Research in Autism Spectrum Disorders 7 (2013) 1617–1624

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

Journal homepage: http://ees.elsevier.com/RASD/default.asp

The influence of static versus naturalistic stimuli on face processing in children with and without Asperger syndrome or high-functioning autism

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ARTICLE INFO

Article history:
Received 19 July 2013
Received in revised form 12 September 2013
Accepted 12 September 2013

Keywords:
Face processing
ASD
Eye-tracking
Dynamic

ABSTRACT

Questions regarding the use of static or dynamic facial stimuli in experimental studies investigating facial processing of individuals with AS/HFA raises issues of both ecological validity and the applicability of experimental findings to clinical or everyday practice. Children with and without AS/HFA ($n = 38$) were fitted with a head-mounted eye-tracker and exposed to either static or interactive dynamic facial stimuli. Average fixation duration, the proportion of fixations in areas of interest and a comparative index that was independent of differences in presentation length between stimuli types were calculated. Visual scanning patterns of individuals with AS/HFA were not affected by stimuli type. However, control participants exhibited different scanning patterns between dynamic and static stimuli for certain regions of the face. Visual scanning patterns in children with AS/HFA are consistent regardless of the stimuli being a static photo or dynamic in the form of a real face. Hence, information from experimental studies with static photos of faces provide information that is valid and can be generalised to “real world” interactions.

1. Introduction

Autism Spectrum Disorders (ASDs) are a group of conditions traditionally defined by impairments in two or all of three clinical domains; i.e., social impairments, communication impairments and restricted and repetitive behaviours and interests (RRBIs). Although RRBIs are usually quite striking, often the most obvious and earliest clinical and developmental warning signs are the manifest socio-communicative impairments (American Psychiatric Association, 2000).

In DSM-IV these socio-communicative impairments include, but are not limited to; impairment in use or response to nonverbal communication, delayed language, little seeking or offering of comfort, a lack of spontaneous seeking, joint attention and/or social and emotional reciprocity, as well as a failure to develop developmentally appropriate peer relationships, and a failure to initiation or sustain conversation. The DSM-5 now recognises another clinical domain as being

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1750-9467/$ – see front matter
http://dx.doi.org/10.1016/j.rasd.2013.09.012

pivotal in the constellation of ASD symptomatology, namely the unique way in which individuals with ASD experience and process sensory information (American Psychiatric Association, 2012). Indeed, it is not a giant leap to consider that these differences in sensory perception may underlie, or at least be fundamental to, much of the socio-communicative symptomatology observed in ASD. The foundation of this perception is based on the ability to attend, integrate and accurately process multiple sensory inputs to build a coherent experience of the world around us (Iarocci & McDonald, 2006).

Many theories describe the unique ways in which individuals with ASD experience and process sensory information. These include, but are not limited to, the Intense World theory (Markram & Markram, 2010), Weak Central Coherence (Happé & Frith, 2006), the Enhanced Perceptual Functioning theory (Mottron, Dawson, Soulières, Hubert, & Burack, 2006) as well as similar information processing accounts (Minshew, Goldstein, & Siegel, 1997; Plaisted, O'Riordan, & Baron-Cohen, 1998). Aside from differences in processing sensory information, a possible source of difference between individuals with and without ASD may be the ways in which information is captured, particularly within the context of socio-emotional stimuli. It is now well established that individuals with ASD process faces differently to those without ASD. Studies using eye tracking technology have established a growing catalogue of evidence for atypical visual search strategies in individuals with ASD when viewing faces (Corden, Chilvers, & Skuse, 2008; Falkmer, Bjällmark, Larsson, & Falkmer, 2011a, 2011b; Falkmer, Larsson, Bjällmark, & Falkmer, 2010; Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Leung, Ordqvist, Falkmer, Parsons, & Falkmer, 2013; Speer, Cook, McMahon, & Clark, 2007; Spezio, Adolphs, Hurley, & Piven, 2007a, 2007b). While most people fixate predominantly on the classic 'face triangle' – primarily on the eyes but also the nose and mouth – individuals with ASD have preponderance towards fixating on the mouth or other areas of the face (Baron-Cohen, Wheelwright, & Jolliffe, 1997; Corden et al., 2008; Falkmer et al., 2010, 2011a,b; Klin et al., 2002; Spezio, Adolphs, Hurley, & Piven, 2007a, 2007b). However, this tendency is not always consistently observed and may depend heavily on the type of facial stimuli used. The majority of this research has been done with static photographic stimuli.

In those studies that do employ dynamic facial tasks, stimuli are largely still abstracted from what could be perceived as naturalistic and ecologically valid, or mimicking real world interactions. Examples of dynamic experimental stimuli are computer-generated morphs between different identities with neutral expressions or between different emotional expressions on single identities (Biele & Grabowska, 2006; LaBar, Crupain, Voyvodic, & McCarthy, 2003; Pelphrey, Morris, McCarthy, & LaBar, 2007; Sato, Kochiyama, Yoshikawa, Naito, & Matsumura, 2004), non-interactive video clips (Sato, Kochiyama, Uono, & Yoshikawa, 2010), rotating Mooney faces (Castelhano, Rebola, Leitão, Rodriguez, & Castelo-Branco, 2013), or manipulated presentations of lone static features amongst their dynamic counterparts (Back, Jordan, & Thomas, 2009; Back, Ropar, & Mitchell, 2007). Whether or not the types of stimuli are crucial for the outcome remains unknown. Previous research in adults with ASD does not suggest this is so (Falkmer et al., 2011a, 2011b), but the issue is yet to be addressed in a developmental population. The current study aimed to examine the visual search strategies of children with and without Asperger syndrome or high functioning autism (hereafter AS/HFA) when viewing static, dynamic and interactive facial stimuli using eye tracking technology.

2. Method

2.1. Participants

Thirty-eight 8–12 year old children with and without AS/HFA were recruited through the Telethon Institute of Child Health Research, personal contacts, local primary schools, and radio and newspaper advertisements throughout the Perth metropolitan area in Western Australia. Medical records were sighted to confirm that each child with ASD had been diagnosed by a multi-disciplinary team assessment (Falkmer, Anderson, Falkmer, & Horlin, 2013; Le Couteur, Haden, Hammal, & McComachie, 2008; Woolfenden, Sarkozy, Ridley, & Williams, 2012). Inclusion criteria were that participants could read and understand written and verbal instructions in English, and the absence of comorbid conditions for participants with AS/HFA. Concordant with a diagnosis of either AS or HFA, it is assumed that all participants with AS/HFA have at least average intelligence, as is required for classification with either condition. For analysis purposes children with AS/HFA were paired with control children to create dyads matched by gender and as closely as possible in regards to age (Table 1).

2.2. Materials/apparatus

The number of fixations and fixation durations of the participants' eyes were recorded using a head-mounted Arrington ViewPoint™ eye tracker operating in 60 Hz. The eye tracker was worn over participants' glasses where necessary. After a screening procedure to assess visual acuity (Albrecht et al., 2012; Falkmer et al., 2011a, 2011b; Falkmer, Stuart, et al., 2011)

Table 1
Participant information.

	Male	Female	Mean age (SD)	Range
AS/HFA	15	4	10.86 (1.07)	8.6–12.7 years
Control	15	4	10.65 (1.04)	9.11–12.6 years