

Finding a face in the crowd: Testing the anger superiority effect in Asperger Syndrome

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Abstract

Social threat captures attention and is processed rapidly and efficiently, with many lines of research showing involvement of the amygdala. Visual search paradigms looking at social threat have shown angry faces ‘pop-out’ in a crowd, compared to happy faces. Autism and Asperger Syndrome (AS) are neurodevelopmental conditions characterised by social deficits, abnormal face processing, and amygdala dysfunction. We tested adults with high-functioning autism (HFA) and AS using a facial visual search paradigm with schematic neutral and emotional faces. We found, contrary to predictions, that people with HFA/AS performed similarly to controls in many conditions. However, the effect was reduced in the HFA/AS group when using widely varying crowd sizes and when faces were inverted, suggesting a difference in face-processing style may be evident even with simple schematic faces. We conclude there are intact threat detection mechanisms in AS, under simple and predictable conditions, but that like other face-perception tasks, the visual search of threat faces task reveals atypical face-processing in HFA/AS.

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1. Introduction

Faces are one of the most important visual stimuli and are potent facilitators for social interaction and communication. Facial expressions of emotion convey critical signals for inferences about the intentions and motivations of others (Blair, 2003; Darwin, 1872/1965). Although faces provide a wealth of information, people are generally able to extract important information rapidly and efficiently and to produce appropriate responses. Humans are so adept at various aspects of face processing it is suggested we may have evolved special face processing modules (Ekman, 2003; Young, 1998).

However, not all humans are proficient at face processing. Autism and Asperger Syndrome (AS) are neurodevelopmental conditions characterised by severe social

and communication difficulties, as well as restricted behaviours and interests (APA, 1994; ICD-10, 1994). From the earliest descriptions of these disorders, striking abnormalities were noted in social-emotional behaviour including difficulties with face processing and social interactions (Asperger, 1944; Kanner, 1943). Face-processing deficits are likely to relate to the social difficulties, in that people with autism spectrum conditions (ASC) have not developed the same expertise with faces as typical controls (Grelotti et al., 2005). Various differences have been reported about how people with ASC process faces. For example, while typically developing people normally use a more holistic style when processing faces and emotional expressions (Tanaka & Farah, 1993; Yin, 1969), people with autism rely on a more feature-based style of processing faces (Hobson, Ouston, & Lee, 1988; Langdell, 1978; Weeks & Hobson, 1987). People with ASC also focus their attention more on the mouth region when processing faces, while typical controls rely on the eye region that provides more information about the

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emotional states of others (Baron-Cohen, Wheelwright, & Jolliffe, 1997; Joseph & Tanaka, 2003; Weeks & Hobson, 1987).

Results concerning emotional expression processing in ASC have been less consistent and suggest an uneven profile. People with ASC show difficulties on tasks with complex mental states and emotions (Baron-Cohen, Spitz, & Cross, 1993; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Baron-Cohen et al., 1997), whereas their accuracy in recognising basic emotions may be intact, particularly when high-functioning participants are studied (Adolphs, Sears, & Piven, 2000; Baron-Cohen et al., 1997; Golan, Baron-Cohen, & Hill, in press; Grossman, Klin, Carter, & Volkmar, 2000; Volkmar, Sparrow, Rende, & Cohen, 1989). However, other studies have reported deficits by people with autism in processing basic emotions (Bolte & Poustka, 2003; Celani, Battacchi, & Arcidiacono, 1999; Howard et al., 2000), somewhat confusing the current understanding of emotion recognition in autism (Frith, 2003). Research involving the more automatic and implicit emotional processing mechanisms in people with ASC has been lacking. When task variables and procedures are kept simple and predictable, people with autism show evidence of normal configural face-processing strategies (Joseph & Tanaka, 2003; Teunisse & de Gelder, 2003). These findings suggest that the ability to process faces using configural or holistic processing styles may not be completely absent in ASC, rather that people with these conditions are just more likely to process information using a 'cognitive style' characterised by enhanced local feature detection over holistic processing (Frith, 2003; Happe, 1999).

Facial expressions of emotion are important for non-verbal communication, and facial threat is a particularly potent social signal. The emotional expression of anger is a typical example and is a very potent facial warning signal. Threatening facial expressions have considerable power to recruit attention and are processed rapidly and efficiently (Vuilleumier & Schwartz, 2001). Neuroimaging experiments have shown that angry and fearful expression faces activate the amygdala (Breiter et al., 1996; Morris et al., 1996; Phillips et al., 1998), a brain area important for detecting threat and producing appropriate responses (Aggleton, 2000; LeDoux, 1996). The amygdala activation occurs even when threatening faces are masked and below the level of awareness (Morris, Ohman, & Dolan, 1998; Whalen et al., 1998), demonstrating a quick and direct sub-cortical route to the amygdala for automatic processing of threat (Morris, Ohman, & Dolan, 1999).

These findings are consistent with investigations of humans with amygdala damage, who show deficits in perceiving fearful expressions (Adolphs, Tranel, Damasio, & Damasio, 1995; Adolphs et al., 1999; Calder et al., 1996). Amygdala patients also judge people rated negatively by typical controls as being more trustworthy and approachable (Adolphs, Tranel, & Damasio, 1998), and do not show the enhanced perception of emotionally significant stimuli normally seen in control participants (Anderson & Phelps,

2001). The face-processing deficits seen in amygdala patients are similar in some ways to emotion processing deficits seen in people with ASC, including reports that the deficits may involve complex emotions more than basic emotions (Adolphs, Baron-Cohen, & Tranel, 2002; Adolphs et al., 2000; Baron-Cohen et al., 1997; Golan et al., in press). Neuroimaging studies of people with ASC have shown decreased amygdala activation while processing faces, including threatening expressions (Ashwin, Baron-Cohen, Wheelwright, O'Riordan, & Bullmore, in press; Baron-Cohen et al., 1999; Critchley et al., 2000; Pierce, Muller, Ambrose, Allen, & Courchesne, 2001).

A simple task developed to investigate the attention capturing abilities of threat is the 'face-in-the-crowd' visual search paradigm. A pioneering study by Hansen and Hansen (1988) found that an angry face was detected more quickly and accurately than a happy face in a crowd of distracter faces. They further found this 'anger superiority' effect was unaffected by the number of distracter faces in the display, supporting the notion that facial threat detection may elicit pre-attentive processing involving 'pop-out.' The pop-out effect shows reaction times (RT's) that do not vary greatly with increasing size of the distracters, as shown by a search slope (the increase in RT divided by the increase in number of distracters) in the range of 5–6 ms/item (Hershler & Hochstein, 2005; Treisman & Souther, 1985).

However, further studies with similar stimuli did not replicate these findings and criticisms were raised about the results involving visual confounds and lack of a condition with neutral face crowds (Nothdurft, 1993; White, 1995). To address these problems and further test the face-in-the-crowd effect, researchers have developed schematic faces for visual search experiments. By using schematic faces it is possible to eliminate many low-level perceptual variations found in emotional expression photographs and to allow for greater control over experimental variables. The features of angry and happy schematic faces can be matched very closely and easily manipulated to test a variety of factors in a consistent way. Naturally, this greater control comes at the cost of a lack in ecological validity.

Several studies have shown schematic threatening faces are found more quickly and accurately than schematic friendly faces, strengthening the idea that social threat captures attention (Eastwood, Smilek, & Merikle, 2001; Fox, Russo, Bowles, Pichler, & Dutton, 2000; Ohman, Lundqvist, & Esteves, 2001). Another intriguing effect is longer response latencies for non-target displays containing all-angry faces compared to all-happy displays, which is thought to reflect that each angry face captures attention to a greater degree than each happy face (Fox et al., 2000; Vuilleumier & Schwartz, 2001; White, 1995). However, other studies have failed to replicate the findings of 'pop-out' for schematic threatening faces (Ohman et al., 2001) and for longer dwell times for all-angry displays (Ohman et al., 2001), suggesting further replication studies of this type are needed.

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