Title: Parent-Child Engagement Mediate Association Between Eye Gaze Patterns and Prelinguistic Development in Infant Siblings of Children with and without ASD

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Introduction: Autism spectrum disorder (ASD) is often associated with difficulties in language learning that impact long-term social, academic, and vocational outcomes. Prelinguistic vocal development has been identified as a predictor of language, and thus as a potentially important target of early interventions that aim to achieve distal effects on language skill, in children affected by ASD. Unfortunately, at present we know little about the mechanisms that underlie prelinguistic vocal development. Theory and recent research suggest looking behavior may be useful for predicting prelinguistic vocal development. By midway through the first year of life, typically developing children begin to shift their gaze from the eyes to the mouth of a speaker, presumably to access audiovisual cues that facilitate speech processing and language learning. This shift has been theoretically linked with qualitative changes in prelinguistic vocal development, such as the onset of canonical babbling. We suspect children’s gaze patterns may scaffold prelinguistic vocal development by signaling to caregivers that children are ready for increased joint engagement. The present project tests this theory in infants with a heightened likelihood of future ASD diagnosis (Sibs-ASD; i.e., infants with an older sibling with ASD) and infants at relatively lower, general population level likelihood of future ASD diagnosis (Sibs-TD; i.e., infants with typically-developing older sibling/s). Specific research questions are as follows: (a) Are there between-group differences in looking to audiovisual speech (i.e., looking to the mouth of a talking face)?, (b) Are individual differences in looking to audiovisual speech associated with prelinguistic vocal development?, and (c) Is the association between looking to audiovisual speech and prelinguistic vocal development explained at least in part by parent-child engagement?

Methods: Participants were recruited from a larger, longitudinal study of infants from primarily English-speaking households. Forty-nine infants aged 6-18 months have completed the study to date (22 Sibs-TD, $M_{\text{age}} = 12.3$ mo, 45% male; 27 Sibs-ASD, $M_{\text{age}} = 12.0$ mo, 56% male). Infants’ eye gaze to the mouth during audiovisual speech was measured via a remote eye tracking task wherein infants viewed a video of a woman producing a 50s monologue in infant-directed speech in their native language (English). Concurrent vocal development was measured using the Communication and Symbolic Behavior Scales Developmental Profile Behavior Sample (CSBS-DP). A partial interval coding system was utilized to code media files of CSBS-DP samples for the presence/absence of communication acts, vocalizations including canonical syllables, and selected consonants. Two indices of vocal development were derived: (a) canonical syllabic communication (i.e., the proportion of intentional communication acts that included a canonical syllable), and (b) consonant inventory (number of different consonants used in communication acts). Z-scores for these two component variables were combined to create an aggregate score. Parent-child engagement was measured in two 15-minute parent child free play (PCFP) sessions. Video files from each PCFP session were coded by an independent coder from Boston College who was naive to infants’ risk status to derive total time spent in higher-order supported joint engagement (HSJE; wherein a caregiver influences child’s play, and the child acknowledges the caregiver by engaging in reciprocal play).

Results: There was not a significant between-group difference in mean looking towards the mouth during audiovisual speech ($d = -0.05, t = -0.17, p = 0.87$). Individual differences in looking to audiovisual speech, however, were associated with the prelinguistic vocal development aggregate (zero-order correlation = 0.44, $p = 0.002$). The confidence interval for the product of the unstandardized coefficients of the two components of the indirect effect $(a*b)$ did not include 0 in the model testing the

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effect of looking to the mouth on vocal development through parent-child engagement (95% CI [0.0005, .0086]), indicating that HSJE did mediate the relation between looking to the mouth and prelinguistic development. Moderated mediation model indicated that sibling-status did not moderate any of the relations relevant to the aforementioned indirect effect.

**Discussion:** These findings provide some empirical support for the theory that eye gaze patterns to audiovisual speech are linked with prelinguistic development. Specifically, looking to the mouth of a speaker was associated with vocal development across infants at high- and low-likelihood for a future ASD diagnosis. Results suggest that this relation occurs at least in part due to the manner in which parents engage with their children (specifically, by spending more time in HSJE). Limitations, implications, and future directions for this line of research will be discussed.

**References:**