Early Communication Characteristics Across Samples From Two Infant Populations At-Risk for Autism

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ABSTRACT
Although no single etiology has been identified for Autism Spectrum Disorders (ASD), two infant populations have emerged as particularly high risk: younger siblings of children diagnosed with ASD and infants born prematurely with low birth weight. A key characteristic differentiating high-risk infants from low-risk peers is early eye gaze fixation behaviors. Early gaze fixation behavior is thought to be predictive of communication and language skills. Consequently, identifying differences in early eye gaze behaviors could lead to early intervention services tailored specifically on counteracting early social withdrawal behaviors. Though few studies have compared eye gaze patterns of these two high-risk infant groups, knowledge of differences between these two groups could inform early interventionists’ service provision approach. The aim of the present exploratory study was to compare eye gaze fixation behaviors across two high-risk groups. The three participants were drawn from a larger pool of participants involved in the Early Diagnostic Signs of Autism study. One participant was a younger sibling of a child diagnosed with ASD and two were born prematurely with low birth weight. Data was collected using wearable eye gaze technology that captured the infant’s eye movements as well as his/her visual surroundings. Infants were shown three 60-second silent videos containing social and nonsocial static visual stimuli. Eye gaze behaviors were analyzed to distinguish where the infant’s pupil was directed during viewing and measured according to time spent fixated on social and nonsocial stimuli and further categorized as two dimensional (social, status nonsocial) and three dimensional (dynamic social, dynamic nonsocial). The eye gaze patterns observed were similar across two participants, one from each high-risk group, and dissimilar for one participant born prematurely with low birth weight. Findings indicate differences in eye gaze behaviors across participants may reflect factors beyond high-risk group status.

Introduction
ASD: Life-long neurodevelopmental condition that interferes with an individual’s ability to communicate and relate to others (Baio et al., 2018)
- Current de statistics: 1 in 59 children diagnosed with ASD (Baio et al., 2018)
- Median age at dx: 50 months (Christensen et al., 2016)
- Average prevalence: 1.2% of population (Christensen et al., 2016)
- Etiology: Unknown; likely a epigenetic (combination of genetic and environmental factors)
- Consequence, dx primarily based on behavioral features
- Early differences in eye gaze fixation behaviors in high-risk infant groups later diagnosed with ASD compared to low-risk infants
- Rate of diagnosis for high-risk infants:
  - Younger siblings of children diagnosed with ASD: 18.7% (Ozsvath et al., 2017)
  - Children born premature and with low birth weight: 10-12% (Joseph et al., 2017)

Early Gaze Behavior Differences in Infants/Toddlers with ASD Compared to Low-Risk Peers
- Focus more on the mouth than other facial features; more disengaged from face (Chawarska, Wijers & Kim, 2010; Kim & Jones, 2008)
- Toddlers later diagnosed with ASD spent more time looking at nonsocial videos than social videos (Frances et al., 2016)

At-Risk Populations’ Eye Gaze Behaviors
- Gaze at eyes 50% less, bodies 26% more, and objects 50% more, differences in object permanence skills, shorter referential gaze time (Jones & Kim, 2013; Pup et al., 2017)

Gaze Fixation Difference Outcomes
- Predictive power for later language skills (Jones, Cari, & Kim, 2008; Terebra et al. 2015)

Aim of Present Study
Compare at-risk infant groups to identify differences in early eye gaze fixation behavior

Research Question
Is there a difference in early eye gaze fixation behaviors for at-risk groups at 6 months of age when presented with social and nonsocial visual stimuli?

Methods

Participants
(n=3): age 6 months; selected for present study from a larger pool of participants involved in the Early Diagnostic Signs of Autism study.

Procedures
Present study data collected as part of the second data collection (out of seven with additional follow up) in the Early Diagnostic Signs of Autism study (ongoing: 2018-2019). Data collection took place in participants homes. While seated at a table on parent lap 1 meter from laptop, infants were shown three one-minute videos of static social and nonsocial image (180 seconds total).

Materials
Eye Gaze Hardware: Positive Science UltraFlex headgear cap and camera (Figure 2) Eye Gaze Software: PS Live Capture (30Hz, Figure 2), Yarbus, GazeTag

Analysis
Using Yarbus software, eye video to scene video was calibrated based on 6 movement and visual surroundings.

Fixations were coded as social if they were within the social image (2D) or on the face of someone in the environment (3D). Fixations were coded as nonsocial if they were within the nonsocial image (2D) or anything else in the environment (3D). Fixations that were not included coded parts of bodies of people within the environment and/or parts of the recording equipment. The spatial parameters for a fixation point was set at 7 pixels and the temporal parameters at 100ms. Percentages were calculated from the output generated through GazeTag use.

Results and Discussion

Eye Gaze Results

Total number of usable fixation points per 180 second sample: P1 = 221, P2 = 116, P3 = 239

Limitations and Future Directions
Participants: Increase diversity and size of sample
Setting: In home is natural and ecologically valid, but limits idealized controlled atmosphere for eye gaze observations (e.g., differences in lighting, surroundings)

Research Design: Exploratory study; consequently, cannot generalize findings beyond participants of the study

Clinical Implications: Present study has limited clinical utility, but important for early childhood professionals to be aware of high-risk group status and differences in early behavioral signs, such as eye gaze fixation behavior, noted within the first 12 months of life. These may eventually be part of early developmental profile that leads to reduced dx age for ASD.

Selected References

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Figure 1. Static social and nonsocial images shown in study

Figure 2. UltraFlex headgear and attached camera.

Figure 3. PS LiveCapture software recordings of eye movement and visual surroundings.

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