Gesture comprehension and core cognitive processes in autism spectrum disorder

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Background

Gesture in Autism (ASD)
- Differences in complexity and frequency of gesture production (Ozer et al., 2020; Silverman et al., 2017; de Marchena & Eigsti, 2010; Morett et al., 2016; Taverna et al., 2021)
- Little work on gesture comprehension (Dimitrova et al., 2017; Silverman et al., 2010)
- No work on gesture production *or* comprehension in individuals who have lost the diagnosis (LAD)

Gesture and Cognition
- Empathy associated with frequency and saliency of interactive gestures
- Do theory of mind (ToM) abilities affect gesture comprehension?

Objectives

- Assess Gesture Comprehension (GeCo) performance in ASD, LAD, TD
- Test relationship between GeCo and ToM performance

Methods

Gesture Comprehension (GeCo)
- 35 sec video: Women discussing a friend's recent move to a new house (Fig. 1)
- 8 multiple choice questions probe recall of events conveyed through gesture (5 items) or speech (3 items); Table 1
- Analyses (preregistered; osf.io/rf2jh) compared GeCo accuracy (full score, gesture only, and verbal only) for ASD, LAD, and TD groups

Figure 1: GeCo Video

Table 1: Multiple choice questions

Question	Correct answer	Modality
When did this event happen?	Last week	Verbal
What picture is most similar to the ones in Sam's apartment?	Spiral staircase	Gesture
What size was the antique vase that Sam was carrying?	The size of a tree stump	Gesture
What animal scared Sam?	Mouse	Verbal
What happened to the vase?	It broke	Verbal
How did Sam contact her sister?	Sam texted her sister	Gesture
On the drawing below, circle what body part Sam broke when she fell.	Her arm	Gesture
On the drawing above, draw a line where Sam got stitches.	Her face	Gesture

Theory of Mind (ToM):
- Social Attribution Task (multiple choice questions about the Heider-Simmel movie; Fig 2) and Reading the the Mind in the Eyes (Fig 3)
- Analyses (preregistered; osf.io/rf2jh) compared GeCo and ToM accuracy for ASD, LAD, and TD groups

Figure 2: Social Attribution Task

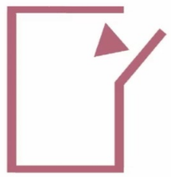


Figure 3: Reading the Eyes In the Mind Task

Individuals with ASD and LAD have difficulty integrating gestured information (in a preliminary sample). ToM performance was unrelated to gesture comprehension.

Figure 4: GeCo gesture accuracy by group

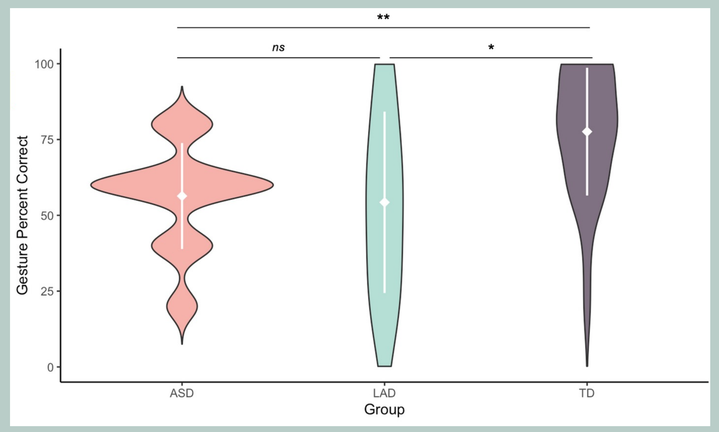


Figure 5: GeCo gesture items and ToM performance by group

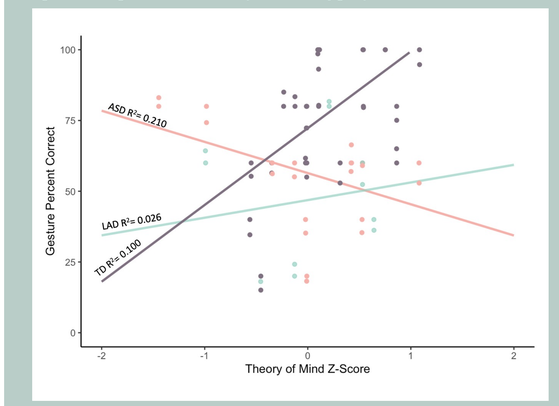
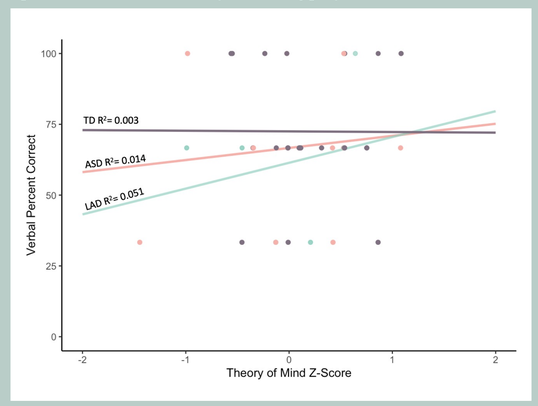


Figure 6: GeCo verbal items and ToM performance by group



Participants

	ASD *n* = 11	LAD *n* = 7	TD *n* = 25
Age in years M(SD)	17.5 (1.59)	22.43 (5.40)	22.29 (5.97)
Sex (M:F:Not Reported; Count)	8:3:0	4:3:0	7:17:1
Race (Count)	American Indian = 0 Asian = 1 Hawaiian/Pacific Islander = 0 Black/African American = 0 White = 9 Multiracial = 1 Unknown = 0	American Indian = 0 Asian = 0 Hawaiian/Pacific Islander = 0 Black/African American = 0 White = 4 Multiracial = 0 Unknown = 3	American Indian = 0 Asian = 1 Hawaiian/Pacific Islander = 0 Black/African American = 0 White = 18 Multiracial = 0 Unknown = 6
Ethnicity (Count)	Hispanic/Latino = 0 Not Hispanic/Latino = 10 Unknown = 1	Hispanic/Latino = 0 Not Hispanic/Latino = 4 Unknown = 3	Hispanic/Latino = 2 Not Hispanic/Latino = 17 Unknown = 6
Household Income M(SD)	$90,833 ($19,497)	$98,611 ($5,892)	$87,333 ($26,795)
ADOS Total Score M(SD)	13.64 (4.25)	1.57 (1.90)	1.00 (1.66)

Table 2: All participants: FSIQ > 85. Groups differed for age (ASD<LAD=TD) and gender (ASD=LAD<TD).

Results

GeCo Accuracy:
- TD group more accurate overall, and for gestures, than ASD and LAD groups; Fig 4

GeCo Modality Effects (Table 3):
- ASD & LAD = verbal accuracy > gesture accuracy
- TD = gesture accuracy > verbal accuracy

GeCo and ToM:
- ToM uncorrelated with gesture (Fig 5) or verbal (Fig 6) accuracy

Table 3: Results on GeCo and ToM measures

	ASD *n* = 11	LAD *n* = 7	TD *n* = 25	
All items (percent correct) M(SD)	60.2 (13.0)	57.1 (20.0)	75.5 (17.0)	ASD = LAD *p*= 0.75 ASD < TD ** *p*= 0.01 LAD < TD * *p*= 0.02
Gesture items (percent correct) M(SD)	56.4 (17.5)	54.3 (29.9)	77.6 (21.1)	ASD = LAD *p*= 0.89 ASD < TD ** *p*= 0.01 LAD < TD * *p*= 0.02
Verbal items (percent correct) M(SD)	66.7 (25.8)	62.0 (23.0)	72.0 (22.9)	ASD = LAD *p*= 0.73 ASD = TD *p*= 0.50 LAD = TD *p*= 0.29
Reading the Mind in the Eyes (total correct) M(SD), range	24.1 (4.3) 14-29	24.5 (2.6) 21-27	25.9 (5.0) 10-34	ASD = LAD *p*= 0.81 ASD = TD *p*= 0.28 LAD=TD *p*= 0.36
Social Attribution (total correct) M(SD), range	16.5 (2.6) 10-19	16.2 (0.6) 12-18	15.6 (2.2) 9-18	ASD = LAD *p*= 0.76 ASD =TD *p*= 0.33 LAD=TD *p*= 0.62

Conclusions

- Difficulty encoding gestured information in ASD and LAD, relative to TD peers and to speech
  - Cognitive abilities were age-appropriate, so differences likely not due to difficulty in comprehension or memory
- Specific difficulty in processing and integrating visual gestured information
- ToM uncorrelated with gesture comprehension abilities

Future Directions

- Data collection is ongoing
- Examine working memory as a predictor of gesture comprehension
- Examine gesture comprehension and production during story narration
- Further refine the GeCo task

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