



# Palm Orientation Errors Are Characteristic of Deaf Children with Autism

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## Introduction

- Multiple studies in the 1970's (Bonvillian et al., 1981) focused on the ability of **hearing children with autism to learn signs** as an alternative to speech.
- Yet, very little research has investigated the linguistic abilities of deaf individuals on the autism spectrum – particularly **native-signing children exposed to sign since birth**.

### Motivation

- Sign **requires learners to match their own body movements to those of others** ("self-other mapping"; Rogers & Pennington, 1991).
- Self-other mapping is believed to be **impaired** in autism (Williams et al., 2004).
- We hypothesize that such a deficit will lead to **articulatory/phonological errors in sign production**.

## Hypothesis and Predictions

- If signer and addressee are **facing each other** (as is typical), then **each sees a different side** of the hand.
- Impaired self-other mapping ability will lead to **palm orientation reversals** on signs specified for inward or outward orientations.
- Such "reversal errors" have been found in several studies on the imitation skills of hearing children with autism (Brown, 1996; Hobson & Lee, 1999; Ohta, 1987); however, these kinds of errors are **not found frequently in the typical development of signing children**.

## Examples

The ASL sign **WEDNESDAY** is produced with an **inward palm orientation**.

- Addressee sees back of hands rather than palms.

- A self-other mapping failure by the sign-learning child – i.e., **reproducing the sign as it appears from his own perspective** – could lead to production of the sign with an outward-facing palm.



The ASL sign **TOILET** is produced with an **outward palm orientation**.



Line drawings of citation form signs reproduced from Humphries, Padden & O'Rourke (1980).

- Addressee sees palm of hand rather than back of hand.
- A self-other mapping failure by the sign-learning child could lead to production of the sign with an inward-facing palm.

## Subjects

- Ten native-signing children with autism (ages 4;7–16;3).
- Prior diagnosis of autism with validated instrument (CARS, GARS) verified.
- Control group: 13 typically-developing (TD) native-signing children (ages 3;7–6;9;  $M=4;9$ ).

Subject	Age	Sex	Hearing Status
Ruben*	4;7	M	Deaf
Brock	5;1, 6;6	M	CODA
Raymond	5;8	M	Deaf
Logan	7;2	M	Deaf
Cameron	7;5, 8;11	M	Deaf
Dana	9;3	F	Deaf
Olga	11;9	F	Deaf
Mark	12;8	M	Deaf
Jonathan	14;1	M	Deaf
Justin	16;3	M	Deaf

Table of Subjects with Autism. \*All names are pseudonyms.

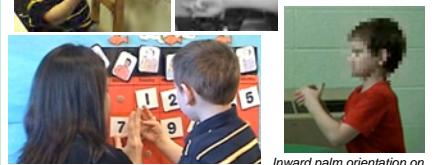
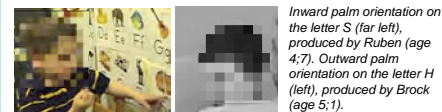
## Tasks

- Naturalistic pilot study:** videotaped classroom observation.
- Elicitation task** using picture stimuli of 24 basic lexical signs. Test items: inward/outward palm orientation. Control items: up/down palm orientation.
- Fingerspelling task** of 8 English words. Control items: up/down palm orientation.
- Imitation task** of 24 ASL-like nonsense signs. Test items: inward/outward palm orientation. Control items: up/down palm orientation.

## Results

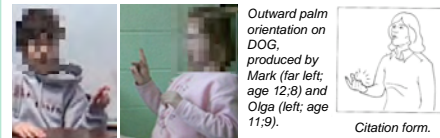
- Autistic subjects made palm orientation errors on **all four tasks**.
- Errors were primarily produced by **autistic children under age 10**.
- Both** kinds of reversals (inward → outward AND outward → inward) were observed. Thus, an **articulatory** explanation is **implausible**.

## Error Examples - SPONTANEOUS ERRORS



Inward palm orientation on SEVEN (above), produced by Ruben (age 4;7). Inward palm orientation on TURTLE (above), produced by Raymond (age 5;8).

## ELICITED PALM ORIENTATION ERRORS



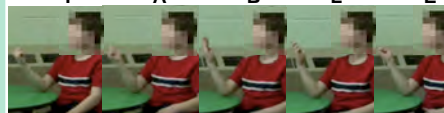
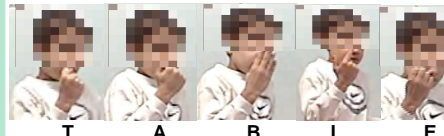
Group	TEST	CONTROL
Autism (N=10)	6/40 (15%)	1/40 (2.5%)
Typically-Developing (N=13)	1/52 (1.9%)	2/52 (3.8%)

Number of palm orientation errors (rates in parentheses) on the Elicitation Task.

- The difference in error rate between the autism group and TD group approached significance ( $p = .079$ ).
- Few errors overall, probably because these signs are learned early in development.

## FINGERSPELLING ERRORS

- Four of the five youngest autistic children** showed a tendency to **reverse their palm orientation while fingerspelling**.
- None** of the typically-developing control subjects reversed palm orientation while fingerspelling.
- This error type has **not** been reported in the literature on the **typical acquisition of fingerspelling**.



The English word "table" fingerspelled with inward palm orientation by Cameron (8;11, top) and Raymond (5;8, bottom).

## IMITATION ERRORS

Group	TEST	CONTROL
Autism (N=6)	8/18 (44%)	3/24 (13%)
Typically-Developing (N=12)	2/36 (6%)	3/48 (6%)

Number of palm orientation errors (rates in parentheses) on the Imitation Task.

- The autism group made **significantly more palm orientation errors** than the TD group on the **imitation of nonsense signs** ( $p < .001$ ).



A palm orientation reversal error on the imitation of a nonsense sign, produced by Brock (age 6;6).

## Discussion and Conclusions

- Given the following converging pieces of evidence:
  - Inward/outward palm orientation reversals **do not appear frequently in typical acquisition** of signed languages.
  - A number of different native-signing children with autism** made palm orientation reversal errors **across a variety of tasks**.
  - Current findings are **consistent** with previous studies on hearing autistic gestural imitation.
- We conclude that inward/outward palm orientation reversal errors are characteristic of and unique to autism.**

## Future Studies

- Identification of cognitive mechanism(s) responsible:
  - Is this related to impaired theory of mind?
  - Which components of self-other mapping are impaired?
- Probing of other grammatical structures that may be impaired in the signing of deaf children with autism:
  - Classifier constructions
  - Directional verb agreement
  - Pronominal reference
  - Facial grammar

## References

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## Acknowledgments

This research was conducted as part of Aaron Shield's doctoral dissertation in linguistics at the University of Texas at Austin under the supervision of Richard P. Meier. Support was provided from an NSF Dissertation Improvement Grant (PI: Richard P. Meier) and a Predoctoral Fellowship from Autism Speaks. We thank the parents, children, and staff at the Texas, Ohio, Indiana, and Iowa Schools for the Deaf, the Minnesota State Academy for the Deaf and the Learning Center for Deaf Children for their collaboration.