Running head: SOCIO-EMOTIONAL FUNCTIONING AND FACE RECOGNITION

Socio-Emotional Functioning and Face Recognition Ability in the Normal Population

[1]Sarah Bate, [2]Benjamin Parris, [1]Catherine Haslam, and [1]Janice Kay

[1]School of Psychology, University of Exeter; [2]Psychology Research Group, School of Design, Engineering and Computing, University of Bournemouth

Address for correspondence:
Sarah Bate
Washington Singer Laboratories
School of Psychology
University of Exeter
Perry Road
Exeter
EX4 4QG
United Kingdom

Telephone: +44 (0) 1392 264626
Fax: +44 (0) 1392 264623
Email: S.Bate@ex.ac.uk

Abstract

Recent research indicates face recognition ability varies within the normal population. To date, two factors have been identified that influence this cognitive process: the age and gender of the perceiver. In this paper, we examine the influence of socio-emotional functioning on face recognition ability. We invited participants with high and low levels of empathy (as indicated by the Empathy Quotient) to take part in a face recognition test. Participants were asked to study a set of faces, and at test viewed the studied faces intermixed with novel faces. As predicted, high empaths achieved higher scores in the face recognition test compared to low empaths. This pattern of findings provides further evidence that face recognition ability varies within the normal population, and suggests socio-emotional functioning may be an additional factor that influences face recognition ability.

Key words: face recognition, empathy, emotion.

Socio-Emotional Functioning and Face Recognition Ability in the Normal Population

Much research indicates that healthy participants' ability to recognise faces is influenced by the properties of the target stimuli. For example, a "same-race superiority effect" has consistently been reported in the literature, where participants are better at recognising faces from their own race compared to those from other races (e.g. Malpass & Kravitz, 1969; Meissnert & Brigham, 2001). Likewise, a similar bias has been reported in the recognition of same-aged compared to other-aged faces (Anastasi & Rhodes, 2005; Lamont, Stewart-Williams, & Podd, 2005); and a same-gender bias has also been reported for women, although there is less evidence to support the same effect in males (Rehnman & Herlitz, 2007).

More recently, psychological research has begun to examine factors within the perceiver that may influence face recognition ability. Indeed, there are increasing reports of individuals who suffer from developmental prosopagnosia, who are very poor at recognising familiar people from their face (e.g. Bate et al., 2008; Duchaine, 2000). This impairment occurs in the absence of any neurological trauma or psychiatric illness, and is thought to affect as many as 2% of the population (Kennerknecht et al., 2006). Further, a recent report identified a group of "super-recognizers" who are extremely good at face recognition, out-performing controls by more than two standard deviations in a face recognition task (Russell, Duchaine, & Nakayama, 2009). These findings suggest that, as observed for other cognitive processes, face recognition ability can be measured on a continuum.

If this is the case, there may be some observable factors that predict an individual's face recognition ability. To date, investigations into individual differences in face recognition have focused on the age and gender of participants. Indeed, a number of studies have demonstrated that older adults and children exhibit poorer memory for faces than younger adults (e.g. Chance &

Goldstein, 1984; List, 1986; Searcy, Bartlett, Swanson & Memon, 2001); and there is some evidence to suggest females are better at face recognition than males (Rehnman & Herlitz, 2007). While no other individual differences have been examined in the normal population to date, there is some neurological and neuropsychological evidence that socio-emotional functioning may be another variable that influences face recognition ability. Indeed, a recent neuronal model of face recognition acknowledges the role of empathic processing in the recognition of familiar faces (Gobbini & Haxby, 2007). These authors argue that, when perceiving a face, cortical areas responsible for empathic processes (i.e. medial prefrontal cortex, temporoparietal junction and temporal poles) spontaneously make inferences about the mental states of others, preparing the perceiver for appropriate and effective social interaction with that person. Evidence from imaging studies indicate a closer relationship between empathic processing and face recognition, suggesting the two processes may interact. Specifically, several authors have noted activation of the fusiform gyrus (the critical brain area for face processing: Kanwisher et al., 1997) when participants perform non-facial tasks requiring empathic processing (Castelli et al., 2000; Gallagher et al., 2000). Further, Penton-Voak et al. (2007) found that performance on a facial gender-judgment task was predicted by scores on a self-report measure of empathic processing, indicating face perception itself may be influenced by an individual's empathy level. While no study to date has examined the relationship between face recognition and empathy level, evidence for a relationship between these processes comes from individuals on the autistic spectrum. Indeed, these individuals tend to achieve low scores on tests of empathy (e.g. Baron-Cohen & Wheelwright, 2004), and are also poor at some face processing tasks (e.g. Dawson et al., 2002). In sum, the above evidence suggests face recognition ability may be influenced by empathic processing in healthy participants.

The current study aimed to investigate this issue. We asked participants who showed high or low levels of empathy to take part in a face recognition test. To ensure recognition was not influenced by the ability to interpret facial expressions or specific mental states, this task consisted of newly-learned expressionless faces. Empathic processing was measured using the Empathy Quotient (EQ: Baron-Cohen & Wheelwright, 2004), a self-report questionnaire thought to be a particularly reliable indicator of empathy (Lawrence et al., 2004). We predicted that individuals who had higher levels of empathy would show superior face recognition ability.

Method

Participants

One hundred and sixty female participants were invited to take part in this study based on their performance in a previous unpublished study that collected scores on the EQ in 682 undergraduate students. Eighty of these participants had achieved a 'high' score on the EQ, and 80 a 'low' score. In the 'high' group, the mean age of the participants was 25.05 years (SD = 2.18), and the mean age in the 'low' group was 26.25 years (SD = 8.17). All participants took part on a voluntary basis, and all were healthy and to our knowledge did not suffer from a socio-emotional disorder. Indeed, participants were asked to declare if they had any known social or emotional processing deficit, and we also excluded any person with a score lower than 20 on the EQ (scores below 20 are believed to be indicative of autism). All of our participants were female

and of a similar age in order to ensure that all other variables were held constant, given age and gender are known to influence empathic processing (Baron-Cohen et al., 2003; Carroll & Yung, 2006). Ethical approval for this study was granted by the School of Psychology Ethics Committee at the University of Exeter.

The Empathy Quotient

The EQ was designed in response to a need for a more valid measure of empathy than provided by previous tests. It consists of 60 self-report questions, 40 measuring empathy and 20 filler items. The maximum score that can be achieved on this test is 80. The authors suggest that scores within the range 33-52 indicate 'average' levels of empathy. Thus, scores lower than 33 are thought to represent 'low' empaths, and those above 52 to represent 'high' empaths. The EQ has been well-used in experimental studies investigating empathic processing in both normal and impaired populations (e.g. Lawrence et al., 2006; Penton-Voak et al., 2007), and several studies have investigated its validity. These studies have reported high test-retest reliability, and moderate to high correlations with other self-report and observable indicators of empathy, i.e. tasks requiring analysis of social situations (e.g. Carroll & Yung, 2006; Lawrence et al., 2004; Wakabayashi et al., 2007)

Face Stimuli

Images of 30 individuals were obtained from the NimStim database (Tottenham et al., 2009). Of these, 15 were allocated to be studied faces, and 15 to be distractor faces. Two different images were obtained of the studied individuals (one for learning and one for test), and one image was obtained of the distractors. All faces displayed a neutral expression. Images were cropped beyond the hairline so only the inner face was displayed. Thus, external features than may cue recognition (e.g. hairstyle) were removed. Stimuli were adjusted to 714 pixels in height and 450 pixels in width.

Procedure

Due to the remote location of some of our participants and the rarity of those with high and low scores on the Empathy Quotient, this study was carried out via the Internet. Data collected through this medium is thought to be as reliable as that collected in lab-based experiments (McGraw, Tew, & Williams, 2000), and has been used to assess face processing in remote participants in previous research (e.g. Todorov & Duchaine, 2008). However, it may be claimed that any findings could simply be attributed to some participants paying more attention to the task than others. To address this issue, we asked participants to make judgments about each face in the study phase (see below). The face recognition study was conducted on the University of Exeter's online testing system. Once participants had logged in, they were provided with a detailed set of instructions.

The test began with a study phase, where participants viewed the set of 15 faces twice, in a random order. In the first presentation, they were asked to judge the gender of each face, and enter their response into the computer. In the second presentation, participants were asked to judge the age of each face. Participants then completed a brief filler task, where they viewed five scenes and were asked to indicate whether or not they liked each image. They then progressed to the recognition test. Different images of the 15 studied faces were intermixed with 15 novel faces. Participants were asked to make a recognition judgment (familiar or novel) for each face, using the 'f' and 'n' keys on the keyboard.

Results

Responses on the age and gender judgments provided in the study phase were initially analysed to check each participant was devoting their attention to the task. Three participants (two from the 'low' group and one from the 'high' group) provided inaccurate responses in the gender and age tasks, indicating they were not devoting full attention to the test, or had more severe face processing problems. For this reason, data from these participants were not included in our analysis of the face recognition scores. Accuracy of the age (high empaths: M = 13.92, SE = .20; low empaths: M = 13.79, SE = .24) and gender (high empaths: M = 14.33, SE = .14; low empaths = 14.47, SE = .09) judgments were high in both empathy groups, and mean scores did not vary in either task, $t(155) = .857$, $p = .393$ and $t(155) = .420$, $p = .675$ respectively.

Sensitivity in discriminating studied from novel faces in the face recognition task was calculated using d prime, and an independent samples *t*-test compared the performance of the high and low empaths. As predicted, participants who achieved a high score on the Empathy Quotient were better at face recognition (d prime: M = 2.14, SE = .06; hits: M = 12.09, SE = .20; false alarms: M = 1.92, SE = 1.13) than those who achieved a low score (d prime: M = 1.86, SE = .07; hits: M = 11.26, SE = .26; false alarms: M = 2.23, SE = .14), $t(155) = 2.930$, $p = .002$, $d = 0.45$ (see Figure 1).

< *Insert Figure 1* >

Discussion

This study aimed to examine if socio-emotional functioning influences face recognition ability in healthy perceivers. As predicted, our results indicated that people with higher levels of empathy are better at face recognition than those with low levels of empathy. This finding (a) provides further evidence that face recognition ability varies in the normal population, and (b) provides the first evidence that socio-emotional functioning may be another factor that influences face recognition ability.

Such a relationship between face recognition ability and socio-emotional functioning is perhaps unsurprising given both socio-emotional processes and expertise in recognising faces are essential for successful social functioning. Indeed, an appropriate social response to a person is intrinsically linked to both their identity (and the biographical knowledge linked to that identity) and their current emotional state. It is therefore likely that someone who is extremely accurate in face identification would also be competent at elucidating a person's current emotions and attitudes. Indeed, the relationship between face processing and empathic processes is acknowledged in a recent neurological model of face recognition (Gobbini & Haxby, 2007), although this model makes no specific predictions regarding the relationship between the two processes. Thus, the data reported here informs models of face recognition, by providing additional evidence linking these cognitive and emotional processes.

Importantly, we have shown that a person's level of socio-emotional functioning influences the recognition of newly learned faces for whom there is no personal attachment. This finding suggests the representation of the intentions, beliefs and feelings of others may provide an additional level of encoding when encountering a face for the first time. Alternatively, we can

assume that individuals who are higher in empathy may show more interest in social interaction. While some authors suggest face processing is largely an inherited process that we possess from birth, other evidence suggests that cortical specialization for faces develops during infancy in response to experience with faces (e.g. Farah et al., 2000). Converging evidence for this suggestion comes from reports of individuals on the autistic spectrum, who tend to be poor at face recognition (e.g. Dawson et al., 2002). This line of evidence suggests social interest may be a critical factor for the development of normal face recognition abilities.

On the other hand, it is possible the reverse situation may be true. That is, face recognition ability may dictate an individual's level of socio-emotional functioning. Indeed, if someone is better at face recognition, they may generally be more successful in social situations. Reports of individuals suffering from prosopagnosia indicate how impaired face recognition can be socially debilitating (Yardley et al., 2008). Thus, it would also make sense that socio-emotional functioning can develop in response to good face recognition abilities. The precise relationship between face recognition and socio-emotional functioning therefore remains unclear, and future research may attempt to clarify this issue. Importantly, our findings provide the first evidence that socio-emotional functioning may be another factor that influences face recognition ability in the healthy population, and this initial research suggests this may be a fruitful line for further investigation. In particular, different components of socio-emotional functioning (i.e. empathy, theory of mind) and their relationship to face recognition may be teased apart.

Finally, the pattern of findings reported here also have practical implications. Given face recognition ability can vary within the normal population, this process should perhaps be tested when juries are assessing the weight of an eyewitness' evidence in a criminal trial. Further, as some key occupations require good face recognition skills (i.e. passport control officers), some initial screening may be beneficial before appointing individuals to these positions.

In sum, the evidence reported in this paper provides the first evidence that empathic functioning is related to face recognition ability. While the precise relationship between these processes remains unclear, future research can attempt to further investigate how this factor and other individual differences may influence face recognition ability.

References

Anastasi, J. S., & Rhodes, M. G. (2005). An own-age bias in face recognition for children and older adults. *Psychonomic Bulletin and Review , 12*, 1043-1047.

Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: An investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders , 34*, 163-175.

Baron-Cohen, S., Richler, J., Bisarya, D., Gurunathan, N., & Wheelwright, S. (2003). The Systemising Quotient: An investigation of adults with Asperger's syndrome or high functioning autism, and normal sex differences. *Philisophical Transactions of the Royal Society: Biological Sciences, 358*, 361-374.

Bate, S., Haslam, C., Tree, J., & Hodgson, T. L. (2008). Evidence of an eye movement-based memory effect in congenital prosopagnosia. *Cortex , 44*, 806-819.

Carroll, J.M., & Yung, C.K. (2006). Sex and discipline differences in empathising, systemising and autistic symptomatology: Evidence from a student population. *Journal of Autism and Developmental Disorders, 36*, 949-957.

Castelli, F., Happe, F., Frith, U., & Frith, C. (2000). Movement and mind: A functional imaging study of perception and interpretation of complex intentional movement patterns. *NeuroImage , 12*, 314-325.

Chance, J. E., & Goldstein, A. G. (1984). Face-recognition memory: Implications for children's eyewitness testimony. *Journal of Social Issues , 40*, 69-85.

Dawson, G., Carver, L., Meltzoff, A., Panagiotides, H., McPartland, J., & Webb, S. (2002). Neural correlates of face and object recognition in young children with autism spectrum disorder, developmental delay, and typical development. *Child Development , 73*, 700-717.

Duchaine, B. C. (2000). Developmental prosopagnosia with normal configural processing. *Neuroreport , 11*, 79-83.

Dziobek, I., Rogers, K., Fleck, S., Hassenstab, J., Gold, S., Wolf, O. T., et al. (2005). In search of "master mindreaders": Are psychics superior in reading the language of the eyes? *Brain and Cognition , 58*, 240-244.

Farah, M. J., Rabinowitz, C., Quinn, G. E., & Lui, G. (2000). Early commitment of neural substrates for face recognition. *Cognitive Neuropsychology , 17*, 117-123.

Gallagher, H. L., Happe, F., Brunswick, N., Fletcher, P. C., Frith, U., & Frith, C. D. (2000). Reading the mind in cartoons and stories: An fMRI study of 'theory of mind' in verbal and nonverbal tasks. *Neuropsychologia , 38*, 11-21.

Gobbini, M. I., & Haxby, J. V. (2007). Neural systems for recognition of familiar faces. *Neuropsychologia , 45*, 32-41.

Kanwisher, N., McDermott, J., & Chun, M. M. (1997). The fusiform face area: A module in human extrastriate cortex specialized for face perception. *Journal of Neuroscience , 17*, 4302-4311.

Kennerknecht, I., Grueter, T., Welling, B., Wentzek, S., Horst, J., Edwards, S., et al. (2006). First report of prevalence of non-syndromic hereditary prosopagnosia (HPA). *American Journal of Medical Genetics , 140A*, 1617-1622.

Lamont, A. C., Stewart-Williams, S., & Podd, J. (2005). Face recognition and aging: Effects of target age and memory load. *Memory and Cognition , 33*, 1017-1024.

Lawrence, E. J., Shaw, P., Baker, D., Baron-Cohen, S., & David, A. S. (2004). Measuring empathy: Reliability and validity of the Empathy Quotient. *Psychological Medicine , 34*, 911-924.

Lawrence, E.J., Shaw, P., Giampitetro, V.P., Surguladze, S., Brammer, M.J., & David, A.S. (2006). The role of 'shared representations' in social perception and empathy: An fMRI study. *NeuroImage, 29*, 1173-1184.

List, J. (1986). Age and schematic differences in the reliability of eyewitness testimony. *Developmental Psychology , 22*, 50-57.

Malpass, R. S., & Kravitz, J. (1969). Recognition for faces of own and other 'race'. *Journal of Personality and Social Psychology , 13*, 330-334.

McGraw, K. O., Tew, M. D., & Williams, J. E. (2000). The integrity of web-delivered experiments: Can you trust the data? *Psychological Science , 11*, 502-506.

Meissner, C. A., & Brigham, J. C. (2001). Thirty years of investigating the own-race bias in memory for faces: A meta-analytic review. *Psychology, Public Policy, and Law , 7*, 3-35.

Penton-Voak, I.S., Allen, T., Morrison, E.R., Gralewski, L., & Campbell, N. (2007). Performance on a face perception task is associated with empathy quotient scores, but not systemizing scores or participant sex. *Personality and Individual Differences, 43*, 2229-2236.

Rehnman, J., & Herlitz, A. (2007). Women remember more faces than men do. *Acta Psychologica , 124*, 344-355.

Russell, R., Duchaine, B., & Nakayama, K. (2009). Super-recognizers: People with extraordinary face recognition ability. *Psychonomic Bulletin and Review , 16*, 252-257.

Searcy, J. H., Bartlett, J. C., Swanson, K., & Memon, A. (2001). Aging and lineup performance at long retention intervals: Effects of meta-memory and context reinstatement. *Journal of Applied Psychology , 86*, 207-214.

Todorov, A., & Duchaine, B. (2008). Reading trustworthiness in faces without recognizing faces. *Cognitive Neuropsychology , 25*, 395-410.

Tottenham, N., Tanaka, J., Leon, A., McCarry, T., & Nurse, M. (2009). The NimStim set of facial expressions: Judgment from untrained research participants. *Psychiatry Research, 168*, 242-249.

Wakabayashi, A., Baron-Cohen, S., Uchiyama, T., Yoshida, Y., Kuroda, M., & Wheelwright, S. (2007). Empathizing and systemizing in adults with and without autism spectrum conditions: Cross-cultural stability. *Journal of Autism and Developmental Disorders, 37,* 1823-1832.

Yardley, L., McDermott, L., Pisarski, S., Duchaine, B., & Nakayama, K. (2008). Psychosocial consequences of developmental prosopagnosia: A problem of recognition. *Journal of Psychosomatic Research , 65,* 445-451.

Figure Caption

Figure 1. Mean d prime scores on the face recognition task for participants with high and low levels of empathy.