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The influence of autism-like traits on cheek biases for the expression and perception of happiness

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ABSTRACT

People with autism show attenuated cerebral lateralisation for emotion processing. Given growing appreciation of the notion that autism represents a continuum, the present study aimed to determine whether atypical hemispheric lateralisation is evident in people with normal but above average levels of autism-like traits. One hundred and twenty-seven right-handed participants ($M = 43$, $F = 84$) completed the AQ questionnaire (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001), and then (a) posed for a photo expressing happiness, and (b) viewed pairs of left and right cheek poses, making a forced-choice decision indicating which image appeared happier (half the images were mirror-reversed to control for perceptual biases). Results indicated that irrespective of AQ status, people were intuitively aware that the left cheek is more emotionally expressive: participants offered the left cheek when posing to appear happy, and perceived left poses as happier than right poses. As the left cheek is predominantly controlled by the right hemisphere, these findings strongly support the right hemisphere hypothesis. The fact that people with normal but above average levels of autism-like traits did not show a reduced leftward bias for either task indicates that the attenuated emotion lateralisation pattern noted in the clinical population does not extend into the normal spectrum. Instead, the results suggest that people with normal but above average levels of AQ traits are as sensitive to the silent social/emotional cues signalled by a left cheek pose as those with lower AQ scores.

1. Introduction

Interpreting social and emotional cues is vital to human communication, but is characteristically deficient in people with autism. Autism encompasses a spectrum of disorders distinguished by deficiencies in social interaction and communication, with abnormal interests and involvement in activities (American Psychiatric Association, 2000). In addition, a diagnosis of autism must also be based on a delay, or abnormal functioning, in social interaction, communication, and symbolic or imaginative play before the age of 3 years (American Psychiatric Association, 2000).

Research investigating the aetiology of the disorder confirms that people with autism exhibit abnormal cerebral lateralisation (e.g., Rinehart, Bradshaw, Brereton, & Tonge, 2002). For example, Muller et al. (1999) used Positron Emission Tomography (PET) to measure cerebral blood flow in people with autism during a number of linguistic tasks. Whereas normal controls showed the greater left hemisphere activation characteristically observed for language-based tasks, people with autism exhibited reversed hemispheric dominance. In addition, the autism group evinced reduced activation in the left auditory cortex, again highlighting their attenuated lateralisation.

Consistently, functional imaging research demonstrates that the reduced language lateralisation evident in people with autism extends to linguistic processes controlled by the right hemisphere (e.g., prosody, pragmatics; see Lindell, 2006 for review). For example, Ting Wang, Lee, Sigman, and Dapretto (2006) measured activation using functional magnetic resonance imaging (fMRI) while children determined the communicative intent of remarks (sincere vs. ironic). Not surprisingly, children with autism were poorer than controls at interpreting such prosodic/pragmatic cues and, moreover, showed reduced rightward asymmetry. As such, these findings suggest that people with autism exhibit reduced lateralisation across a variety of language processes.

Recent conceptualization of autism suggests that rather than being a categorical diagnosis, autism represents a continuum of traits that are exhibited to a greater or lesser degree in all members of the population (e.g., Baron-Cohen, 1995; MacIntosh & Dissanayake, 2006). This "autism spectrum" describes the range of autism-like traits present, ranging from low levels in the normal population, to higher levels in people with Asperger's syndrome or a clinical diagnosis of autism (Baron-Cohen, 1995). Baron-Cohen, Wheelwright, Skinner, Martin, and Clubley (2001) developed the Autism Quotient (AQ) questionnaire specifically to measure

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levels of autism-like traits exhibited by adults. The measure is easy to self-administer, and yet effective in discriminating adults with autism and Asperger's syndrome (mean score 35.8/50) from normal controls (mean score 16.4/50; cut-off score of 32+ indicates clinically significant levels of autism-like traits). Critically, AQ scores of males are higher than females, and scores of scientists (particularly mathematicians) are higher than those of people in the arts, consist with well-documented links between clinical diagnoses of autism spectrum disorders and occupations in the "hard" sciences (Baron-Cohen et al.). As such, the AQ questionnaire provides a well-validated measure for screening autism-like traits in the normal population.

Critically, research confirms that people with normal but above average levels of autism traits exhibit reduced hemispheric lateralisation for language, consistent with (a) the reduced lateralisation noted in people with a clinical diagnosis of autism (e.g., Muller et al., 1999), and (b) the notion of the autism spectrum. Lindell, Notice, and Withers (2009) asked participants to complete the AQ questionnaire and a lateralised lexical decision task that required them to indicate whether letter strings appearing in their left or right visual field (projecting to the right or left hemisphere respectively) were real words. Consistent with prediction, Lindell et al. found that people with lower AQ scores exhibited a strong right visual field (left hemisphere) advantage for 'word' decisions, however people with higher AQ scores performed equally well in response to words directed to the left and right hemispheres. This finding supports the notion that the reduced hemispheric lateralisation characteristic of people with a clinical diagnosis of autism extends to those with normal but above average levels of autism-like traits.

Whereas articulate language is functionally lateralised to the left hemisphere, other cognitive processes, such as emotion perception, rely on the right hemisphere (Demaree, Everhart, Youngstrom, & Harrison, 2005). This right hemisphere hypothesis for emotion lateralisation is based predominantly on clinical data: damage to the right hemisphere results in difficulty interpreting emotion in speech (Hellige, 1993), recognising emotional words (Borod, Andelman, Obler, Tweedy, & Welkowitz, 1992), and identifying emotion in faces (Bowers, Bauer, Coslett, & Heilman, 1985). Given the right hemisphere's predominance for emotion control, both human and nonhuman primates express stronger emotion on the left hemiface (the lower two-thirds of the face are innervated contralaterally; Patten, 1996). Consequently, chimeric face research using mirrored left-cheek and mirrored right-cheek composites demonstrates that people perceive left cheek composites as showing stronger emotion (Sackeim, Gur, & Saucy, 1978). Such expressional asymmetries lead to striking differences in terms of perception, and may have contributed to a notable asymmetry in portraiture.

McManus and Humphrey (1973) first reported that the majority of portraits, from the renaissance to the present day, depict the sitter posing with the left cheek forward (56% male, 68% female). Nicholls, Clode, Wood, and Wood (1999) propose that the left cheek bias stems from the sitters' unconscious desire to show their emotive left cheek (hence the stronger bias in females than in males, with the former more willing to express emotion; Kring, Smith, & Neale, 1994). Nicholls et al. demonstrated that when asked to pose for a photo in an emotive (family portrait) condition, people intuitively offer the left cheek; when asked to pose in an impassive (Royal Society scientist) condition, people present the right cheek. These data indicate that people are implicitly aware that the left side of the face is the more expressive.

Subsequent research has demonstrated that people who rate themselves as more emotionally expressive are more likely to offer the left cheek (Nicholls, Clode, Lindell, & Wood, 2002a). Congruently, we judge individuals who pose offering the left cheek as more emotionally expressive (Nicholls, Wolfgang, Clode, & Lindell, 2002b). This bias profoundly influences perceptions of academic specialisation: Lindell and Savill (2010) asked participants to make a forced choice indicating which of a pair of left and right cheek images of a model looked more like a student of a particular academic discipline. They found that participants were more likely to select left cheek images for English students, and right cheek images for Chemistry students, consistent with stereotypical representations of creative writers and cool-headed, impassive scientists. Such results indicate that the implicit awareness of the left cheek's greater expressivity prompts us to interpret the cheek shown as a silent social signal.

As people with autism are known to exhibit deficits in interpreting social and emotional cues (American Psychiatric Association, 2000), it is not surprising that these deficits are accompanied by abnormal patterns of lateralisation in response to emotional stimuli (e.g., Dapretto et al., 2006). In particular, Wong, Fung, Chua, and McAlonan (2008) demonstrated that children with autism show reduced right hemisphere activity in comparison to normal controls when viewing emotional faces. These data imply attenuation of the expected right hemisphere emotion processing bias and thus reduced lateralisation of function in people with autism.

Research confirms that children with autism have difficulty replicating facial expressions (Langdell, 1981), and fail to exhibit gestural emotion in peer interactions (Attwood, 1986). Macdonald et al. (1989) demonstrated that emotional expression deficits extend into adulthood, even for high functioning adults. Strikingly, Dapretto et al. (2006) found that though imitation of facial expressions in typically-developing children produces the strongest fMRI activation peaks in the right pars opercularis, expression imitation in children with autism fails to induce brain activity in this region. Given that the pars opercularis is a crucial component of the mirror neuron system (a neural mechanism argued to facilitate the automatic understanding of the link between intention and action), it seems likely that a dysfunctional mirror neuron system involving the right inferior frontal gyrus lies at the heart of the emotion expression deficits seen in people with autism. As such, it appears clear that both the perception and expression of emotion are compromised in people with a clinical diagnosis of autism, and that deficits in these social functions reflect an underlying abnormality in hemispheric lateralisation.

Whilst differential patterns of emotion lateralisation have been identified in people with autism, this has yet to be investigated outside the clinical spectrum. Assuming that autism represents a continuum of deficiency (e.g., Baron-Cohen, 1995; MacIntosh & Dissanayake, 2006), difficulty in the expression and perception of emotion may extend into the normal population. Hence the present study was designed to determine whether the reduced lateralisation noted for language at the normal but above average end of the autism spectrum (Lindell et al., 2009) is similarly evident for emotion. We asked participants to complete the AQ questionnaire (Baron-Cohen et al., 2001), and tasks assessing emotion perception and emotion expression. For the perception task participants examined pairs of photos depicting left and right cheek poses and made a forced choice indicating which image appeared "happier" (half the images were mirror-reversed to control for perceptual biases; Gordon, 1981). For the expression task participants were instructed to reflect upon something that made them happy for 30 s, and then pose for a photo expressing that happiness; the cheek participants offered to the camera was noted. For both the perception and expression tasks, people with lower levels of autism-like traits were expected to show a strong left cheek bias, whereas people with normal but above average levels of autism-like traits were anticipated to exhibit a reduced asymmetry, indexing attenuated lateralisation.