

An investigation of the 'female camouflage effect' in autism using a new computerized test showing sex/gender differences during ADOS-2

Agnieszka Rynkiewicz^{1,2}, Björn Schuller^{3,4,5}, Erik Marchi³, Stefano Piana⁶, Antonio Camurri⁶, Amandine Lassalle⁷, Simon Baron-Cohen⁷

¹ Medical University of Gdańsk, Department of Psychiatry, Gdańsk, Poland, ² Centrum Diagnozy, Terapii i Edukacji SPECTRUM ASC-MED, Gdańsk, Poland, ³ Machine Intelligence & Signal Processing Group, Technische Universität München, Munich, Germany, ⁴ Department of Computing, Imperial College London, London, UK, ⁵ Complex & Intelligent Systems, University of Passau, Germany, ⁶ Casa Paganini-InfoMus Research Centre DIBRIS, University of Genoa, Genoa, Italy, ⁷ Autism Research Centre, Cambridge University, Department of Psychiatry, Cambridge, UK



Background and objectives

Autism is diagnosed more frequently in males than in females. Females with autism may have been under-identified due to a male-biased understanding of autism but also females' camouflaging.

The primary aim of this study is to present an innovative computerized technique to objectively evaluate the nonverbal modality of communication (gestures) during two demonstration tasks of ADOS-2 (Autism Diagnostic Observation Schedule, Second Edition). The authors describe a new technique allowing automated coding of non-verbal mode of communication (gestures) and offering the possibility of objective, evaluation of gestures, independently of human judgment and automatically measured participants' gestures, allowing computation of a "Gestures Index" (GI). This GI was compared between males and females with autism. The authors tested if females with autism had a higher GI compared to males with autism.

Since Polish diagnostic and screening measures tap the symptomatology associated with autism, and since the intensity of autistic traits and the emotional competence of Polish children with autism are not widely described in the international literature, the results obtained on these measures with particular focus on parent-report screening measurements are also presented as they include the questions on the communication of a child, both verbal and non-verbal (gestures) [1].

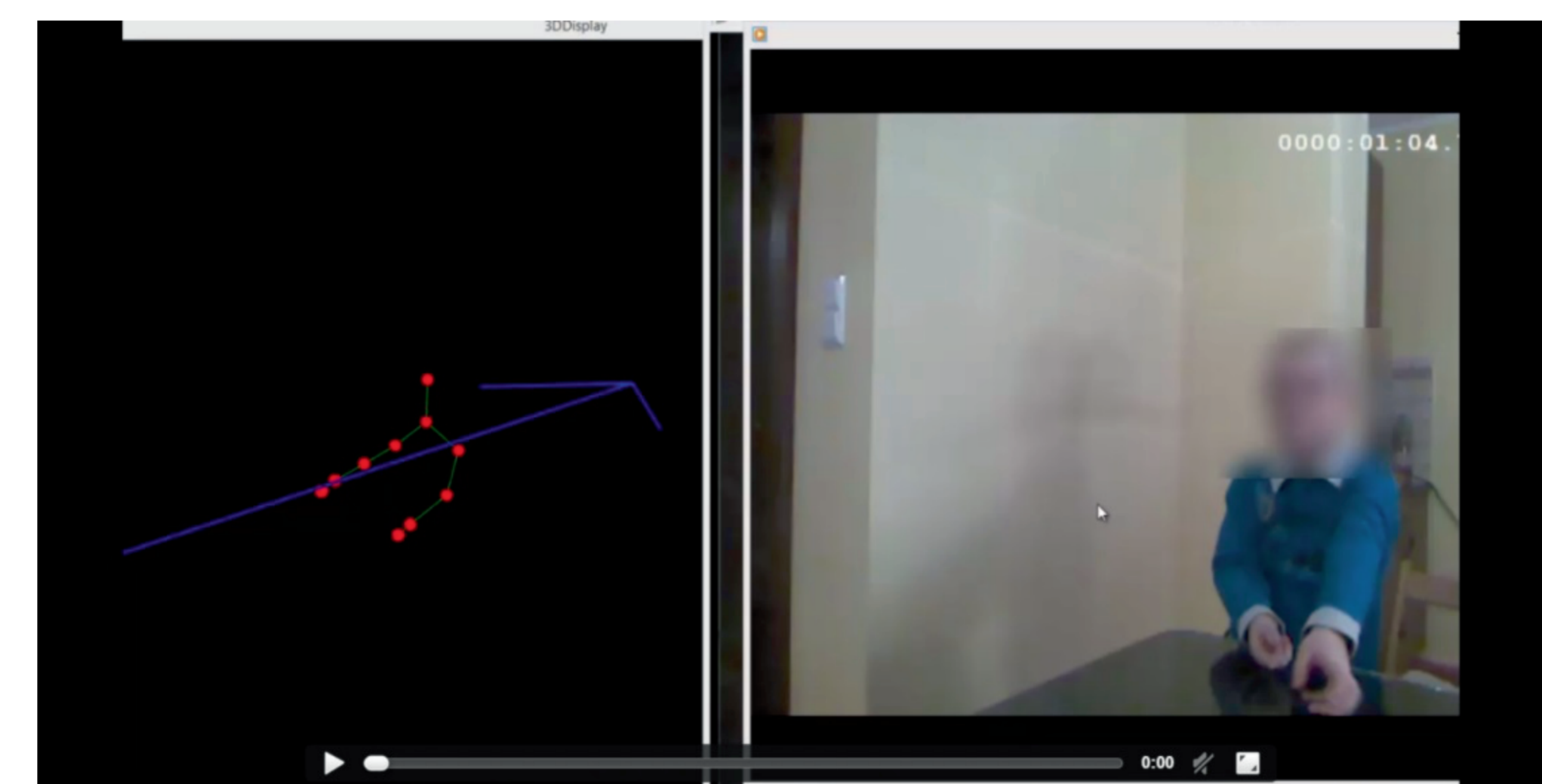
Sample and methods

33 high-functioning Polish girls (n=16) and boys (n=17) aged 5-10 with formal diagnosis of autism or Asperger's syndrome made by a psychiatrist and a clinical psychologist based on ICD-10 or DSM-IV criteria, children with an IQ average or above, and with fluent speech, with no co-occurring serious mental, neurological or paediatric illnesses (e.g., epilepsy). Children were assessed during two demonstration activities of Module 3 of ADOS-2, administered in Polish, coded using Polish codes.

The automated measurement was performed by a software application designed and build on the EyesWeb software platform by the Casa Paganini – InfoMus Research Centre of University of Genoa. The application returns with coordinates in the X, Y, Z dimensions of ten characteristic points of a child being recorded (head, neck, left shoulder, right shoulder, left elbow, right elbow, left wrist, right wrist, left palm with the fingers and right palm with the fingers). The Microsoft Kinect sensor for the automated gesture analysis task was used as well. If any of the coordinates were missing or incomplete on the Kinect recordings, the data did not move to the final analysis and the comparison. As a result, 10 girls with autism and 16 boys with autism were compared on gestures. Children were also assessed with Polish versions of the Reading the Mind in the Eyes and Faces Tests.

Parents provided information on the author-reviewed Polish research translation of SCQ (Social Communication Questionnaire, Current and Lifetime) and Polish version of AQ (Autism Spectrum Quotient, Child) [1].

Two demonstration tasks of ADOS-2 sessions recorded with Kinect



The length of gestures [mm] in autism group according to sex/gender (10 females, 16 males)

| | Demonstration Task | | Cartoons | | Sum of two activities | |
|----------------|--------------------|------------|------------|------------|-----------------------|------------|
| | Girls | Boys | Girls | Boys | Girls | Boys |
| Mean | 191,419.9 | 192,023.8 | 45,607.41 | 43,459.44 | 237,027.26 | 235,483.28 |
| SE | ±30,769.97 | ±29,795.39 | ±32,788.59 | ±24,804.43 | ±59,295.35 | ±40,124.21 |
| Mann-Whitney U | 74.00 | | 71.00 | | 78.00 | |
| p-value | 0.78 | | 0.66 | | 0.94 | |

The time of gestures [s] in autism group according to sex/gender (10 females, 16 males)

| | Demonstration Task | | Cartoons | | Sum of two activities | |
|----------------|--------------------|-------|----------|-------|-----------------------|--------|
| | Girls | Boys | Girls | Boys | Girls | Boys |
| Mean | 35.6 | 47.6 | 37.8 | 45.3 | 72.9 | 92.9 |
| SE | ±4.35 | ±8.77 | ±4.85 | ±5.27 | ±7.98 | ±10.64 |
| Mann-Whitney U | 70.00 | | 65.00 | | 60.00 | |
| p-value | 0.62 | | 0.42 | | 0.31 | |

The Gesture Index, length to time [mm/s], according to sex/gender in autism group (10 females, 16 males)

| | Demonstration Task | | Cartoons | | Sum of two activities | |
|----------------|--------------------|---------|----------|---------|-----------------------|----------|
| | Girls | Boys | Girls | Boys | Girls | Boys |
| Mean | 5,485.3 | 4,521.8 | 965.0 | 1,318.2 | 3,092.72 | 2,806.73 |
| SE | ±524.70 | ±585.12 | ±606.51 | ±857.14 | ±547.53 | ±606.46 |
| Mann-Whitney U | 56.00 | | 70.00 | | 66.00 | |
| p-value | 0.22 | | 0.62 | | 0.48 | |

Demographic table including the age, IQ scores and ADOS-2 scores

| | Age | | IQ score | | ADOS-2 score | |
|------|---------|-------|----------|--------|--------------|-------|
| | Females | Males | Females | Males | Females | Males |
| N | 16 | 17 | 13 | 16 | 16 | 17 |
| Mean | 8.06 | 8.23 | 109.58 | 112.31 | 8.94 | 9.71 |
| SD | 1.57 | 2.05 | 11.70 | 13.10 | 2.46 | 2.95 |

N number of included participants in the sample, SD standard deviation

Summary table for participant scores by sex/gender

| | SCQ Lifetime | | SCQ Current | | AQ Child | | Eyes Test | | Faces Test | |
|------|--------------|---------|-------------|---------|----------|---------|-----------|---------|------------|---------|
| | Males | Females | Males | Females | Males | Females | Males | Females | Males | Females |
| N | 16 | 16 | 16 | 16 | 14 | 12 | 12 | 13 | 15 | 14 |
| Mean | 22.94 | 23.31 | 14.19 | 14.13 | 31.86 | 32.58 | 0.54 | 0.40 | 0.80 | 0.72 |
| SD | 6.98 | 5.39 | 3.90 | 5.94 | 7.77 | 8.75 | 0.18 | 0.14 | 0.08 | 0.09 |

N number of included participants in the sample, SD standard deviation

Results and conclusions

- Girls with autism had a higher GI than boys with autism during two demonstration activities of ADOS-2. Girls differ on the non-verbal communication dimension (gestures). The automatic analysis of their gestures shows that they present longer and faster gestures. These gestures are more "vivid": longer in shorter time and thus probably more noticeable by an examiner (a human); as a result such non-verbal communication may be noted as not autistic.
- The number of stereotypic behaviours only significantly diminished in boys but not girls during their life.
- Girls with autism made significantly more mistakes than boys with autism on the Faces Test.
- Current communication skills as reported by parents on the SCQ were significantly better in boys with autism than in girls. Based on SCQ both girls and boys with autism had improved in their social and communication abilities during their life.
- The study raises questions about parent-report screening measures such as the SCQ. As parents are not supervised when completing the SCQ, it is unclear whether they take into consideration non-verbal communication (gestures) when they judge their children's communication skills, or only their verbal communication.
- The results of the present study contribute to further understanding of the under-diagnosis of autism in girls.

References: [1] Rynkiewicz et al. (2016). Mol Autism. 2016; 7:10. DOI:10.1186/s13229-016-0073-0. Contact: rynkia@gumed.edu.pl