Research in Autism Spectrum Disorders 6 (2012) 391–398

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

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

Movement perception and movement production in Asperger's Syndrome☆

Kelly J. Price [a,*], Maggie Shiffrar [b], Kimberly A. Kerns [c]

[a] Department of Psychiatry, University of British Columbia, Vancouver, BC, Canada
[b] Department of Psychology, Rutgers University-Newark, Newark New Jersey, USA
[c] Department of Psychology, University of Victoria, Victoria, BC, Canada

ARTICLE INFO

Article history:
Received 27 June 2011
Accepted 29 June 2011
Available online 26 July 2011

Keywords:
Autism spectrum disorder (ASD)
Asperger's Syndrome (AS)
Motor skills
Motion perception
Biological motion

ABSTRACT

To determine whether motor difficulties documented in Asperger's Syndrome (AS) are related to compromised visual abilities, this study examined perception and movement in response to dynamic visual environments. Fourteen males with AS and 16 controls aged 7–23 completed measures of motor skills, postural response to optic flow, and visual sensitivity to static form and coherent motion in random dot kinematograms and point-light walkers. No group differences were found in sensitivity to static form or coherent motion. However, significant group differences were found in visual sensitivity to human movement and postural responsivity to optic flow, which both correlated with motor skills. This may suggest difficulties in perception and production of movement and dysfunctional perceptual-motor linkages in AS.

Previously researchers have documented movement impairments in individuals with Asperger's Syndrome (AS) and autism (e.g., Freitag, Kleser, Schneider, & von Gontard, 2007; Ghaziuddin & Butler, 1998; Green et al., 2002, 2009; Jansiewicz, Goldberg, Newschaffer, Denckla, & Mostofsky, 2006; Manjiviona & Prior, 1995; Miyahara et al., 1997; Smith, 2000). Motor behavior is not an isolated process but instead depends upon input from the visual, proprioceptive, and vestibular systems. Children with Autism Spectrum Disorder (ASD) rely heavily upon visual cues for balance in static environments (Molloy, Dietrich, & Bhattacharya, 2003). The purpose of the present study was to determine whether visual sensitivity to dynamic cues was related to motor abilities in youth with AS.

The accurate and timely visual analysis of movement is fundamentally important for the production and control of motor activity. Several studies have been published suggesting that children with ASD are compromised in their sensitivity to coherent visual motion (Davis, Bockbrader, Murphy, Hetrick, & O'Donnell, 2006; Milne et al., 2002; Pellicano, Gibson, Maybery, Kevin, & Badcock, 2005; Spencer et al., 2000; Spencer & O'Brien, 2006; Tsermentseli, O'Brien, & Spencer, 2008). Other researchers have concluded that, to the contrary, children with ASD do not differ from typicals in their visual motion sensitivity (e.g., De Jonge et al., 2007; Del Viva, Igliozzi, Tancredi, & Brizzolara, 2006). This variability in findings may be due to a relationship between individual differences in the visual perception of movement and differences in motor ability (Milne et al., 2006), which would be in keeping with other evidence of perception–action coupling such as, for example, enhanced visual sensitivity to one's own actions (e.g., Loula, Prasad, Harper, & Shiffrar, 2005).

☆ Funding was provided by the Michael Smith Foundation for Health Research, the Canadian Institutes of Health Research, and the Simons Foundation. The authors wish to thank Peter Hansen, University of Oxford for sharing the form and motion tasks, Drs. Dorothy Edgell, Naznin Virji-Babul, and Catherine Mateer for conceptual input into the project, and Robert MacInerny and Sunny Mahajan for computer programming assistance.

* Corresponding author at: Queen Alexandra Centre for Children's Health, 2400 Arbutus Road, Victoria, BC, V8N 1V7, Canada. Tel.: +1 250 519 5390; fax: +1 250 519 6937.
E-mail address: kprice@uvic.ca (K.J. Price).

1750-9467/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.rasd.2011.06.013

Optic flow is the pattern of dynamic visual information that is projected onto the retina whenever individuals move through their environment (Gibson, 1950). Because specific patterns of motor activity produce specific patterns of optic flow, the visual perception of large field optic flow normally triggers postural adjustments. When viewing large field optic flow displays, children with autism exhibit atypically small postural responses while the postural adjustments of children with AS are slightly larger than those in typically developing people (Gepner & Mestre, 2002). Atypical postural reactivity to optic flow by observers with autism and AS may reflect compromises in the coupling between the visual and motor system (Gepner, Mestre, Masson, & de Schonen, 1995; Gepner & Mestre, 2002). A related possibility is that observers with autism and AS demonstrate atypical motor responses because their motor systems receive atypical input from the visual system.

When people move, they do so relative to the surfaces in their environment. The above studies investigated visual sensitivity to surface motion in random dot kinematograms. People also move relative to other people. Neurophysiological (Herrington et al., 2007) and behavioural (Blake, Turner, Smoski, Pozdol, & Stone, 2003; Kaiser, Delmolino, Tanaka, and Shiffrar, 2010) evidence indicates that young observers with autism and AS are compromised in their visual sensitivity to human movement. These studies used point-light stimuli that are constructed by placing markers, or point-lights, on the major joints of moving people and filming their actions so that only the point-lights can be seen (Johansson, 1973). While observers with autism and AS can identify human motion in point-light displays, they demonstrate relative decrements in their visual sensitivity to human motion (Hubert et al., 2007; Moore, Hobson, & Lee, 1997). Since movement production depends upon visual motion perception, the above results raise the possibility that deficits in motor behavior reflect, at least in part, compromised input from needed visual processes.

The goal of the current study was to determine how children with AS perceive and respond to dynamic aspects of their visual environments and determine if their dynamic visual perception is related to their motor ability. Different perceptual and motor skills were assessed. First, motor tests from a standardized battery were administered. Then, visual sensitivity to static patterns was assessed as a non-dynamic control condition. Visual sensitivity to dot-defined surfaces and people in motion and postural responses to optic flow were then measured. To the extent that motor clumsiness in AS reflects compromised processing of dynamic visual information, visual sensitivity to motion, but not static form, should correlate with motor skills.

1. Methods

1.1. Participants

The AS group consisted of 14 youths recruited through a child and youth health centre. The control group consisted of 16 individuals recruited through advertisements in local newspapers. All participants were male. Exclusionary criteria included clinically significant language impairment, a Full-Scale IQ under 70, and significant neurological disorders or physical anomalies that interfere with motor behavior. The ages of the AS group (mean = 14.14 years, SD = 4.80 years, range = 7.75–23.00 years) and the control group (mean = 14.08 years, SD = 4.61 years, range = 7.42–23.67 years) did not significantly differ, $t(28) = .03$, $p > 0.5$. The University of Victoria Human Research Ethics Committee granted ethical approval for this study. Informed consent was sought from parents whenever a participant was less than 18 years old.

Diagnoses of AS were made independently of this study by a multidisciplinary team. Within this study, symptom patterns and severity were assessed with three parent-completed symptom checklists: the Gilliam Asperger Disorder Scale (GADS, Gilliam, 2001), the Asperger Syndrome (and high functioning autism) Diagnostic Interview (ASDI Gillberg, Gillberg, Råstam, & Wentz, 2001), and the high-functioning Autism Spectrum Screening Questionnaire (ASSQ Ehlers, Gillberg, & Wing, 1999).

Symptom frequencies between the AS and control groups were clearly separated (Table 1). For seven of the eight measures, score distributions did not overlap. All measures of symptomatology differed significantly ($p < .001$) across the two groups. In terms of diagnostic cut-offs, the GADS showed clear separation with only one of the participants with AS in the "Borderline" range and the rest in the "High/Probable" range. All of the controls had GADS scores falling in the "Low/Not Probable" range. On the ASSQ, only one participant with AS had a score below the cut-off, and no controls had a score approaching the cut-off. On the ASDI, only four participants with AS had scores below the cut-off.

All participants were also given the Wechsler Abbreviated Scale of Intelligence (WASI, Wechsler, 1999). The verbal abilities (Vocabulary) of the AS (reported as *T*-scores, M = 60.14, SD = 9.44, range 43–73) and control (M = 57.81, SD = 9.29, range 40–70) groups did not significantly differ, $t(28) = 0.68$, $p > .50$. Likewise, scores on the Matrices subtest, a measure of nonverbal intellectual ability, did not significantly differ across the AS (M = 57.14, SD = 7.43, range 42–65) and control (M = 52.63, SD = 9.29, range 38–68) groups, $t(28) = 1.46$, $p > 0.10$.

1.2. Materials and procedure

After providing informed consent, participants completed WASI testing. Following this, all participants completed the tasks below in the order listed. All participants were tested individually in a university laboratory, and completed all tasks using the same equipment.