Quantifying the use of gestures in Autism Spectrum Disorder
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Introduction

• Individuals with ASD appear to be less proficient in their motor coordination, including the production of co-speech gesture (Fournier et al., 2010)

• Kinematics are affected in ASD: children fail to plan a full motor sequence (Fabbi-Destro et al., 2009) while adults do not minimize jerk and move with greater acceleration and velocity (Cook et al., 2013)

• Individuals with ASD show atypical coordination between iconic gestures and related speech and diminished quality of communication (de Marchena and Eigsti, 2010), as well as difficulties with speech and gestures integration (Silverman et al., 2010)

→ Characterise the temporal dynamics of speech and gesture in ASD

Materials & Methods

• Participants

<table>
<thead>
<tr>
<th></th>
<th>ASD (n=17)</th>
<th>TD (n=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>41.9 ± 13.5</td>
<td>46.6 ± 12.2</td>
</tr>
<tr>
<td>VIQ</td>
<td>110 ± 11</td>
<td>111 ± 13</td>
</tr>
<tr>
<td>PIQ</td>
<td>107 ± 14</td>
<td>109 ± 14</td>
</tr>
<tr>
<td>FIQ</td>
<td>109 ± 12</td>
<td>111 ± 14</td>
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</tbody>
</table>

• Task: Participants took part in a live event scenario in which they performed first aid manipulations on a manikin following a script. Later on, participants were interviewed on what they recalled of the event, starting with a free recall procedure.

• Materials: Interviews were videotaped for further analysis (Maras et al., 2012). The present study analyses the free recall segment of the interview.

• Analysis

1) Temporal dynamics

- Quantity of movement (QoM): extracted from each participant’s video as the number of pixels for which luminance changed by more than 30dB from frame n to frame n+1
- Speech volume: extracted using the software Praat, in dB
- Speech pitch: fo, extracted using the software Praat, in Hz

2) Quality of communication ratings

Recordings were presented in the audio or audio-visual modality to two 15-raters groups (counter-balanced) who rated the quality of communication on a 1-9 scale

Introduction (Continued)

Results

1) Temporal dynamics

- Normalised cross-correlation coefficients were computed between quantity of movement and the two acoustic measures
  → no group difference

![Characteristic lag between acoustic features and quantity of movement in both groups (in ms)]

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech volume / QoM</td>
<td>17</td>
<td>26.5</td>
<td>± 1652.5</td>
<td>.204</td>
<td>.840</td>
</tr>
<tr>
<td>TD</td>
<td>17</td>
<td>-61.8</td>
<td>± 670.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speech pitch / QoM</td>
<td>17</td>
<td>-258.8</td>
<td>± 1865.7</td>
<td>.292</td>
<td>.772</td>
</tr>
<tr>
<td>TD</td>
<td>17</td>
<td>-343.3</td>
<td>± 1555.6</td>
<td></td>
<td></td>
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</tbody>
</table>

Cross correlogram showing the characteristic lag between speech pitch and quantity of movement (in s)

2) Quality of communication

- Gain = rating(AV) – rating (audio)
  → main effect of question (Q6 > all other questions)
  → no group effect or interaction

![Cross Recurrence Quantification Analysis was conducted on:](

QoM / volume (ns) → QoM / pitch (ns) → QoM:

Average length of a diagonal (L)

ASD < TD (t(34,32)=3.361, p=0.002)

Length of vertical lines (TT)

ASD > TD (t(34,32)=3.609, p=0.001)

![Cross recurrence plot volume (black) / QoM (red) in TD participant](

Discussion

1) No evidence for group differences in the temporal dynamics of speech and gesture or in the perceived quality of communication

2) Temporal dynamics of movement alone are atypical in ASD but not their coordination with speech behaviour

3) Higher organisation of QoM (in TD) and between speech volume and QoM (in ASD) is detrimental to the quality of communication: suggests that flexible use of gesture boosts communication efficacy

References