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Is it avoidance or hypoarousal? A systematic review of emotion recognition, eye-tracking, and psychophysiological studies in young adults with autism spectrum conditions

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ABSTRACT

A systematic review was conducted for studies exploring the link between gaze patterns, autonomic arousal and emotion recognition deficits (ERD) in young adults with Autism Spectrum Conditions (ASC) in the context of the eye-avoidance/hyperarousal and the orientation/hypoarousal hypotheses. These hypotheses suggest that ERD in ASC can be explained by either exacerbated physiological arousal to eye-contact interfering with emotion recognition, or blunted arousal not engaging the necessary attention and awareness mechanisms to process emotionally salient cues, respectively. Most studies have suggested that individuals with ASC display an overall reduced attention to the eyes, however, this was not always associated with ERD, and some studies also reported ERD with no evidence of atypical gaze patterns. The evidence from psychophysiological studies is also mixed. While some studies supported that individuals with ASC are hypoaroused during emotion processing, others reported hyperarousal or even partially supported both. Overall, these results suggest that the current autonomic arousal and gaze hypotheses cannot fully account for ERD in ASC. A new integrative model is proposed, suggesting a two-pathway mechanism, in which avoidance and orientation processes might independently lead to ERD in ASC. Current methodological limitations, the influence of alexithymia, and implications are discussed.

1. Introduction

Autism Spectrum Conditions (ASC) are mainly characterized by deficits in emotional reciprocity, socio-communication skills and restricted interests (American Psychiatric Association, 2013). Emotion Recognition Deficits (ERD) in particular have been extensively studied in individuals with ASC (see Harms, Martin, & Wallace, 2010; Lozier, Vanmeter, & Marsh, 2014; Uljarevic & Hamilton, 2013 for a review) and quoted as part of the core diagnostic aspects of the condition. These deficits are often reported to have the greatest impact on day-to-day social functioning, but the underlying neurobiological mechanisms remain poorly understood.

Prominent explanations for ERD in ASC have suggested atypical gaze as one of the possible underlying mechanisms. In fact, atypical gaze in children as early as 12 months of life has been found to be a valuable biomarker for predicting later severity of autism symptoms (Jones, Carr, & Klin, 2008; Papagiannopoulou, Chitty, Hermens, Hickie, & Lagopoulos, 2014).

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Two specific explanations linking abnormal gaze and ERD have been independently studied. Some have suggested that individuals with ASC display a reflexive 'eye-avoidance' in which they perceive the eyes to be threatening and over-arousing, thus interfering with emotion processing (Kliemann, Dziobek, Hatri, Baudewig, & Heekeren, 2012; Mathersul, McDonald, & Rushby, 2013a; Tanaka & Sung, 2016). Alternatively, others argue that individuals with ASC may display a 'lack of orientation' to the eyes due to a general hypoarousal state, not engaging the necessary physiological mechanisms to generate awareness and resonance to emotionally salient cues (Dalton et al., 2005; Schultz, Chawarska, & Volkmar, 2006).

These hypotheses are in line with the current views of emotion processing, consensually conceptualized as a psychophysiological goal-oriented process (Atkinson & Adolphs, 2011; Calder & Young, 2005; Niedenthal & Brauer, 2012). It is also known that changes in physiological arousal (e.g. SCR) can index orienting responses to novel or significant environmental information, including socially-relevant stimuli (Sokolov, 1960; Barry, 1984; Mathersul, McDonald, & Rushby, 2013b). Furthermore, models of empathy have consistently suggested that the perception of emotion in others involves some level of physiological resonance that allows emotional contagion to occur.

Classical simulationist models such as the perception-action model (Preston & De Waal, 2002a,b; Preston, 2007) suggest that the perception of emotion automatically activates shared neural networks that represent the movements required to produce the observed action, which in turn activates somatic and autonomic responses. According to such accounts, this process instantiates automatic mirroring or re-creation of the observed emotional expression, facilitating understanding of the affective content in it (Blair, 2005; Decety & Moriguchi, 2007).

While these models generated a lot of interest surrounding putative notions on the mirror neuron system debate, some of the more modern and prominent models of empathy offer an alternative account for the mechanisms underlying empathy. These models detail the information processing elements that are necessary for empathy to occur (e.g. Bird & Viding, 2014; Coll et al., 2017). For instance, the SOME model proposed by Bird and Viding (2014) includes emotion identification as one important component of empathy, suggesting however that facial expressions are only one of the many inputs or routes that allow people to classify the affective state of another person. A prerequisite for empathy, however, is that of affect sharing, where the empathizer shares the affective experience of another. Bird and Viding's model suggests that information inputs such as facial expressions trigger automatic associations learned through development, between emotional cues (e.g., facial expressions) and the representation of the affective state of another person and the corresponding affective states in the self. Importantly, this process is also thought to involve psychophysiological and somatic reverberances that validates the affective experience as veridical (Bird & Viding, 2014).

What the models just described have in common is the idea that failures in emotion identification and affect sharing may arise from attentional and motivational constraints as well as deficits in interoceptive and physiological signals. This gives plausibility to the gaze and arousal theories of ERD in ASC, as studies of neurotypical individuals have shown that different facial expressions have specific diagnostic features one should attend to, such as 'eye' for fear, and 'mouth' for happy (Ekman, 1999; Posamentier & Abdi, 2003; Scheller, Büchel, & Gamer, 2012). Furthermore, there is evidence suggesting that successful emotion recognition is partly influenced by the appropriate eye to mouth fixation ratios, which have to be adjusted accordingly for different emotions (Adolphs et al., 2005; Atkinson & Adolphs, 2011; Dadds et al., 2014). Validating the importance of eye and mouth cues and appropriate physiological responses for emotion processing, neuroanatomical studies have linked atypical processing of emotions to neural dysfunctions in the emotional circuitry, including but not limited to the amygdala, fusiform gyrus, insula and anterior cingulate cortex (Adolphs, Sears, & Piven, 2001; Atkinson & Adolphs, 2011; Bird et al., 2010; Craig, 2009; Critchley, Wiens, Rotshtein, Öhman, & Dolan, 2004; Dalton et al., 2005; Hadjikhani et al., 2004; Nacewicz et al., 2006).

The present systematic review aimed to analyze studies that tested gaze and arousal hypotheses for ERD in young adults with ASC, employing eye-tracking technology and/or psychophysiological measures of autonomic arousal. We also advance an initial attempt of an integrative model to explain gaze and psychophysiological arousal mechanisms underlying ERD in ASC.

It is important to point out that two recently published reviews have focused on a similar topic. One meta-analysis of gaze patterns during emotion recognition in children and adolescents has reported that atypical gaze patterns predicted social difficulties in groups with ASC (Papagiannopoulou et al., 2014). Likewise, Black et al. (2017) reviewed eye-tracking and electroencephalography (EEG) studies spanning from children to adult samples with ASC and reported altered visual attention to facial emotions and atypical activation of cortical areas associated with the processing of facially expressed emotions in ASC. It also highlighted that these deficits are more apparent in adult samples, which justifies the focus of the current review on adults.

However, neither of these reviews has focused specifically on emotion recognition deficits of adults with ASC, employing eye-tracking techniques combined with autonomic arousal measures. Additionally, prior reviews did not consider in detail both the avoidance and the orientation hypotheses with which the present review is primarily concerned, nor have attempted to put forward a model integrating the proposed mechanisms underlying the heterogeneity of emotion processing, gaze and arousal in ASC, which we seek to achieve in this paper. The purpose of our review was to shed light on the extent to which abnormalities in attention to the eyes and/or autonomic arousal may contribute to ERD in ASC.

2. Method

2.1. Study design

The present review was conducted in accordance with the PRISMA guidelines for systematic reviews and meta-analyses (Moher, Liberati, Tetzlaff, Altman, & Prisma Group, 2009). A literature search for articles published before October 2017 was conducted on PsycINFO, PsycArticles and the Elsevier Neuroscience and Psychology databases, using the following search terms: "autism spectrum