scores.

The depression and anxiety subscales of the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) asks participants to rate how often each of 14 statements (e.g., *"I look forward with enjoyment to things"*) has been true for them recently using a 4-point scale ('as much as I ever did (0)' to 'hardly at all (3)'). Following reversals, higher summed item values (range 0 - 21) represent higher levels of disorder. The HADS has been comprehensively validated in clinical and community samples (Bjelland, Dahl, Haug, & Neckelmann, 2002).

2.3 Analytical plan

A general linear model examined the effects of Emotion (within-subject variable, 6 levels: anger, disgust, fear, happiness, sadness, surprise), Intensity (within-subject variable, 4 levels: 40%, 60%, 80%, 100%), and mean-centered total scores for Trait EI (TEI), Ability EI for emotion understanding (AEI-EU), and Ability EI for emotion management (AEI-EM) on participants' accuracy (H_u). All EI variables were entered simultaneously into the model to identify variables that predicted emotion recognition performance above and beyond the influence of the other related variables. Participant sex (female vs. male) was entered as a control variable, given known differences in facial emotion recognition skills (e.g., Hall et al.,

2010; Hoffman et al., 2010). Greenhouse-Geisser corrections were applied based on results of Mauchly's test of sphericity (all *p*s < .05).

To examine whether associations between EI and ERA persisted when accounting for known covariates of EI, we computed a secondary analysis in which mean-centered scores for depression, anxiety, crystallized IQ, and fluid IQ were added to the above model.

2.3.1 Power analysis

The full sample (*n*=92) was powered at 66% and 97% for medium and large effects, respectively (f = .25 and f = .40; G*Power), with α=.05, numerator df=1, and 28 groups [(6 emotion types x 4 levels of intensity) + 4 predictors]. However, during data analysis, we discovered an error in the program used for data collection that occasionally counted double-clicks as two responses[1]. As a result, some participants (57%; *n*=52) did not see 95 unique trials of facial stimuli. H_u is robust to missing data at a trial-by-trial level because its computation accounts for the number of times a stimulus type was seen. However, although all 92 participants saw at least one trial of each emotion at 40%, 60%, and 80% intensity, missing data occurred for some participants who saw no 100% exemplars of anger (*n*=6), disgust (*n*=12), fear (*n*=18), happiness (*n*=31), sadness (*n*=9), or surprise (*n*=7). As a result, only 61 participants had data in each cell of emotion type and intensity level. This reduced sample was powered at 47% and 86% for medium and large effects, respectively (α=.05, numerator df=1, and 24 groups [(6 emotion types x 3 levels of intensity) + 4 predictors]). We executed our planned analytical model (described above) with the reduced sample (*n*=61), and a reduced model removing 100% intensity trials (for which there were missing data) in the full sample (*n*=92). Results were nearly identical across both models[2], suggesting our findings were robust

[1] The online versions of the ERT released prior to Version 1.0.0.7 in April 2019 erroneously count double-clicks as two responses and adjust the number of remaining trials to be presented accordingly.
[2] In the original model (section 3.1), all effects are identical except for the interaction of AEI-EU and Emotion type (non-significant). In the expanded model with additional covariates (section 3.2), all effects are identical (with an additional interaction of Intensity and crystallized IQ; see Supplemental Materials for details).

to unplanned decrements in sample size. We report the planned analysis in the main text, but small to medium effects should be interpreted with caution.

3. Results

Means and standard deviations for emotion recognition accuracy are provided in Table 1, with summary statistics and intercorrelations for predictor variables in Table 2.

3.1 Can EI predict recognition of subtle displays of facial emotion?

The full factorial model is presented in *Supplemental Table 1*. There was a main effect of Emotion type on ERA, $F(3.32, 185.79) = 64.45$, $p < .001$, $\eta^2 = .54$: happiness was the best recognized emotion, followed by anger, disgust, sadness, surprise, and fear (all significantly different from one another [*p*s < .01], except for sadness and surprise, $p = .38$). There was also a main effect of Intensity, $F(2.55, 142.54) = 18.76$, $p < .001$, $\eta^2 = .25$, whereby accuracy was greater at higher levels of intensity (all *p*s < .05, although performance was equivalent at 80% and 100%, $p = .74$]). Those effects were qualified by a small magnitude interaction between Intensity and Emotion type, $F(8.89, 497.69) = 2.18$, $p = .02$, $\eta^2 = .04$. Simple-effects tests revealed accuracy was greater at higher levels of intensity for most expressions, except for surprise, which did not change across intensity levels (see Figure 1).

Further, there was a main effect of emotion understanding (AEI-EU) on accuracy, $F(1,56) = 7.95$, $p < .01$, $\eta^2 = .12$, such that higher scores were associated with better performance on the task (Figure 2). There was also a small magnitude interaction between AEI-EU and Emotion type, $F(3.32, 185.81) = 2.89$, $p = .03$, $\eta^2 = .05$), such that high AEI-EU was particularly predictive of better performance in identifying anger, disgust, and sadness (see *Supplemental Materials*). AEI-EM, TEI, and Sex were not associated with accuracy (*p*s > .35).

3.2 Do EI-related effects persist when controlling for known covariates?

In the secondary analysis that includes the above correlates of EI, the effects of Emotion, $F(3.28, 170.42) = 62.37$, $p < .001$, $\eta^2 = .55$, Intensity, $F(2.49, 129.56) = 14.18$, $p < .001$, $\eta^2 = .21$, and the small magnitude interaction of Intensity and Emotion, $F(8.87, 461.25) = 2.07$, $p = .03$, $\eta^2 = .04$, remained unchanged. AEI-EU no longer predicted performance ($p = .98$, $\eta^2 < .001$), nor did other EI variables ($ps > .29$). There was a small magnitude effect of Sex, $F(1, 52) = 4.10$, $p = .048$, $\eta^2 = .07$, with females outperforming males on the ERA task. Crystallized IQ also predicted performance, $F(1, 52) = 7.59$, $p < .01$, $\eta^2 = .13$, whereby higher scores were related to greater ERA performance (*Supplemental Figure 2*). There were no effects of fluid IQ, depression, or anxiety ($ps < .15$). This complex model is likely overfitted for the sample size, but results suggest that broader cognitive abilities associated with AEI (e.g., crystallized IQ) may be more predictive of facial emotion recognition performance than TEI or related mood variables.

4. Discussion

Our findings suggest that high levels of strategic emotion understanding (AEI-EU) are associated with more accurate recognition of both low- and high-intensity dynamic facial emotions. However, that effect was not distinct from the influence of general cognitive ability (*viz* acquired knowledge/crystallized ability). We also show that TEI (together with allied psychosocial variables of depression/anxiety) does not predict ERA. Taken together, our findings question whether (1) the current measures of EI are limited in the information they can provide about emotion recognition and (2) EI can incrementally predict task performance beyond related variables, such as general cognitive ability.

4.1 AEI scores are associated with dynamic facial emotion recognition, but not beyond IQ

The predictive effect of emotion knowledge for identifying subtle to intense emotional displays coheres with and *extends* prior findings limited to examining ERA of intense facial

emotion (Farrelly & Austin, 2007, study 2; MacCann et al., 2011; Roberts et al., 2006). That emotion knowledge is especially useful for detecting negatively valanced emotion (anger, disgust, sadness) also accords with the notion that specific skills may subserve ERA for different families of emotions (Schlegel et al., 2012), and with the emotion-specific factor structure of the STEU (comprising anger, sadness and fear; MacCann et al., 2011). However, our findings show that emotion knowledge does not predict ERA above and beyond the effect of crystallised knowledge.

This converges with research supporting the association between ERA and cognitive ability (Hall et al., 2010; Schlegel et al., 2010) and feeds into the long-standing debate concerning the construct validity of AEI (e.g., Fiori & Antonakis, 2012). Moderate correlations between strategic emotion knowledge and crystallized ability are commonly found (e.g., MacCann et al., 2011; Roberts et al., 2006) and, whilst some researchers argue that this shows AEI *is* a form of intelligence (i.e., positive manifold), questions remain over the distinctiveness of 'emotion-specific' knowledge. The STEU and Esoteric Analogies tasks used in the current study are untimed, employ similar multiple-choice response formats, and tap stored (acculturated) knowledge and verbal ability. Since successful ERA performance does not require extensive verbal fluency, we can infer that *general* information processing resources common to all three tasks (e.g., skills in test-taking/learning, retrieval of information, attention), rather than emotion-specific resources (e.g., template matching) promoted successful performance. When variations in the mode of presentation or sensory modality are primary task features (over emotional content), general vs. emotional processing skills may be drawn upon to a greater extent (MacCann et al., 2011).

4.2 ERA and TEI

TEI did not predict emotion recognition accuracy, suggesting that self-evaluations of emotional skill do not predict actual performance. This is in line with Matthews et al., (2015), who found TEI did not relate to enhanced detection of micro-expressions, or visual search skills for emotional stimuli. Since TEI represents a mixture of emotional self-concept and emotion-related personality traits, effects of TEI may be evident in broader tests of interpersonal sensitivity, where positive traits are important for predicting characteristics and behaviour of individuals within affective contexts (Hall et al., 2009). In this sense, TEI may be beneficial for ongoing management of social encounters, rather than de-contextualised decoding of cues in performance-based settings.

Our data also suggest that TEI (measured by the TEIQue) is not sufficiently distinct from measures of mental health. As with AEI, debate concerning the distinctiveness and novelty of TEI continues (Alegre, Pérez-Escoda, & López-Cassá, 2019; cf. Andrei et al., 2016); we encourage researchers to scrutinize the unique predictive effects of TEI in performance-based settings.

4.3 Conclusions

Dynamic ERA is associated with scores on a measure of strategic emotional knowledge, but effects cannot be discriminated from crystallised intelligence. TEI shows no association with ERA. At worst, this calls into question the validity of the global EI construct; at best, this may be a measurement issue, where current EI tools are inadequate for representing socially-relevant aspects of emotion recognition. Those with high AEI may well possess a distinct form of emotional ability to interact effectively in everyday situations, but popular measures only capture effortful emotional processing about emotional experience (Fiori 2009; Roberts et al., 2006). This limitation is not just directed at the STEU, but other EI measures too. There have been repeated calls in the literature for improved measures of emotion

317 recognition (Castro et al., 2016), and specifically AEI testing (e.g., Schlegel & Mortillaro,
318 2019); some progress has been made towards this, and it may now be time for the field to
319 switch to, or to integrate, more innovative applied tests that can capture spontaneous
320 performance. Doing so will be particularly important to establish the utility of EI training in
321 school- and workplace interventions.

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Table 1. Mean (standard deviation) unbiased hit rate in the emotion recognition task

Emotion type	40%	60%	80%	100%
Anger	1.52 (0.60)	1.78 (0.53)	1.90 (0.62)	2.05 (0.90)
Disgust	1.29 (0.54)	1.59 (0.61)	1.72 (0.70)	1.75 (0.91)
Fear	0.63 (0.59)	0.59 (0.70)	0.74 (0.71)	0.82 (0.88)
Happiness	1.62 (0.38)	2.02 (0.39)	2.03 (0.39)	2.20 (0.56)
Sadness	0.67 (0.54)	1.05 (0.90)	1.40 (0.86)	1.26 (1.03)
Surprise	1.03 (0.47)	1.02 (0.44)	1.11 (0.44)	1.07 (0.71)

Table 2. Bivariate correlations, reliabilities and descriptive statistics for predictor variables

	TEI	AEI-EU	AEI-EM	Crystallized IQ	Fluid IQ	Depression	Anxiety
TEI	-						
AEI-EU	.27**	-					
AEI-EM	-.04	.28**	-				
Crystallized IQ	.16	.48**	.18	-			
Fluid IQ	.11	.30**	.08	.65**	-		
Depression	-.70**	-.04	.12	-.03	.10	-	
Anxiety	-.62**	-.12	.10	-.04	.11	.66**	-
Mean	146.43	11.92	11.33	15.01	11.33	4.43	8.92
SD	(24.90)	(2.65)	(2.03)	(4.30)	(2.17)	(3.44)	(4.60)
α	.91	.60	.58	.79	.68	.86	.77

Note. TEI: trait EI; AEI-EU: AEI emotion understanding; AEI-EM: AEI emotion management.
** $p < .01$.

Figure 1. Accuracy (H_u) for each emotion type across intensity levels

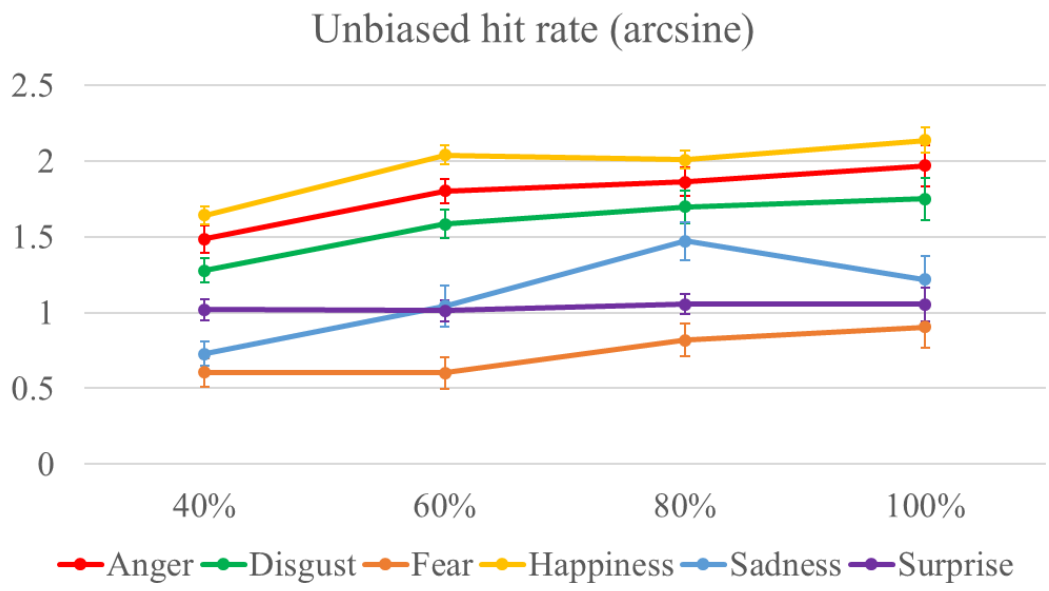
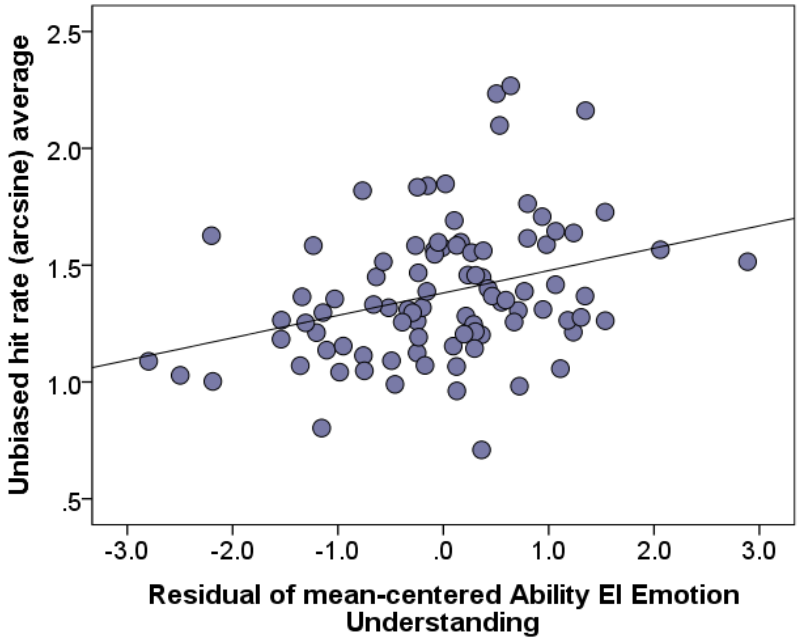


Figure 2. Association between AEI emotion understanding (AEI-EU) and unbiased hit rate



Note. AEI-EU on the *x*-axis is a residual of mean-centered AEI-EM (emotion management), mean-centered Trait EI, and Sex.

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Ms. Ref. No.: Ref: PAID-D-20-00090

Ability EI predicts recognition of dynamic facial emotions, but not beyond the effects of crystallized IQ

Credit Author Statement

Sarah K. Davis: Conceptualization, Methodology, Investigation, Project administration, Writing – Original Draft. **Michele Morningstar**: Formal analysis, Investigation, Writing – Review and Editing. **Pamela Qualter**: Investigation, Writing – Review and Editing.

Ability EI predicts detection of subtle emotional expressions, but not beyond the effects of crystallized IQ

Supplemental Materials

General linear model with 3 intensity levels (*n* = 92)

The main effect of Emotion, $F(3.46, 300.73) = 93.92$, $p < .001$, $\eta^2 = .52$, main effect of Intensity, $F(2, 174) = 21.21$, $p < .001$, $\eta^2 = .20$, and of Intensity and Emotion, $F(7.22, 628.23) = 3.99$, $p < .001$, $\eta^2 = .04$, remain significant in this amended model. AEI-EU predicts accuracy, $F(1, 87) = 6.75$, $p = .01$, $\eta^2 = .07$. There are no effects of TEI, AEI-EM, or Sex, nor is there an interaction of AEI-EU and Emotion ($p = .16$).

General linear model with 3 intensity levels (*n* = 92), including additional covariates

The main effect of Emotion, $F(3.45, 286.27) = 90.70$, $p < .001$, $\eta^2 = .52$, main effect of Intensity, $F(2, 166) = 16.04$, $p < .001$, $\eta^2 = .16$, and interaction of Intensity and Emotion, $F(7.25, 601.40) = 3.76$, $p < .001$, $\eta^2 = .04$, remain significant in this amended model. Crystallized IQ predicts accuracy, $F(1, 83) = 5.95$, $p = .02$, $\eta^2 = .07$. There is also an interaction of crystallized IQ and Intensity, $F(2, 166) = 5.04$, $p < .01$, $\eta^2 = .06$, such that the effect of crystallized IQ is more predictive of accuracy at 80% intensity than at lower intensities (see Supplemental Figure 1). There are no effects of TEI, AEI-EU, AEI-EM, Sex, depression, or anxiety.

Parameter estimates for interaction of AEI-EU and Emotion

Parameter estimates suggested that greater levels of AEI-EU were associated with higher recognition of 40% anger, $\beta = .27$, $p = .04$, 60% anger, $\beta = .29$, $p = .03$, and 100% anger, $\beta = .29$, $p = .03$. AEI-EU was also related to greater recognition of 40% disgust, $\beta = .32$, $p = .02$, and 100% disgust, $\beta = .30$, $p = .03$, as well as 60% sadness, $\beta = .27$, $p = .046$, and 40% surprise, $\beta = .27$, $p = .047$.

519 *Supplemental Table 1*. Parameter estimates for planned, full-factorial general linear
520 model (4 levels of Intensity, *N*=92)

Effect	*df*	*F*	*p*	η^2
TEI	(1, 56)	.88	.35	.02
AEI-EU	(1, 56)	7.95	<.01	.12
AEI-EM	(1, 56)	.03	.87	<.001
Sex	(1, 56)	.01	.92	<.001
Intensity	(2.55, 142.54)	18.76	<.001	.25
Intensity x TEI	(2.55, 142.52)	2.27	.09	.04
Intensity x AEI-EU	(2.55, 142.52)	0.65	.56	.01
Intensity x AEI-EM	(2.55, 142.52)	.35	.76	<.01
Intensity x Sex	(2.55, 142.52)	.21	.86	<.01
Emotion	(3.32, 185.79)	64.45	<.001	.54
Emotion x TEI	(3.32, 185.81)	1.22	.30	.02
Emotion x AEI-EU	(3.32, 185.81)	2.89	.03	.05
Emotion x AEI-EM	(3.32, 185.81)	.15	.94	<.01
Emotion x Sex	(3.32, 185.81)	.70	.57	.01
Intensity x Emotion	(8.77, 497.69)	2.18	.02	.04
Intensity x Emotion x TEI	(8.89, 472.88)	1.05	.40	.02
Intensity x Emotion x AEI-EU	(8.89, 472.88)	.88	.55	.02
Intensity x Emotion x AEI-EM	(8.89, 472.88)	1.28	.25	.02
Intensity x Emotion x Sex	(8.89, 472.88)	.93	.50	.02

521 *Note*. All continuous variables (TEI, AEI-EU, AEI-EM) are mean-centered before
522 inclusion in the model. *df* = degrees of freedom; η^2 = partial eta squared.

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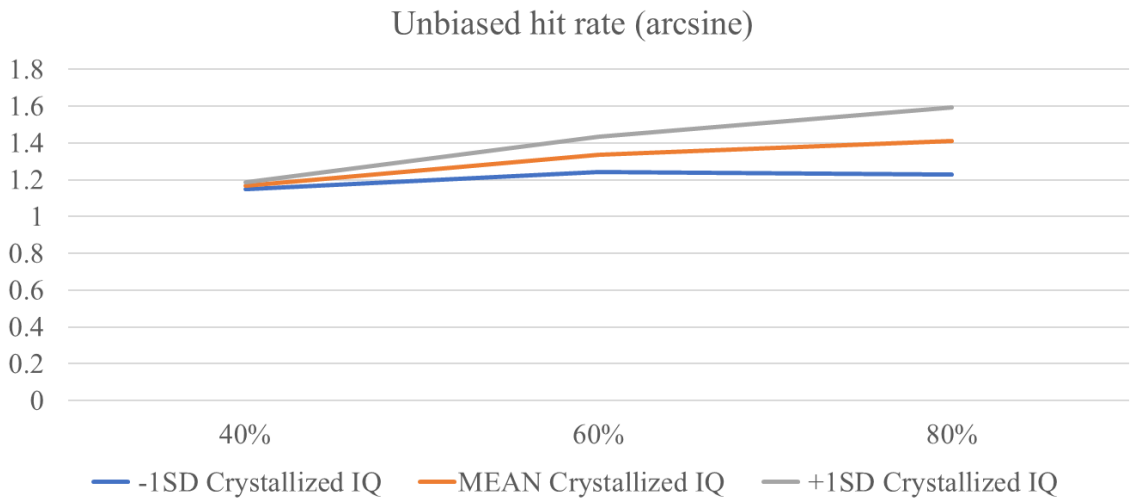
Supplemental Table 2. Expected Cronbach alpha (α) for predictor variables measured

	Expected α
Brief Situational Test of Emotional Understanding (AEI-EU)	.72[a]
Brief Situational Test of Emotion Management (AEI-EM)	.84[b]
Trait Emotional Intelligence Questionnaire-Short Form (TEI)	.85[c]
Quickie Test Battery, Esoteric Analogies (Crystallized IQ)	.70 - .78[d]
Quickie Test Battery, Letter Series (Fluid IQ)	.64 - .72[e]
Hospital Anxiety and Depression Scale (HADS), Anxiety	.80[f]
Hospital Anxiety and Depression Scale (HADS), Depression	.76[f]

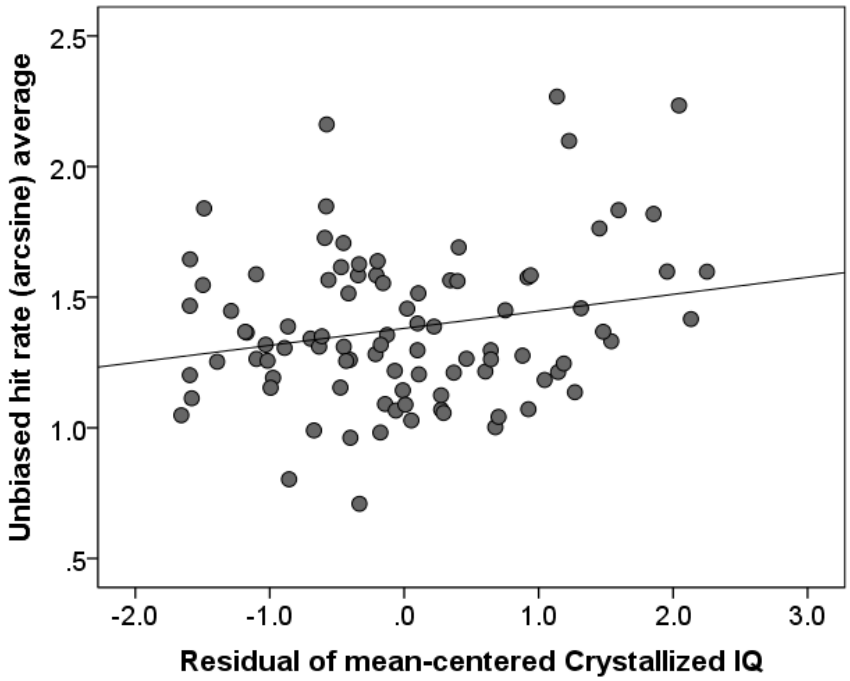
a. Allen, Weissman, Hellwig, MacCann, & Roberts, 2014 (full reference in text)
b. Allen et al., 2015 (full reference in text)
c. Petrides, 2009 (full reference in text)
d. Roberts et al., 2006 (full reference in Supplemental Materials)
e. Stankov & Cregan, 1993 (full reference in Supplemental Materials)
f. Mykletun, Stordal, & Dahl, 2001 (full reference in Supplemental Materials)

Supplemental Figure 1. Association between crystallized IQ and unbiased hit rate across different levels of intensity.



Note. SD = standard deviation.

Supplemental Figure 2. Association between Crystallized IQ and unbiased hit rate



Note. Crystallized IQ on the *x*-axis is a residual of mean-centered AEI-EU (ability emotional intelligence – emotion understanding), AEI-EM (ability emotional intelligence - emotion management), TEI (trait emotional intelligence), Fluid IQ, Anxiety, Depression, and Sex.

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