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Empathy costs: Negative emotional bias in high empathisers

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ABSTRACT

Excessive empathy has been associated with compassion fatigue in health professionals and caregivers. We investigated an effect of empathy on emotion processing in 137 healthy individuals of both sexes. We tested a hypothesis that high empathy may underlie increased sensitivity to negative emotion recognition which may interact with gender. Facial emotion stimuli comprised happy, angry, fearful, and sad faces presented at different intensities (mild and prototypical) and different durations (500 ms and 2000 ms). The parameters of emotion processing were represented by discrimination accuracy, response bias and reaction time. We found that higher empathy was associated with better recognition of all emotions. We also demonstrated that higher empathy was associated with response bias towards sad and fearful faces. The reaction time analysis revealed that higher empathy in females was associated with faster (compared with males) recognition of mildly sad faces of brief duration. We conclude that al-though empathic abilities were providing for advantages in recognition of all facial emotional expressions, the bias towards emotional negativity may potentially carry a risk for empathic distress.

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1. Introduction

Empathy as the ability to share and understand another person's feelings has been known to underlie effective social interactions (Baron-Cohen and Wheelwright, 2004; Singer and Lamm, 2009).

Empathy is a multidimensional construct. Researchers in the field have traditionally described two facets of empathy: emotional empathy and cognitive empathy (for review see Gonzalez-Liencres et al., 2013). Apart from the above aspects of empathy, some authors (Decety and Jackson, 2004; Decety and Lamm, 2006) have outlined the control mechanisms that regulate whether someone's empathic reactions are self or other-oriented.

Zahn-Waxler et al. (2000) emphasised that empathy is a necessary component of emotional health and well-being. The authors postulated that deviations towards either low or excessive empathy are reflected in different forms of psychopathology. In particular, the empathy deficits have been observed in psychiatric disorders that are known for poor interpersonal relationships e.g. Autism spectrum disorders (Sucksmith et al., 2013; Dapretto et al., 2006) and psychopathy (Mullins-Nelson et al., 2006). On the other hand, excessive empathy has been associated with vulnerability to emotional disorders in health professionals and caregivers. These conditions have been described under different terms-empathic distress, compassion fatigue or burnout, all of which were associated with an intense sharing of the other's negative emotions (Batson et al., 1987; Eisenberg et al., 1989; Gleichgerrcht and Decety, 2012). It has been also found that emotional empathy in caregivers positively correlated with emotional exhaustion (Williams, 1989) or with decreased life satisfaction (Lee et al., 2001).

In order to better understand mechanisms of distress in high empathisers, it would be useful to investigate relationships between empathic abilities and individual characteristics of emotion processing. Facial emotion recognition has been known as reliable tool for emotion research (Leppanen, 2006). Studies in non-clinical populations have demonstrated positive relationships between self-reported emotional empathy and facial emotion recognition. Thus, study of Besel and Yuille (2010) using fearful expressions of varying durations (50 ms and 2000 ms) demonstrated superior facial emotion recognition in high vs. low empathisers. Gery et al. (2009) employed a paradigm with different emotions (anger, disgust, fear, happiness, neutral, sadness, and surprise) of varying intensity and found a main effect of empathy on emotion recognition. A meta-analysis (Marsh and Blair, 2008) showed deficits of fearful facial emotion recognition among antisocial populations. The authors emphasized that lack of empathy was one of the characteristics common for all study samples included - which lends support to the link between empathy and facial affect

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recognition. However, a study of patients with traumatic brain injury vs. control participants (Neumann et al., 2014) reported no significant association between affect recognition and the affective empathy as measured by Empathic Concern subscale of Interpersonal Reactivity Index (Davis, 1983). The authors acknowledged that these results were unexpected, which may have been due to the use of different methods (affect recognition task and empathy measure) compared with other studies. A replication of the above results on larger sample has been proposed. Importantly, the data were not controlled for depression, anxiety and cognitive/neuropsychological status which may have been important covariates with empathy and affect recognition. Therefore, the generalisability of the above findings is limited.

Thus, although there are some indications of positive association between empathy and facial affect recognition, more research on non-clinical populations is warranted.

Importantly, the emotion recognition and empathy have been found to interact with sex. Riggio et al. (1989) employed a paradigm with faces expressing a range of emotions (happiness, sadness, anger, disgust, fear and surprise vs. neutral faces). In the whole sample, emotional empathy index was positively correlated with the ability to recognise emotional expressions. However, if taken separately by male and females, the positive correlations between emotional empathy and the emotion recognition seemed to hold only for female subjects. There was a negative relationships for male subjects between the scores of IRI personal distress and success in emotion recognition task. The interaction of sex and empathy during facial affect recognition was demonstrated in neuroimaging study (Rueckert and Naybar, 2008) adding to the notion of neurobiological mechanisms of empathy.

Females in general have been known to outperform the males in recognising others' facial expressions, especially negative ones (Hampson et al., 2006; Thompson and Voyer, 2014).

On the other hand, women have been consistently found to score higher in empathy, compared with men (Hoffman, 1977; Rueckert and Naybar, 2008; Baron-Cohen, 2010; Perry et al., 2013). The gender effect is observable as early as the age 5–7 (Hastings et al., 2000) and has been demonstrated not only in Western but also in Asian populations (Shashikumar et al., 2014). The authors of recent review argued that these gender differences in empathy have phylogenetic and ontogenetic roots in biology and are not merely cultural by-products driven by socialisation (Christov-Moore et al., 2014).

Taken together, the studies suggest that empathy either on its own or in interaction with sex could contribute to individual differences in emotion processing. It is less clear, whether the empathy improves recognition of all emotions or there is a valence – specific effect, e.g. better recognition of positive or negative emotions.

We have designed our study with the aim to examine the effects of empathy and sex on emotion processing in healthy individuals.

We employed an experimental task involving facial affect recognition of four emotional expressions – fearful, angry, happy and sad. This neuropsychological paradigm differed from the above mentioned affect recognition tasks (Besel and Yuille, 2010; Gery et al., 2009) in that it combined three different factors: there were four types of emotions, presented at various degrees of intensity and at different durations. The expressions were either of mild (50%) or prototypical (100%) degree and were presented at two different durations – 500 ms and 2000 ms. By employing rapid stimuli of mild degree we attempted to bring the experimental conditions closer to everyday life where the emotional signals are far less intense than are the prototypical facial expressions that are contained in standardized picture sets (LeMoult et al., 2009). In terms of presentation timing, it has been proposed that testing accuracy to briefly presented expressions presumably isolates an important early component of the empathy process, accessing a more automatic level of emotion processing (Besel and Yuille, 2010).

We set out to experimentally test the following hypotheses:

- 1. Based on the reports of excessive sharing of negative affect by high empathisers, and the evidence of empathisers' superiority in facial emotion recognition, we predicted that high empathisers will outperform low empathisers in processing of emotionally negative faces.
- 2. Based on females' superiority in recognising negative emotions and their greater ability to empathise (compared with males), we predicted that females with high levels of empathy will perform better than males in identifying negative facial emotions.

2. Methods

2.1. Participants

The sample comprised 137 students and staff (92 females) of Ilia State University in Tbilisi, Georgia, who were recruited by advertising via the website.

All participants were White Caucasians, neuro-psychiatrically healthy, with normal or corrected to normal vision, and no reported history of mental illnesses. The SCID screen (First et al., 2007) was used to exclude any mental illness, organic brain injury or substance abuse. Each participant signed an informed consent form. The study was approved by the Academic Committee of the llia State University. The experimental procedure was in accordance with the ethical standards of the World Medical Organization (1996). The demographical and psychometric data are detailed in Table 1.

2.2. Instruments

Wechsler Adult Intelligence Scale (WAIS-III, Wechsler, 1997) subtests of Block design and Matrix reasoning were administered and composite pro-rated scores and full-scale IQ were derived.

The following self-administered questionnaires were employed:

Empathy Quotient EQ (Baron-Cohen and Wheelwright, 2004). This instrument provides for measurement of trait Empathy. It has been demonstrated that EQ appears to be picking up considerable individual, sex, and group differences, in both a general population sample and a clinical sample. The questionnaire comprises 60 statements (40 tapping on empathy and 20 filler statements). Responses are given on a 4-point Likert scale. Scores can range from 0 to 80. The original version of the EQ showed acceptable internal consistency, concurrent and convergent validity, and good

Table 1

Demographic and psychometric data.

	Females (92)	Males (45)	<i>t</i> (df)	Significance (p)
Age (SD)	29.9 (9.6)	24.9 (6.5)	t(134)=3.6	0.000
IQ (SD)	104.6 (11.3)	106.6 (11.6)	t(135)=	0.34
			0.96	
Education years	12.2 (3.1)	12.0 (4.1)	t(135) =	0.74
(SD)			0.33	
EQ (SD)	45.2 (10.1)	40.53 (10.0)	t(134) = 2.5	0.011
STAI trait (SD)	39.34 (9.48)	35.47 (7.59)	t(134) = 2.3	0.018
STAI state (SD)	37.7 (11.9)	35.1 (8.3)	t(135) = 1.3	0.20

test-retest reliability (Baron-Cohen and Wheelwright, 2004; Lawrence et al., 2004). The original English EQ has been validated in Japanese (Wakabayashi et al., 2007); French (Berthoz et al., 2008) and Italian (Preti et al., 2011).

State-Trait Anxiety Inventory STAI (Spielberger et al., 1983). This instrument comprises 40 statements, and distinguishes between a person's state anxiety and their trait anxiety. When participants rate themselves on these statements, they are given a 4-point scale with degrees from 1 (not at all) to 4 (very much so). Higher score indicates higher level of either state or trait anxiety.

Both instruments were translated into Georgian following the back-translation procedure. First, the authors (LB, TG and NI) translated the items from English into Georgian. Then the Georgian items were back-translated into English and compared with the original English items. Finally the items where there was any discrepancy between the original English version and the back-translated one, were checked by bilingual colleagues and re-formulated as appropriate. The final versions of the Georgian STAI and EQ were similar to the original English versions. The measure of internal consistency (Cronbach's alpha) was above 0.75 for both translated instruments.

2.3. Experimental procedure

The procedure of facial expression recognition was based on the one used in an earlier study (Surguladze et al., 2004). There were four separate blocks, with one emotion per block, e.g. happy, angry, fearful or sad faces, intermixed with neutral faces. The facial stimuli were used from a standardised series Facial Expressions of Emotion: Stimuli and Tests FEEST (Young et al., 2002) where each emotional facial expression was morphed using computer software with the facial expression of the same individual to depict two different intensities: mild (50%) and prototypical (100%).

During the experiment, 80 black–white photographs with faces of 10 individuals were presented. Each emotional expression (i.e. 10 photographs with 50% and 10 with 100% emotion intensity), was presented twice during the block: for 500 ms (short condition) and 2000 ms (long condition). Total number of emotional faces was 40 per block. In the same block, 40 neutral faces were



High empathy associated with response bias to sad and fearful faces

Fig. 1. Association of empathy with response bias.

presented: 20 for 500 ms each and 20 for 2000 ms duration.

Each face was presented individually, with an inter-stimulus interval of 1500 ms, during the first 500 ms of which a fixation cross was displayed. Participants were instructed that they would view either emotional or neutral faces and were requested to label a facial expression – for example as "happy" or "neutral" by pressing one of the two buttons on a computer gamepad as quickly as they could. Duration of each emotional block was in average 2 min. Before testing, all participants performed practise trials to ensure they were able to perform the task.

2.4. Analysis

We have employed a two-high threshold (2-HT) approach based on a signal-detection theory (Corwin, 1994). This was used to produce the variables of discrimination accuracy Pr and response bias Br. The discrimination accuracy measure represents the ability to discriminate among neutral faces and emotional expressions. The response bias measure reflects the tendency of participants, when uncertain about the category to which a facial expression should belong, to categorize the expression as emotional rather than neutral.

The 2-HT approach is especially useful when numbers of criteria items (targets) and distractors differ, as was the case in the current study-there were 10 happy faces with 50% intensity, presented for 500 ms (targets) vs. 20 neutral faces presented for 500 ms (distractors) within the same block.

As described in the same paper (Corwin, 1994), when the numbers of targets and distractors are different, the differences between raw numbers are affected by response bias. Therefore the author suggested to use the hit rates and false alarm rates instead of raw numbers. For example, the discrimination accuracy is computed not as simply the difference between hits and false alarms, but as the difference between the hit rates and false alarm rates. In this case the denominators are the actual numbers of targets and distractors, respectively. Another problem addressed by 2-HT approach is a theoretical possibility of hit rates to reach the values of 1 and false alarm rates to equal 0. To correct for such a possibility, a simple transformation has been introduced i.e. 0.5 was added to each cell of the stimulus-response matrix. In this case, the transformed hit rate becomes a number of the hits plus 0.5 divided by the number of targets plus 1. Similarly, the transformed false alarm rate is the number of false alarms plus 0.5 divided by the number of distractors plus 1.

Thus, hit rate (HR) equals:

Number of hits
$$+ 0.5$$

Number of targets $+ 1$

False alarms rate (FAR) equals:

Number of false alarms + 0.5

Number of distractors + 1

Discrimination accuracy Pr was computed as a difference between the hit rates and false alarm rates: Pr=HR-FAR. Response bias Br was computed based on false-alarm rates and discrimination accuracy: Br=FAR/(1-Pr).

Log transformations were used when accuracy and response bias data were not normally distributed. For the purposes of analysis we have split the whole sample into two groups, based on median split of EQ, with one group having high EQ scores and another group with lower EQ. The Pr and RT data were entered into repeated measures ANOVA with 4 (emotion: happy, angry, fearful, and sad) \times 2 (duration: short, long) \times 2 (intensity: 50%, 100%) as within-group factors and empathy group (high, low) and gender (females, males) as between – group factors. There was no meaningful way to analyse the Br in terms of the intensity of

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Table 2

Discrimination accuracy Pr and response bias Br.

	Low empathy						High empathy						
	Total (68)		Female (38)		Male (30)		Total (64)		Female (51)		Male (13)		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Pr short													
Fear50	0.41	0.17	0.42	0.18	0.41	0.16	0.51	0.14	0.50	0.15	0.55	0.13	
Fear100	0.71	0.31	0.73	0.32	0.67	0.29	0.79	0.31	0.77	0.33	0.88	0.20	
Anger50	0.33	0.18	0.33	0.19	0.34	0.18	0.41	0.18	0.39	0.19	0.48	0.13	
Anger100	0.58	0.27	0.58	0.27	0.57	0.28	0.76	0.25	0.74	0.27	0.81	0.16	
Happy50	0.50	0.18	0.49	0.21	0.50	0.15	0.58	0.16	0.57	0.17	0.63	0.14	
Happy100	0.65	0.25	0.65	0.27	0.66	0.21	0.81	0.26	0.79	0.27	0.87	0.23	
Sad50	0.29	0.19	0.32	0.19	0.26	0.19	0.34	0.21	0.34	0.22	0.38	0.16	
Sad100	0.53	0.32	0.56	0.31	0.50	0.35	0.54	0.33	0.53	0.35	0.60	0.23	
Pr long													
Fear500	0.75	0.29	0.75	0.30	0.75	0.27	0.76	0.31	0.73	0.34	0.87	0.10	
Fear100	0.75	0.32	0.74	0.33	0.76	0.30	0.78	0.30	0.77	0.32	0.85	0.15	
Anger50	0.65	0.24	0.66	0.23	0.64	0.27	0.73	0.27	0.72	0.28	0.77	0.19	
Anger100	0.65	0.28	0.64	0.25	0.65	0.31	0.79	0.28	0.76	0.30	0.88	0.16	
Happy50	0.84	0.27	0.83	0.28	0.84	0.26	0.80	0.26	0.79	0.26	0.86	0.25	
Happy100	0.86	0.33	0.87	0.37	0.83	0.28	0.85	0.25	0.82	0.25	0.90	0.23	
Sad50	0.34	0.18	0.34	0.17	0.34	0.19	0.34	0.16	0.34	0.17	0.38	0.11	
Sad100	0.63	0.32	0.66	0.31	0.60	0.35	0.63	0.34	0.62	0.37	0.70	0.23	
Br mean													
Fear	0.24*	0.13	0.23	0.13	0.25	0.12	0.30	0.17	0.30	0.17	0.31	0.14	
Anger	0.23	0.16	0.22	0.16	0.24	0.16	0.26	0.15	0.26	0.16	0.25	0.14	
Нарру	0.26	0.15	0.27	0.17	0.25	0.12	0.25	0.16	0.24	0.16	0.29	0.18	
Sad	0.26**	0.17	0.24	0.15	0.29	0.20	0.34	0.18	0.33	0.17	0.35	0.22	

In bold: significant differences.

* Significant difference between low and high empathy groups: p=0.029. ** Significant difference between low and high empathy groups: p=0.015.

Significant unrefere between low and high empathy groups. p=0.01.

presented expressions, as the Br by definition is based on false alarm rates to neutral faces. Therefore the effect of intensity for Br data was not calculated.

Since the measures of STAI trait and age have been found to be associated with EQ, we have entered both these variables as covariates in ANOVAs.

3. Results

Compared with the female subgroup, males were significantly younger, had lower EQ and lower STAI trait scores.

3.1. Emotion discrimination accuracy Pr

Repeated measures ANOVA showed the following main effects:

- a. Main effect of duration: F(1,118) = 19.7; p < 0.001 which was accounted for by discrimination accuracy Pr being higher in a long condition (2000 ms) compared with the short one (500 ms).
- b. Main effect of emotion: F(3,96) = 51.7; p < 0.001, accounted for by better recognition of happy faces compared to other expressions.
- c. Main effect of EQ: F(1,98)=3.2; p=0.034 accounted for by better recognition of all facial expressions by people with higher EQ compared with those with lower EQ.
- d. Main effect of intensity: facial expressions of 100% were recognised better than those with 50% expression intensity F (1,94)=4.5; p=0.02.

There were no significant main effects of age (F[1,96]=0.066; p=0.798) or STAI trait (F[1,96]=0.626; p=0.431) and no significant interactions with any other variables (Table 2).

3.2. Response bias Br

Repeated measures ANOVA did not show any main effects of emotion (F[3,122]=1.02; p=0.38); EQ (F[1,124]=1.2; p=0.20); gender (F[1,124]=0.12; p=0.73); or duration (F[1,124]=0.04; p=0.85).

There was an interaction of emotion by EQ: F(3,121)=4.4; p=0.03. This was accounted for by the individuals with higher EQ having greater bias than those with lower EQ in conditions with sad (t[130]=2.5; p=0.015) and fearful (t[129]=2.2; p=0.029) faces.

In other words, the effect of EQ was expressed to the greatest degree in sad and fear conditions. There was no significant main effect or interaction of age and STAI trait with any other variables. Test of between-subjects effect of age: F(1,123)=1.84; p=0.177; STAI: F(1,123)=0.472; p=0.494 (Fig. 1).

3.3. Reaction time

Repeated measures ANOVA produced no main effects of emotion (F[3,119]=1.4; p=0.24), gender (F[1,121]=0.097; p=0.76), EQ (F[1,121]=.67; p=0.42), or duration (F[1,121]=1.2; p=0.28).

Main effect of intensity was detected: F(1,121) = 7.9; p = 0.006. This was accounted for by RT being faster to expressions with 100% intensity vs. those with 50%.

There was a significant interaction of emotion × intensity × duration × gender × EQ: F(6,36)=5.23, p=.022. This was accounted for by faster RT in females with high EQ compared with the males in conditions with mildly sad faces presented at short duration: t(61)=2.5; p=0.014.

There was a main effect of age: F(1,121)=8.8; p=0.004 and an interaction emotion × age: F(3,119)=6.5; p=0.013. The main effect reflected general slowing of RT with age.

An interaction was accounted for by differential relationship

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Table 3

Reaction time: means and standard deviations.

	Low EQ						High EQ						
	Total (68)		Female (38)		Male (30)		Total (64)		Female (51)		Male (13)		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
RT short													
Fear50	0.724	0.14	0.750	0.19	0.690	0.21	0.687	0.22	0.685	0.22	0.692	0.22	
Fear100	0.640	0.09	0.671	0.16	0.661	0.15	0.607	0.18	0.600	0.17	0.637	0.22	
Anger50	0.710	0.16	0.740	0.19	0.672	0.18	0.696	0.16	0.694	0.18	0.699	0.11	
Anger100	0.628	0.18	0.647	0.14	0.603	0.13	0.633	0.15	0.622	0.17	0.651	0.10	
Happy50	0.667	0.15	0.689	0.17	0.638	0.14	0.623	0.14	0.622	0.16	0.628	0.11	
Happy100	0.588	0.18	0.602	0.13	0.571	0.13	0.567		0.575		0.534		
Sad50*	0.830	0.19	0.832	0.23	0.827	0.21	0.666	0.24	0.634	0.21	0.790	0.26	
Sad100	0.722	0.22	0.739	0.20	0.700	0.18	0.663	0.18	0.627	0.18	0.669	0.19	
RT long													
Fear50	0.810	0.26	0.860	0.33	0.747	0.32	0.746	0.27	0.742	0.27	0.761	0.27	
Fear100	0.641	0.19	0.631	0.15	0.679	0.13	0.599	0.21	0.589	0.16	0.652	0.27	
Anger50	0.803	0.26	0.798	0.23	0.811	0.39	0.754	0.38	0.745	0.41	0.787	0.32	
Anger100	0.633	0.16	0.645	0.15	0.617	0.15	0.633	0.18	0.624	0.16	0.666	0.20	
Happy50	0.694	0.21	0.716	0.20	0.667	0.20	0.663	0.17	0.663	0.19	0.664	0.16	
Happy100	0.565	0.15	0.574	0.12	0.552	0.16	0.546	0.10	0.549	0.12	0.531	0.08	
Sad50	0.855	0.31	0.881	0.30	0.821	0.33	0.791	0.40	0.793	0.35	0.778	0.47	
Sad100	0.744	20	0.763	0.23	0.737	0.18	0.671	0.24	0.674	0.21	0.659	0.27	

50, 100 - per cent intensities of facial expressions.

In bold: significant difference.

* RT in females < males t(61)=2.5; p=0.014 in high empathy group.

between age and RT per emotional condition: there was no significant association between age and RT in angry faces condition (r=0.11; p=0.20) whereas the effect of age on RT in three other emotional conditions was significant. Pearson correlation analysis showed that the RT increased with age in sad condition (r=0.21; p=0.016); in happy condition (r=0.20; p=0.019) and in fear condition (r=0.23; p=0.009). There was no significant effect of STAI trait: F(1,95)=0.21; p=0.65 (Table 3).

4. Discussion

This study demonstrated differential effects of empathy on various aspects of facial emotional expression processing. Some of the results have replicated previous studies. In particular, females in our study had higher empathy scores which was consistent with the previous studies (Baron-Cohen and Wheelwright, 2004; Perry et al., 2013). Our results of advantage in recognition of happy faces relative to other expressions as well as the effect of stimulus duration on better performance have been in line with previous studies (for review see Posamentier and Abdi, 2003).

The novelty of our study was in examining the effect of empathy on separate aspects of facial expression processing, presented at different duration and intensity i.e. discrimination accuracy, response bias and reaction time.

We observed a main effect of empathy on discrimination accuracy i.e. high empathisers were better than low empathisers in recognising all four emotional expressions. This was consistent with other studies (Gery et al., 2009; Besel and Yuille, 2010). As regards to the predicted association between empathy and negative emotion processing, this has been demonstrated in response bias rather than accuracy scores – i.e. high empathy was associated with higher response bias towards sad and fearful faces. The links between empathy and emotions of sadness and fear has been highlighted in the work of Blair's group. In particular, one of the studies showed specific association between the low empathy and poor recognition of emotions of sadness and fear in children with psychopathic tendencies (Blair et al., 2001). Similarly, children with psychopathic tendencies have been found to show selective recognition difficulties for sad and fearful expressions but not for angry, disgusted, surprised, or happy expressions (Blair and Coles, 2000; Stevens et al., 2001). Because our sample comprised healthy individuals where the variance in empathy scores was not high, it appeared difficult to demonstrate the predicted negative emotion recognition differences between two empathy groups. We suggest that our findings of increased response bias towards sadness and fear in high empathisers, although not fully confirming our prediction, highlight more subtle aspects of emotion processing in healthy individuals. This propensity of high empathisers to misrecognise neutral faces as fearful or sad adds a new dimension to the literature of relationship between empathy and facial emotion processing.

Reaction time measure interacted with the empathy and sex: females with higher EQ, compared with males had faster responses to brief presentations of mild sadness.

This confirmed our second hypothesis regarding impact of sex on emotion-specific processing. Previous studies showed faster recognition of negative faces by females compared with males (Hampson et al., 2006). In a similar vein, a meta-analysis (Thompson and Voyer, 2014) reported that sex differences in emotion recognition were larger in recognition of negative than positive emotions. Our results add a dimension of empathy to the above reported superiority of females in processing of emotionally negative signals.

The primary goal of this study was to uncover neuropsychological characteristics of emotion processing in high empathisers that may underlie their potential vulnerability to stress. The researchers have just started to explore the neurobiology of empathic stress. A recent study has directly addressed a question about a possible involvement of stress processes in empathic reactions in healthy people (Engert et al., 2014). This study demonstrated that core stress responses involving Hypothalamicpituitary-adrenal (HPA) axis and sympathetic nervous system could be elicited by the mere observation of another individual undergoing psychosocial stress, which obviously involved empathic processes.

We suggest that studies are warranted specifically looking at potential impact of negative emotional bias on stress tolerance in high empathisers.

Our study has *limitations*. The female group was significantly larger than male. The groups were not matched in terms of age and STAI trait. We have controlled for the possible effects of the above variables by entering them as covariates in analysis of variance. As regards to the methodology of the first-time use of selfreport measure EQ in our population, we have relied on good cross-cultural properties of the test and adhered to most rigorous translational procedure. We acknowledge that it would have been desirable to use several different versions of empathy to crossvalidate them against each other. We propose that further studies are warranted in this respect.

The study participants have not been tested for attentional abilities, therefore the question may arise whether the results pertaining to empathy may have been affected by the cognitive differences rather than emotional perception per se. First, to test for the possible differences in cognitive abilities we ran an independent samples t-test of IQ between high vs. low empathy groups. This did not show significant difference: t(134) = 0.033; p=0.97. We would like to emphasise that the IQ assessment was based on two tests that involve visual-spatial attention i.e. Block design and Matrix reasoning, so they would have shown any possible attentional differences between two empathy groups. Secondly, the facial affect recognition task allows the differentiation of emotion vs. non-emotion processing by contrasting emotional faces with the neutral ones. Indeed, the measures of discrimination accuracy and response bias are computed by taking into account the responses to emotionally neutral faces. This is where the measures of discrimination accuracy and response bias complement each other. As we have demonstrated emotion-specific response bias (i.e. response bias to sad and fearful, but not to angry and happy faces in high empathisers) – it helps to rule out the general attentional differences. We believe that if there was a general attentional effect, it would have shown itself in generally higher response bias to all facial expressions in high empathisers. And thirdly, the reaction time data again demonstrated emotionspecificity in terms of faster RT to sad rather than any other faces. All this taken together indicates that our results truly reflected emotion processing rather than attentional differences in our participants.

5. Conclusions

We suggest that high ability to empathise, along with the advantages in social interactions (e.g. faster recognition of the faces of distress) may carry some hidden costs associated with negative bias, e.g. perceiving neutral faces as emotionally negative. Future research capitalising on the findings of this study may aim at examining emotion processing in people of caring professions that have been shown to be vulnerable to empathic stress.

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