Research in Developmental Disabilities xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Communication deficits and avoidance of angry faces in children with autism spectrum disorder

Ana García-Blanco[a,b,*], Concepción López-Soler[c], Máximo Vento[a], María Carmen García-Blanco[d], Belén Gago[a], Manuel Perea[b]

[a] Health Research Institute La Fe, Av. de Fernando Abril Martorell, 106, 46026 Valencia, Spain
[b] University of Valencia, Av. Blasco Ibáñez, 21, Valencia 46010, Spain
[c] Virgen de la Arrixaca University Hospital, Ctra. Madrid-Cartagena, s/n, 30120 El Palmar, Murcia, Spain
[d] University of Castilla-La Mancha, Plaza La Universidad, 3, 02071 Albacete, Spain

ARTICLE INFO

Article history:
Received 12 October 2016
Received in revised form 4 February 2017
Accepted 5 February 2017
Available online xxx
Number of reviews completed is 2

Keywords:
Autism spectrum disorder
Childhood
Attentional biases
Emotional faces
Dot-probe task

ABSTRACT

Background: Understanding how emotional faces are processed is important to help characterize the social deficits in Autism Spectrum Disorder (ASD).
Aims: We examined: (i) whether attention is modulated by emotional facial expression; (ii) the time course of the attentional preferences (short vs. long stimulus presentation rates); and (iii) the association between attentional biases and autistic symptomatology.
Method and procedures: We applied a dot-probe experiment with emotional faces (happy, sad, and angry). The sample was composed of ASD children without additional language and/or intellectual impairments (n = 29) and age-matched Typically Developing (TD) children (n = 29).
Outcomes and results: When compared to the TD group, the ASD group showed an attentional bias away from angry faces at long presentation rates. No differences between groups were found for happy or sad faces. Furthermore, correlational analyses showed that the higher avoidance of angry faces, the greater are the social communication difficulties of ASD children.

The attentional bias away from angry faces may be an underlying mechanism of social dysfunction in ASD. We discuss the implications of these findings for current theories of emotional processing in ASD.

What this paper adds?

This paper examines attentional biases to emotional faces in Autism Spectrum Disorders (ASD) children. Previous findings on how attentional biases are modulated by the stimulus emotional relevance are not fully consistent. Whereas some studies reported an attentional bias to distressing stimuli, others failed to show any attentional biases in ASD children. We tested if this apparent discrepancy was due to the type of processing (automatic vs. controlled) of emotional stimuli. Using a dot-probe task, we found an attentional bias away from angry faces during controlled processing, but not during automatic processing in ASD children. Furthermore, unlike typical developing children, the attentional bias away from angry faces was not associated with anxiety but with autistic communication. These results strongly suggest that the processing of distressed faces is impaired in ASD children—in particular during more controlled processing. This impairment may play an import

* Corresponding author at: Health Research Institute La Fe, Av. de Fernando Abril Martorell, 106, 46026 Valencia, Spain.
E-mail address: ana.garcia-blanco@uv.es (A. García-Blanco).

http://dx.doi.org/10.1016/j.ridd.2017.02.002
0891-4222/

Please cite this article in press as: García-Blanco, A., et al. Communication deficits and avoidance of angry faces in children with autism spectrum disorder. *Research in Developmental Disabilities* (2017), http://dx.doi.org/10.1016/j.ridd.2017.02.002

role in their social functioning in terms of communication difficulties. This finding opens a window of opportunities at an applied level (e.g., can attention training with emotional faces be a useful treatment target in ASD individuals?).

1. Introduction

Autism Spectrum Disorders (ASD) are typically characterized by persistent deficits in communication and social interaction across multiple contexts, together with restricted, repetitive patterns of behavior, interests, or activities (DSM 5;American Psychiatric Association [APA], 2013). It has been posited that the abnormal social behavior in ASD individuals may be explained by reduced attention to emotional facial expressions during childhood (Klin, Jones, Schultz, & Volkmar, 2003)—note that emotional faces should be effectively attended to for an adjusted social functioning (see Waters, Mogg, Bradley, & Pine, 2008). Clearly, the examination of whether children with ASD attend emotional facial information in a biased way (i.e., depending on their valence) may help elucidate the underlying mechanisms of their social dysfunction.

Attentional biases to emotional faces in ASD individuals have been studied with reaction time and eye-tracking techniques. Most of this research focused on ASD children because older individuals may have learned to attend to relevant facial expressions and modulate their social behavior (see Bastiaansen et al., 2011). Among the reaction-time techniques, double cueing or dot-probe tasks are the preferred paradigms to examine how emotional faces capture attention (see Bar-Haim et al., 2007, for review). In the emotional version of the dot-probe task, two cued faces (e.g., one neutral and one emotional) are displayed simultaneously in different locations on a screen (e.g., left and right). Immediately after the faces disappear, a dot probe (target) replaces one of the two cued faces. This cue could be: (i) an emotional face (i.e., an emotion trial) or ii) a neutral face (a neutral trial). Participants are instructed to press a button (left vs. right) to indicate the position in which the dot probe appeared. Faster responses to "emotion trials" would reflect an attentional bias towards emotional faces, whereas faster responses to "neutral trials" would reflect an attentional bias away from emotional faces (see MacLeod, Mathews, & Tata, 1986). Importantly, the dot-probe task allows characterizing whether the selective attention process is automatic or controlled: cue presentation rates briefer than 500 ms have been associated with automatic processing, whereas cue presentation rates longer than 1 s have been associated with controlled processing (see Yiend, 2010). To our knowledge, Uono, Sato, and Toichi (2009) were the first that employed an emotional version of the dot-probe task to examine the attentional bias in ASD adolescents versus typically developing (TD) adolescents. In their version of the dot-probe task, known as gaze cueing task, Uono et al. employed dynamic gaze cues (either to the left or to the right) of fearful or neutral faces displayed during 460 ms. The cueing effect (i.e., faster responses when the eye-direction cue and the target appeared at the same location relative to the opposite location) was greater for fearful than neutral faces in the TD group. However, the ASD group did not show an attention bias towards fearful faces. That is, unlike TD adolescents, fearful faces did not capture the attention of ASD adolescents.

Subsequent studies have examined both attentional biases in ASD and their association with other measures such as anxiety (e.g., Hollocks, Ozsivadjian, Matthews, Howlin, & Simonoff, 2013; May, Cornish, & Rinehart, 2015) and degree of autistic social symptoms (e.g., Matsuda, Minagawa, & Yamamoto, 2015). In the Hollocks et al. (2013) experiment, two cued faces were displayed simultaneously on the left and right side of a computer screen for 500 ms. These cues were: (i) an emotional face (angry or happy); and ii) a neutral face. Results showed that neither ASD nor TD children displayed an attentional bias—this was so despite the fact that ASD children had higher levels of anxiety than TD children. That is, while anxious TD children usually show an attentional bias toward angry faces (Bar-Haim et al., 2007), angry faces did not seem to capture the attention of ASD children despite their relatively high levels of anxiety. Likewise, May et al. (2015) employed a dot-probe task similar to the Hollocks et al. (2013) experiment that compared anxious ASD children and non-anxious TD children. Similarly to Hollocks et al. (2013), May et al. (2015) failed to find an attentional bias to emotional faces in either group. Taken together, these response time experiments failed to show an attentional bias toward distressed faces in ASD children. Conversely, Matsuda et al. (2015) examined the association between attentional biases and autistic symptoms. They conducted an eye-tracking experiment with ASD and TD children that examined gaze behavior towards surprised, happy, neutral, angry, and sad faces that were individually displayed for 3 s. Bear in mind that eye movements have been considered an indicator of cognitive processes during visual tasks because shifts in gaze position closely follow—and are guided by—shifts in attentional focus (see Rayner, 2009; for a review). While there were no global differences between the two groups in gaze behavior when looking at faces, Matsuda et al. (2015) found that ASD children with more severe autistic symptomatology showed shorter fixation durations to angry faces than to the other faces. This finding suggests that attentional bias away from angry faces can be used as an indicator of autism severity.

An explanation for the apparent discrepancy between the findings reported by Matsuda et al. (2015) and the findings reported by Uono et al. (2009), Hollocks et al. (2013) and May et al. (2015) is in terms of automatic versus controlled processing—note that this is determined by the presentation rates of the visual cues. Hollocks et al. (2013), May et al. (2015), and Uono et al. (2009) employed cue presentation rates $\leq$ 500 ms—this would be an indicator of automatic processing. In contrast, Matsuda et al. (2015) used longer cue presentation rates—this would be an indicator of controlled processing. Thus, it may be the case that automatic visual attention to emotional facial expression is preserved in ASD children (see May, Cornish, & Rinehart, 2016, for a similar finding with a visual search paradigm; and Yerys et al., 2013; for a similar finding with an attentional blink paradigm). That is, the presence of an attentional bias away from distressed faces in ASD children would occur during controlled processing (i.e., at long presentation rates) rather during automatic processing (i.e., at short presentation rates). To test this hypothesis, it is critical to manipulate the cue presentation rate (short vs. long). The present

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