Imitation and Joint Attention as Predictors of Language Outcome In Infants at High and Low Risk for Autism Spectrum Disorder

Sarah R. Edmunds¹, Lisa V. Ibanez¹, Devon Gangi², Daniel Messinger², & Wendy L. Stone¹
¹University of Washington, ²University of Miami

Abstract

Expressive language impairment in infant siblings of children with ASD is predictive of later adaptive functioning. Infants’ motor imitation and responding to joint attention (RJA) skills were hypothesized as sequential predictors of later expressive language. A longitudinal model was estimated in which RJA at 15 months mediated the association between motor imitation at 12 months and expressive language at 18 months for both high risk and low risk infants. For low risk infants only, 12-month imitation significantly predicted 18-month expressive language above and beyond the RJA pathway. This study was one of the first to employ a prospective, longitudinal design to study predictors of language in infants at risk for ASD. By increasing our knowledge of the multimodal skills underlying infants’ language growth, we can employ early intervention strategies that target those skills.

Background

- Expressive language impairment in ASD is prevalent and predictive of children’s long-term functioning (Lyster et al., 2008).
- Infant siblings of children with ASD have a 1 in 5 chance of also being diagnosed with ASD (Chawarski et al., 2000; Morigo et al., 2000; Stone et al., 2001).
- However, the sequence of these behaviors in predicting language has been little explored.
- We hypothesize that imitation predicts RJA, which then predicts language:
  - Imitative play may promote RJA because it encourages infants to follow others’ attention for further chances to imitate (Ingersoll et al., 2008; McDuffie et al., 2007).
  - The strength of this sequence may be stronger for HR infants: Some studies have found associations between imitation, RJA and expressive language for HR but not LR infants (McDuffie et al., 2007; Presmanes et al., 2007).
  - In mediation, the indirect effect, or c’ is defined as the path from the predictor (X) to the outcome variable (Y) through the mediator (M).
  - The direct effect, or c, is the association between X and Y that remains after accounting for the indirect effect (see Figure 1).

Results: Mediation Analysis

- As hypothesized, the indirect effect was significant for all infants such that:
  - For each additional imitation pass at 12 months, they were estimated to speak an average of 1.64 more words at 18 months.
  - This association occurred as a result of imitation’s influence on RJA, which then influenced EL (see Table 4, Figure 3).

Research Aim 1: Longitudinal mediation.

- Both conditional indirect and direct effects were estimated. The direct, but not the indirect, effect differed by risk group.
- A more parsimonious model was estimated in which only the direct effect was specified as conditional on ASD risk.
- The direct effect was present such that for LR infants but not HR infants, infants with one additional imitation pass at 12 months were estimated to speak 12.67 more words on average at 18 months, independent of the indirect effect (see Table 4, Figure 4).

Conclusions

These findings support the concept of a developmental sequence in which infants’ early imitation ability leads to higher levels of later expressive language in part through their intermediate RJA behaviors. Many interventions aim to improve infants’ social communication abilities to foster later language growth; this study suggests that targeting imitation before, or along with, RJA skills may be an effective approach for infants at risk for ASD. Results suggest that infants at risk for ASD may gain language specifically through the imitation to RJA pathway, whereas for low-risk infants, imitation affects expressive language both indirectly, through RJA, and directly. This study was one of the first to examine the sequential contribution of infants’ early skills to their later language ability in a prospective, longitudinal design. Further analyses will be conducted as diagnostic visits and behavioral coding continue.

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Table 1: Sample Characteristics

Variable | HR Infants | LR Infants | p
--- | --- | --- | ---
Maternal level of education | 13 (58) | 10 (42) | 0.75
Socioeconomic status | 35 (42) | 30 (35) | 0.59
Major degree or higher | 28 (37) | 24 (29) | 0.51
Response (11) | 9 (11) | 10 (13) | 0.89
Participant Race/Ethnicity (%) | M | F | p
Caucasian | 46 (73) | 21 (38) | 0.03
African American | 13 (15) | 3 (11) | 1.00
Hispanic/Latino | 2 (3) | 1 (2) | 1.00

Table 2: Mean (SD) for Imitation, RJA, and EL: all infants, LR infants, and HR infants

Variable | HR Infants | LR Infants | p
--- | --- | --- | ---
Imitation 12 mo | 4.86 (9.9) | 2.19 (5.8) | 0.01
Imitation 15 mo | 5.39 (8.8) | 2.82 (4.0) | 0.00
RJA 12 mo | 3.90 (22.9) | 3.83 (23.3) | 0.86
RJA 15 mo | 3.29 (20.4) | 3.36 (20.9) | 0.65
EL 18 mo | 3.00 (2.1) | 2.60 (1.5) | 0.05

Table 3: Final model coefficients

| Predictor | B | SE | t | p |
--- | --- | --- | --- | ---
Imitation, 12 mo | 0.51 | 0.26 | 1.96 | 0.05
RJA, 15 mo | 3.20 | 1.75 | 1.85 | 0.07
Constant | 5.87 | 7.56 | 0.78 | 0.44
RJA, 12 mo | -0.45 | 0.11 | -4.19 | 0.00
EL, 18 mo | -0.16 | 0.06 | -2.60 | 0.01
Constant | 3.20 | 1.75 | 1.85 | 0.07
RJA, 15 mo | 0.29 | 0.22 | 1.33 | 0.19
EL, 18 mo | 0.05 | 0.05 | 0.97 | 0.33
Constant | -0.16 | 0.05 | -3.20 | 0.00
RJA, 15 mo | 0.26 | 0.19 | 1.37 | 0.17
EL, 18 mo | 0.05 | 0.05 | 1.03 | 0.30

Table 4: The indirect effect is significant for all infants.

| Group | Effect | p | LLCI | ULCI |
--- | --- | --- | --- | ---
LR infants | 0.50 | 0.26 | 0.25 | 0.75
HR infants | 0.26 | 0.11 | 0.05 | 0.47

Imitation at 12 months affects RJA at 15 months, which then affects EL at 18 months (see Figure 3).

Research Aim 2: Moderation of the pathways by ASD risk.

- Both conditional indirect and direct effects were estimated. The direct, but not the indirect, effect differed by risk group.
- A more parsimonious model was estimated in which only the direct effect was specified as conditional on ASD risk.
- The direct effect was present such that for LR infants but not HR infants, infants with one additional imitation pass at 12 months were estimated to speak 12.67 more words on average at 18 months, independent of the indirect effect (see Table 4, Figure 4).

Table 5: Mean (SD) for Measures & Variables

| Measure | HR Infants | LR Infants | p |
--- | --- | --- | ---
Imitation 12 mo | 4.86 (9.9) | 2.19 (5.8) | 0.01
Imitation 15 mo | 5.39 (8.8) | 2.82 (4.0) | 0.00
RJA 12 mo | 3.90 (23.9) | 3.83 (23.3) | 0.86
RJA 15 mo | 3.29 (20.4) | 3.36 (20.9) | 0.65
EL 18 mo | 3.00 (2.1) | 2.60 (1.5) | 0.05

Table 6: Mean (SD) for Results: Group Differences

| Measure | HR Infants | LR Infants | p |
--- | --- | --- | ---
Imitation 12 mo | 4.86 (9.9) | 2.19 (5.8) | 0.01
Imitation 15 mo | 5.39 (8.8) | 2.82 (4.0) | 0.00
RJA 12 mo | 3.90 (23.9) | 3.83 (23.3) | 0.86
RJA 15 mo | 3.29 (20.4) | 3.36 (20.9) | 0.65
EL 18 mo | 3.00 (2.1) | 2.60 (1.5) | 0.05