The predictive coding framework in motion and biological motion perception in ASD

We aimed to create a quantitative summary of previous findings and investigate potential factors, which could lead to the variable and often contradictory results on perception of biological motion in autism. We included papers, which compared ASD and neurotypically developing individuals, and focused on biological motion perception (detection, action and emotion perception). An electronic search from Dissertations & Theses A&I, Dissertation & Theses: UK & Ireland, Web of Science, PsycINFO and MEDLINE yielded 52 eligible papers.

We included behavioural, eye-tracking, EEG and fMRI studies. In all included studies, the face was not visible. We used a three-level random effects meta-analytic approach to analyse the behavioural, eye-tracking and EEG papers eligible for a quantitative summarisation. Results suggest that greater difficulties occur when higher order information, such as emotion (g=1.0618), is required. Adults appear to perform better than children (g=0.4528) whilst children and adults show an equivalent difficulty as adolescents (g=-0.07848). No effect of either sex or IQ was found.

To summarise, there appears to be a general deficiency in the ability of individuals with ASD to perceive and interpret biological motion (g=0. 6639). This effect is influenced by age and type of paradigm. Nevertheless, moderate heterogeneity exists, and thus these results require cautious interpretation. We did not find significant differences in eye-tracking studies and EEG studies.

In terms of fMRI, the analysis found five clusters where neurotypically developing individuals had greater activation than autistic individuals when detecting biological motion. The identified clusters were consistent with the perception of human motion found in the literature.

Data collection method

A computerised search involved using the following electronic databases: Dissertations & Theses A&I (ProQuest), Dissertation & Theses: UK & Ireland (ProQuest), Web of Science, PsycINFO (EBSCOhost) and MEDLINE (OVID). The following search terms were used ‘autis\*’, ‘biological motion’, ‘human motion’, ‘asd’, ‘asperger\*’, ‘childhood schizophrenia’, ‘kanner\*’, ‘pervasive development\* disorder\*’, ‘PDD-NOS’, ‘PDD\*’, ‘PLD\*’, ’point-light display\*’, “action observation\*”, “action observation network\*”, ‘AON’. The asterisk represents truncation, allowing the search to find items containing different endings of the term.

The following inclusion/exclusion criteria were applied to the extracted results by two researchers independently to select the final set of studies: (1) Published before week one of November 2017(Search 1) and May 2019 (Search 2); (2) Published primary empirical articles and theses with non-published results – excluding review articles, opinion pieces, correspondences, case studies, and meta-analyses; (3) Participants in the sample must have an ASD diagnosis; (4) Diagnosis must be confirmed through Autism Diagnostic observation Schedule (ADOS), Autistic Diagnostic Interview - Revised form (ADI-R), a clinician, 3-Di, DISCO; those that are specific to Asperger's disorder, for example the Gilliam Asperger Disorder Scale (GADS), the Asperger Syndrome (and high functioning autism) Diagnostic Interview (ASDI), and the high-functioning Autism Spectrum Screening Questionnaire (ASSQ) were also accepted as confirmation of ASD diagnosis. Additionally, the Chinese/Japanese equivalents of tests were accepted. (5) Study must contain fMRI, EEG, eye-tracking and/or behavioural designs; (6) An ASD and NT control group must be present and compared; (7) Although human biological motion includes face motion and eye-gaze, only papers involving human body movement were included to provide a more focused review. These include full-light displays, PLDs and stick figures; (8) When stimuli that aim to minimize the availability of structural cues e.g. (PLDs and Stick Figures) were used, the stimuli must represent human form with a minimum of two points for PLDs; (9) Studies that used videos of people or cartoons where the face was not obstructed were not included as faces could confound with the participants’ performance; (10) Papers that focus on imitation of biological motion were not included; (11) If papers focusing on imitation included a separate analysis of BM observation, solely the BM observation was included where possible; (12) Similarly, if paradigms included additional stimuli, but performance on the BM paradigm was analysed and could be extracted separately from the other stimuli, only that analysis was included; (13) Only papers that included t-statistics, descriptive statistics and/or effects sizes were included. Data requests were made to authors, where eligible papers did not include the necessary data.

Data was extracted and converted to csv/txt formats. Data, R and SAS scripts for analysis and a readme file are included in a zip. folder.