

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** (Fabbri-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

	ASD (n=17)			TD (n=17)		
	mean	SD	range	mean	SD	range
age	41.9	± 13.5	25-62	46.6	± 12.2	26-61
VIQ	110	± 11	81-123	111	± 13	82-128
PIQ	107	± 14	84-128	109	± 14	75-136
FIQ	109	± 12	81-127	111	± 14	77-135

• **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:** f0, 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

Results

1) Temporal dynamics

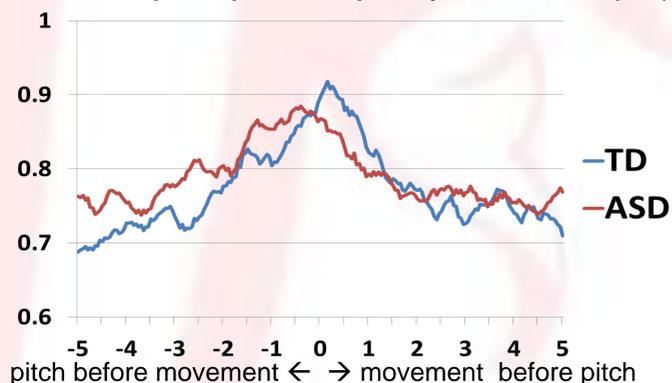
• Normalised **cross-correlation** coefficients were computed between quantity of movement and the two acoustic measures

→ **no group difference**

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

		N	Mean	SD	t	p
Speech volume / QoM	ASD	17	26.5	± 1652.5	.204	.840
	TD	17	-61.8	± 670.0		
Speech pitch / QoM	ASD	17	-258.8	± 1865.7	.292	.772
	TD	17	-435.3	± 1655.6		

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



• Cross Recurrence Quantification Analysis was conducted on :

→ QoM / volume (ns)

→ QoM / pitch (ns)

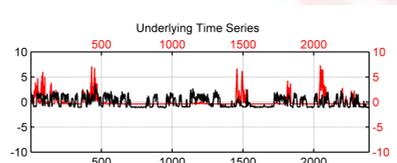
→ QoM:

Average length of a diagonal (L)

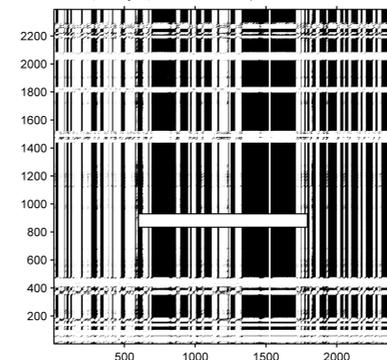
ASD < TD ($t(34,32)=-3.361, p=.002$)

Length of vertical lines (TT)

ASD > TD ($t(34,32)=-3.609, p=.001$)



Cross Recurrence Plot
Dimension: 12, Delay: 1, Threshold: 1.7σ (fixed distance maximum norm)



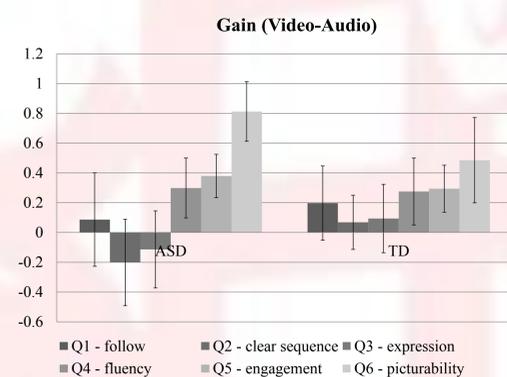
Cross recurrence plot volume (black) / QoM (red) in TD participant

2) Quality of communication

• Gain = rating(AV) – rating (audio)

→ **main effect of question (Q6 > all other questions)**

→ **no group effect or interaction**



• High recurrence rate between speech volume and QoM were associated with lower AV quality of communication in ASD

• Shorter L, TT and lower entropy in QoM cross recurrence were associated with higher audio and AV quality of communication in TD

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

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