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Early Infant Gaze Patterns in Interaction:

Considering Maternal Depression among Infants at Elevated and Typical Likelihood of Autism

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Abstract

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The first months of life are a crucial time for infants' social development. One of the earliest ways infants are able to exert influence on their social environments and interactions is through control of their gaze. Certain features of caregivers' behavior during interaction have been shown to sustain infants' gaze and visual attention, thus contributing to the overall frequency and quality of infants' social exposures and learning (Propper & Moore, 2006). Infants who spend more time sharing eye-contact, gaze, and attention with their caregivers have more opportunities to engage in social learning – which is crucial in supporting development across domains (Safyer et al., 2020; Niedzwiecka et al., 2018). The present study considered two contexts in which early social engagement might be disrupted – infant autism spectrum disorder (ASD) and maternal postpartum depression (PPD). Given caregivers' role in scaffolding social engagement in typical development, exploring early caregiver-infant interaction may provide avenues for supporting social development and engagement for children diagnosed with autism. We compared the eye-looking behavior of infants with typical- and elevated-likelihoods of developing autism (TL-ASD & EL-ASD, respectively), with elevated-likelihood status being based upon the autism diagnosis of an older sibling. Infants' overall duration of eye-looking did not significantly differ across ASD likelihood groups ($M_{EL\text{-}ASD}$ = 0.4588, $M_{TL\text{-}ASD}$ = 0.5117, t = 1.25, p = 0.212). We found no significant main effects or interactions between ASD likelihood and caregiver depressive symptoms on eye-looking, regardless of whether EPDS scores was treated as continuous or dichotomous (p = 0.182, p = 0.121, respectively). However, visual inspection of data suggests maternal depressive symptoms might relate to EL-ASD infants' eye-looking differently than TL-ASD infants' eye-looking. The present study helps to further underscore the critical nature of social environments for early development in ASD. These findings, pending investigation within a larger sample, have implications for early interventions to support infants at elevated likelihood of autism.

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Early Infant Gaze Patterns in Interaction: Considering Maternal Depression among Infants at Elevated and Typical Likelihood of Autism

The first months of life are a crucial time for infants' social development. Within their earliest interactions, infants begin learning how to engage with others. This process, however, is not simply a matter of infant observation, but rather a dynamic interaction that is constructed by both infants and caregivers in tandem (Feldman et al., 2006; Northrup & Iverson, 2020). During the first few months of life, caregivers play a critical role in guiding infants' social development, as they attune their own behavior and affect to their infants', either matching arousal or guiding situationally appropriate adjustment accordingly (Beebe & Gerstman, 1980; Somers et al., 2021). By five months of age, infants are reliably contributing to this process, as they both initiate social engagement and respond to caregivers' behavior and affect (Ostlund et al., 2017). Even within the earliest caregiver-infant interactions, it is clear that the joint contributions of caregiver and infant engagement exert a stronger force than either one's actions alone.

One of the earliest ways infants are able to exert influence on their social environments and interactions is through control of their gaze. Certain features of caregivers' behavior during interaction have been shown to sustain infants' gaze and visual attention, and thus contribute to the overall frequency and quality of infants' social exposures and learning (Propper & Moore, 2006). For example, caregiver responsiveness and sensitivity in face-to-face interaction support infants' social engagement, measured by gaze to the eyes during interaction (Mcquaid et al., 2009). Increases in infants' general preference for eyes in social interaction predicts greater time spent in mutual gaze and better social developmental outcomes, such as later communication and emotion regulation skills (Tomasello & Farrar, 1986; Thomas et al., 2017; Lowinger, 1999). Infants who spend more time sharing gaze, eye-contact, and attention with their caregivers have

more opportunities to engage in social learning - which is crucial in supporting infant skill-building across developmental domains (Safyer et al., 2020; Niedzwiecka et al., 2018). Thus, infants' early social experiences and interactions play a key role in shaping their later social interest, engagement, and development.

Postpartum Depression and Early Interaction

Postpartum depression (PPD) is typically defined as any major depressive episode or clinically significant depressive symptom level occurring in the postpartum period – the first year after birth – a foundational time for establishing patterns of caregiver-infant interactions (Stewart & Vigod, 2019). Caregivers with PPD, when observed interacting with their infants, tend to express less positive affect and engage less responsively with their infants than non-depressed caregivers (Egmose, 2018; Goodman et al., 2020; Porto et al., 2020). Thus, infants of caregivers with PPD may generally be exposed to less 'rich' social environments, by virtue of receiving less frequent or attentive social engagement from caregivers in their early development (Granat et al., 2017). The atypical social environment of infants of depressed caregivers might be contributing to later reductions in infants' engagement and attention in face-to-face social interactions, apparent by 3-months of age (Beebe et al., 2008; Lotzin, 2015; Tronick et al., 1977).

Infants of caregivers with PPD spend less time sharing mutual gaze with their mothers. Lower levels of mutual gaze in infancy predict reduced social attention overall, even when interacting with non-depressed adults, further limiting their exposure to social information over time (Aktar et al., 2017; Skotheim et al., 2013). Current research suggests that elements of caregiver-infant interaction characteristic of mothers with depression might be related to decreasing infant social attention within interaction. Depressed mothers often use less animated and infant-directed speech, show decreased responsiveness to infants' affect and behavior, and

express fewer signs of positive affect – all of which might reduce infants' interest in social interaction (Bigelow et al., 2018; see Feldman, 2007 for a review; Manian & Bornstein, 2009). Infants' eye-looking behaviors in infancy are centrally related to later developmental outcomes (Jones & Klin, 2013; Lozano et al., 2023), thus PPD may be an important context in which to study infant gaze.

Autism Spectrum Disorder and Early Social Development

The dynamics of caregiver-infant interaction might play a particularly critical role in infant social development in the context of infants at elevated likelihood of autism spectrum disorder (ASD). ASD is a neurodevelopmental disorder that involves specific delays in social development and restricted or repetitive patterns of behavior – an estimated 1 in 44 children meet the criteria for diagnosis (Maenner et al., 2021; Zablotsky et al., 2019). Within the first months of life, infants later diagnosed with ASD are already orienting uniquely to social stimuli, though many are able to continue meeting typical developmental milestones from birth to six months of age. However, at 6-months, infants who later go on to be diagnosed with ASD begin to diverge from the typical developmental trajectory – looking more to non-social stimuli and less to others' eyes (Shultz et al., 2018; Tanner & Dounavi, 2020; Ozonoff et al., 2010). Developmental differences in infants' social engagement are often noticed by caregivers, impacting both caregivers and infants' behaviors in future interactions (see Bradshaw et al., 2022 for a review). Developmental trajectories of social engagement, thus, are not isolated, or fixed, in a predestined progression, but rather jointly shaped by caregivers, infants, and their dyadic engagement in early social environments (Dawson, 2008).

Measures of eye-gaze have been useful when quantifying social differences among individuals with ASD, providing opportunities to capture individuals subjective perceptions of

their social environments **(**Guillon et al., 2014; Jiang et al., 2019; Jones & Klin, 2013**).** For example, while viewing naturalistic social scenes, toddlers with ASD tend to look less at the social features of scenes, specifically others' eyes compared to typically-developing peers (Klin et al., 2015). Toddlers' eye looking in these naturalistic paradigms predict their levels of social disability later in development (Jones et al., 2008). Notably, infants with ASD do not necessarily present with diminished preference for eye-looking at birth but rather have been shown to experience a decline in eye looking over the first year of life (Jones & Klin, 2013). While the exact reasons for declining eye gaze among infants later diagnosed with autism is unknown, this course of development provides an opportunity for early intervention to capitalize on higher levels of eye looking in the earliest months of life. Given caregivers' role in scaffolding social engagement in typical development, exploring early caregiver-infant interaction may provide avenues for supporting social development and engagement for children diagnosed with autism.

Infant siblings of children already diagnosed with autism provide a unique opportunity to study the early presentation of ASD and social vulnerability. These infants are at an elevated likelihood of being diagnosed with autism (EL-ASD) themselves (19% recurrence) and have diverse developmental outcomes outside of ASD including communication and social delays relative to infant siblings of typically developing children (Marrus et al., 2018; Ozonoff et al., 2011). In naturalistic eye-tracking studies EL-ASD siblings have increased interest in non-face stimuli, which may still pull them away from important social exposures (Ibanez et al., 2008; see Tiede & Walton, 2020 for a review).

Caregiver-Child Interaction in Autism

As in typical development, caregiver responsiveness and scaffolding predicts positive developmental outcomes for children with autism and elevated likelihood infants (Wan et al.

2019, Choi, 2019; Bang & Nadig, 2015; Ozonoff et al., 2010). Siller and Sigman (2002) demonstrate that caregivers responsive communication predicts the language outcomes of toddlers with autism up to 16 years after measurement. Among elevated likelihood infants, caregiver-infant mutuality in naturalistic interaction at 6-months was related to children's cognitive, language and social development at 12 months (Kellerman et al., 2020). Recent studies suggest that caregiver input has an even greater influence on children's developmental outcomes among elevated likelihood (EL-ASD) infants compared to typical likelihood infants (Choi et al., 2020; Romeo et al., 2022). This underscores the importance of understanding how qualities of caregiver-infant interaction influence these children's social development.

Caregiver Depression and Early Development in Autism

Parents of children with ASD, relative to parents of typically developing children, are more likely to struggle with poor mental health and depression (Benson, 2006; Zablotsky, 2013). Further, rates of PPD may be greater among caregivers of EL-ASD infants compared to the general population (Wan et al., 2019). Outside the context of autism, infants' exposure to caregivers with PPD predicts less gaze to the eyes of others (Vaever et al., 2015). EL-ASD infants demonstrate particular social vulnerabilities and may be differentially impacted by their social environments and caregiver interactions compared to infants at typical likelihood of ASD (TL-ASD). Given noted differences in input and responsiveness among caregivers experiencing PPD, relative to caregivers with no depression, an important next step in this line of research is to explore the associations between caregivers' symptoms of depression and infant eye-looking behavior EL-ASD relative to typically developing infants. This is particularly important to explore given that EL-ASD infants whose caregivers are experiencing PPD may be especially vulnerable to delays in social development.

The Present Study

The present study compared the eye-looking behavior of infants with typical- and elevated-likelihoods of developing autism (TL-ASD & EL-ASD, respectively), with elevated-likelihood status being based on the autism diagnosis of an older sibling. We expected EL-ASD infants and infants exposed to maternal depressive symptoms to gaze less towards caregivers' eyes than their typically developing peers. We also considered whether infants autism likelihood status might moderate the relationship between caregivers' depressive symptoms and infants' eye gaze during an interaction with their mothers. That is, we expected to see an interaction between maternal depressive symptoms and infant autism likelihood, such that infants in dyads impacted by both elevated depressive symptoms in their mothers and ASD likelihood would present with reduced eye-gaze beyond the expected reductions from either context alone. This inquiry provided opportunities to explore how autism likelihood and variations in caregiver depression relate to infant social attention, a construct with long-term impacts on child development.

Method

Participants

The present study included 54 mother-infant pairs (55% female) – with *n* = 28 (57% female) dyads coming from families with an older child diagnosed with autism, and *n* = 26 dyads (54% female) having no familial history of autism. Participants were recruited in a previously IRB approved longitudinal study of the earliest development in autism. At enrollment (near birth), mothers' age averaged 33.1 years (*std* = 4.48**,** *range* = 22–45). During eye-tracking lab sessions, infants' age averaged 4.56 months (*std* = 1.14, *range* = 2.1–6.8). Most mothers were Caucasian and had a college or professional degree. All caregivers identified as mothers; thus, caregiver and mother are used interchangeably. For more participant demographics, see Table 1.

Procedure

The present study used data collected in a longitudinal study in which children participated in eye-tracking and developmental assessments across the first three years of life. The current study focuses on data collected within the first 6 months of life. Infants and caregivers engaged in a live interaction via closed-circuit televisions once each month for the first 6 months, during which eye tracking measures were collected. Video recording and eye-tracking of dyadic interaction captured faces, voices, and infant gaze throughout the interaction. Concurrently (within the same visit as an infant eye-tracking session), mothers completed a depression symptom scale measure at 1, 3, and/or 6 months of infant age during the longitudinal study. In the present study, we analyzed concurrent measures of eye-tracking and depression.

Infant Eye Tracking

During all procedures, caregivers accompanied their infants. After entering the testing room, infants viewed cartoons displayed on a central monitor, encouraging their engagement with

visual stimuli. Caregivers then placed infants into a car seat, from which they would view the rest of the stimuli presented on the monitor. Complete audiovisual stimuli were presented in all videos. As infants continued to watch the orienting cartoons, a five-point calibration procedure was completed, in which flashing or spinning shapes and animated cartoons were presented on the otherwise empty monitor. This five-point calibration was verified by further procedures, which presented additional calibration stimuli to ensure accuracy. These verification procedures were repeated at regular intervals throughout data collection to check accuracy and possibly correct accuracy drift. In scenarios where drift exceeded 3º, data collection was paused so that measures of infant eye movement could be recalibrated in alignment with fixation targets before continuing. This recalibration procedure generally operated by attuning to infants' head positioning and movement in refence to the monitor. During eye-tracking sessions, all infants engaged in a live interaction with their caregiver, with the caregiver image projected to infants on the video monitor.

Naturalistic Caregiver-Infant Interaction. Before each eye-tracking session, caregivers were led by researchers into a soundproof booth equipped with a camera and video display monitor. Caregivers were told they would soon see their infant on the monitor and instructed to interact with their infant just as they would normally. Infants and caregivers were then connected, and displayed on each other's video monitor, allowing them to engage in a 70-90 second interaction. Researchers recorded both infants' and caregivers' face through-out the interaction, while simultaneously collecting infant eye-tracking data (see Figure 1).

Measures

Edinburgh Postnatal Depression Scale

The Edinburgh Postnatal Depression Scale (EPDS), a well-validated measure of symptoms of postpartum depression, was used as an indicator of mothers' depression symptom levels (Levis,

2020). It consists of 10 statements (ex: “I have been anxious or worried for no good reason,” “I have looked forward with enjoyment to things,” etc.) for which caregivers’ frequency of agreement is rated on a 4-point Likert scale. For this analysis we considered caregivers’ depressive symptoms two ways: continuously and dichotomized at a score of 9 on the EPDS, a reliable threshold of elevated depressive risk (Cox et al., 2015).

Data Reduction

Hardware and software from ISCAN Inc, which uses dark pupil/corneal reflection techniques, identified eye-movement, collecting infant gaze data at a 60 Hz rate (Woburn, Massachusetts). Researchers used in-house software to analyze this data, which included eye movements and identified points of fixation. The first phase of this analysis denotes non-fixation moments, such as saccades, blinks, and time spent gazing away from the monitor. In subsequent phases, all data regarding points of fixation is categorized into one of four regions of interest: caregivers’ eyes, mouth, body, or background objects (see Figure 2). These regions of interest were created in MATLAB with the Kanade–Lucas–Tomasi (KLT) feature tracking module, which notes eye, mouth, body, and object regions frame by frame for each video. Regions are mutually exclusive, covering all possible points shown. After processing, these values are represented as proportions of viewing time that an infant fixated on eyes, mouth, body or objects. For the present study, the data are the proportion of viewing time that an infant fixated on the eyes.

Data Analysis

We planned to utilize multilevel modeling with random and fixed effects to analyze the effects of autism likelihood status, mothers’ postpartum depression symptom levels, and their potential interactions on infants’ concurrent eye fixations during interaction with their caregivers.

Results

Preliminary Results

To ensure infant age at data collection did not influence results, we included it in our original model, which revealed no main effects of infant age on eye-looking (F=1.626, p=0.205). Infants' overall duration of eye-looking did not significantly differ across ASD likelihood groups ($M_{EL\text{-}ASD}$ = 0.4588, $M_{TL\text{-}ASD}$ = 0.5117, t = 1.25, p = 0.212). Caregivers' continuous depressive symptoms were low overall, and significantly higher in EL-ASD dyads than in TL-ASD dyads ($M_{EL\text{-}ASD}$ = 6.23, $M_{TL\text{-}ASD}$ = 4.38, t = 2.67, p = 0.009). Few caregivers' exceeded the cut score of 9 or higher on the EPDS and the likelihood of exceeding the cut score or not did not differ between caregivers based on infant autism likelihood ($\mu_{EL\text{-}ASD}$ = 6.36 %, $\mu_{TL\text{-}ASD}$ = 4.87 %, t = 1.28, p = 0.206). There were nine (9) caregivers in the EL-ASD group and five (5) caregivers in the TL-ASD group included in this 'high depression' subset (see Table 2 for more detailed description of caregivers' depressive symptoms). Generally, about 30% of mothers of EL-ASD infants presented with elevated levels of depression (32.14% of EL-ASD mothers scored a 9+ on the EPDS, n = 9). Mothers with higher levels of depression (ever scoring a 9 or above on the EPDS) were less likely to have attended 4+ lab sessions ($p < 0.1$). Infant eye-looking did not significantly differ across depressive groups from session to session (p = 0.174), so individual eye-tracking sessions were considered in our main analyses. For more descriptions of session attendance and eye-looking across groups, see Table 2.

Main Results

Our models accounted for main effects of caregivers' depressive symptoms and infants' ASD likelihood status as well as interactions between the two on infant eye-looking. As some children had multiple eye tracking sessions, each model included a random intercept for

individual to account for a lack of independence between participants. *(see Tables 3 & 4 for full regression models).* We found no significant main effects or interactions between ASD likelihood and caregiver depressive symptoms on eye-looking, regardless of whether EPDS scores was treated as continuous or dichotomous ($p = 0.182$, $d = 0.02$; $p = 0.121$, $d = -0.25$).

When visually inspecting our data, several patterns emerge, in which increasing maternal depressive symptoms predicted different frequencies of eye-looking in EL- and TL-ASD infants. We see that EL-ASD infants looked more to mothers' eyes in the absence of maternal depressive symptoms, but reduced their eye-looking more than TL-ASD infants as symptoms increased (see Figure 3). Our dichotomized visualization of depression shows that among TL-ASD infants, those whose mothers' depressive symptom levels exceeded scores of 9 on the EPDS had higher eye-looking than those whose mothers' depressive symptom levels were low (see Figure 4).

Discussion

The central aim of the present study was to characterize patterns of infant gaze to eyes across infants at elevated- versus typical-likelihoods of autism, while considering a potential moderating role of mothers' symptoms of postpartum depression. Our estimated effects were not statistically significant, though visual inspection of data suggests maternal depressive symptoms might relate to EL-ASD infants' eye-looking differently than TL-ASD infants' eye-looking.

We expected EL-ASD infants to look less to their caregivers' eyes in postpartum depressive contexts, as partially explained by these infants' developmental differences (Merin et al., 2007; Steiner et al., 2018; Young et al., 2009). EL-ASD infants, even those who do not go on to receive diagnoses of autism, demonstrate social vulnerabilities (Bailey et al., 1998; Di Giorgio et al., 2021; Piven et al., 1997), and tend to benefit from additional scaffolding in early social engagement (Kellerman et al., 2020). Recent research suggests that EL-ASD infants may be differentially susceptible to the influence of their environment, particularly int their social-communicative development (Romeo et al., 2022). This effect has been observed outside the context of ASD. Mertesacker and colleagues (2004) studied effects of negative infant emotionality and caregiver psychopathology on caregiver child interactions. They found that dyads were generally able to compensate for a single risk-factor in interaction, but when maternal *and* child risk factors were introduced dyads were less resilient to consequences in dyadic interaction If EL-ASD infants are more impacted by – or differentially susceptible – to caregiver inputs, they may also be especially vulnerable to PPD-related, adverse experiences that present risk to development even among TL-ASD infants.

The differential susceptibility of EL-ASD infants to their mothers' PPD in dyadic interaction might both amplify infants' vulnerabilities, but also lower the threshold at which maternal depressive symptoms begin to pose risk. In other words, if EL-ASD infants are already

more impacted by their caregivers' behaviors, it might also just generally take 'less' to impact them. Mothers' mean depression symptom levels in the present sample were significantly higher for mothers of EL-ASD infants than for mothers of typically developing infants. However, depression symptom levels in both groups were generally low, with averages well below clinical cutoff scores and few mothers reaching these cutoffs. This may be why we see limited correlates of depression, relative to our expectations based on published studies linking maternal depression and infant outcomes. We may be seeing generally low depressive levels across groups by nature of just how early we are focusing. Benson proposes 'stress proliferation' as a mediating factor in the relationship between children's autism symptom severity and caregivers' depression (Benson, 2006).The elevated depression levels we expected to see in EL-ASD dyads may not be very high yet because, even if these caregivers are implicitly attuning to their infants' development, they may not yet be consciously aware of differences their infants are displaying.

Our results differ from previous research showing that maternal depression is negatively related to infant social attention (Granat et al., 2016). This could possibly be due to differences in the severity and duration of maternal depression measured in previous studies, versus within the current study. In general, depressive symptom levels were low in our sample; we also only considered levels of PPD at concurrent time-points with infant eye-tracking, thus not accounting for the duration or severity of PPD infants were previously exposed to. If we considered PPD exposure duration in future analyses, we may expect typically-developing infants with prolonged exposure to more severe PPD to show reductions in their eye-looking. Additionally, few prior studies measuring social attention in infants with depressed mothers have utilized eye tracking measures, which have the ability to locate infant gaze to the eyes more precisely. Thus, typically developing infants may not show differences in their eye fixation within overall viewing time.

Limitations and Future Directions

The present study was limited by statistical power – particularly examining depression symptom levels dichotomously, as very few dyads in the present sample reached levels of clinically significant depression. Further, the present study cannot speak to changes in the relationship between depression and eye gaze over time, as not all infants completed more than one eye-tracking session and for those who did, we collapsed their data, limiting us to a cross-sectional approach. By increasing our sample size in future studies, we can pursue group comparison with more statistical power to assess relationships between infants' engagement and maternal PPD symptoms over time, providing more opportunities to consider trajectories of dyadic interaction.

It is important to note that we did not measure caregiver behavior within the present study; though we may be able to make some general inferences about how mothers with higher depression scores might interact with their infants, we do not know for certain how caregiving behaviors in mother-infant interactions differed across groups. It is quite possible that mothers of EL-ASD infants are using more scaffolding behaviors – such as increased gesture use, more infant-directed speech, greater animation or responsiveness – as they naturally attune and adjust to their infants' developmental differences.

In future studies, we would like to expand upon the present study's operationalization of both infants' and caregivers' contributions to dyadic engagement. Beyond considering maternal PPD symptoms with a screener like the EPDS, incorporating more direct measures of caregiver behavior might give us a better idea of the mechanisms by which PPD interrupts typical mother-infant engagement. Exploring maternal behaviors like smiling, vocalizing, and gesturing might also clarify how infants' attention is influenced from second-to-second (Nystrom et al., 2017), allowing us to more vividly characterize the reciprocal nature of these dyadic interactions.

Implications and Conclusions

In sum, we failed to support either main effects of autism likelihood status or of mothers' depression symptom levels, or their interaction, on infants' proportion of time gazing at their mothers' eyes during live interactions. Visual inspection of the data suggested a different relationship between maternal depression and eye fixation among EL-ASD infants compared to TL-ASD. Specifically, as mothers endorsed more symptoms of depression, EL-ASD infants gazed less to the eyes of their mothers during interaction, whereas we did not observe a relationship between maternal depression symptoms and eye fixation among TL-ASD infants. This visualized pattern is consistent with our hypotheses and previous research, which suggested that EL-ASD infants may present with unique developmental differences in social engagement and attention, leaving them more vulnerable to any additional environmental risks. The present study helps to further underscore the critical nature of social environments for early development in ASD. These findings, pending investigation within a larger sample, have implications for early interventions to support infants at elevated likelihood of autism. Specifically, we may need to further consider how caregiver depression might influence infant development and how to support caregiver-infant interactions within this population.

References

Aktar, E., Colonnesi, C., de Vente, W., Majdandzic, M., & Bogels, S. M. (2017). How do parents' depression and anxiety, and infants' negative temperament relate to parent-infant face-to-face interactions? *Dev Psychopathol*, *29*(3), 697-710. https://doi.org/10.1017/S0954579416000390

Azak, S. (2012). Maternal depression and sex differences shape the infants' trajectories of cognitive development. *Infant Behavior and Development*, 35(4), 803-814.

Bailey, A., Palferman, S., Heavey, L., & Le Couteur, A. (1998). Autism: the phenotype in relatives. *J Autism Dev Disord*, *28*(5), 369-392. https://doi.org/10.1023/a:1026048320785

Bang, J., & Nadig, A. (2015). Learning language in autism: maternal linguistic input contributes to later vocabulary. *Autism Res*, *8*(2), 214-223. https://doi.org/10.1002/aur.1440

Beebe, B., & Gerstman, L. J. (1980). The "packaging" of maternal stimulation in relation to infant facial–visual engagement: A case study at four months. *Merrill-Palmer Quarterly*, *26*, 321-339.

Beebe, B., Jaffe, J., Buck, K., Chen, H., Cohen, P., Feldstein, S., & Andrews, H. (2008). Six-week postpartum maternal depressive symptoms and 4-month mother-infant self- and interactive contingency. *Infant Ment Health J*, *29*(5), 442-471. https://doi.org/10.1002/imhj.20191

Benson, P. R. (2006). The impact of child symptom severity on depressed mood among parents of children with ASD: the mediating role of stress proliferation. *J Autism Dev Disord*, *36*(5), 685-695. https://doi.org/10.1007/s10803-006-0112-3

Bigelow, A. E., Power, M., Bulmer, M., & Gerrior, K. (2018). The Effect of Maternal Mirroring Behavior on Infants' Early Social Bidding During the Still-Face Task. *Infancy*, *23*(3), 367-385. https://doi.org/10.1111/infa.12221

Bradshaw, J., Schwichtenberg, A. J., & Iverson, J. M. (2022). Capturing the complexity of autism: Applying a developmental cascades framework. *Child Dev Perspect*, *16*(1), 18-26. https://doi.org/10.1111/cdep.12439

Chetcuti, L., Uljarevic, M., Varcin, K. J., Boutrus, M., Pillar, S., Dimov, S., Barbaro, J., Dissanayake, C., Green, J., Wan, M. W., Segal, L., Slonims, V., Whitehouse, A. J. O., Hudry, K., & Team, A. (2021). Caregiver Psychological Distress Predicts Temperament and Social-Emotional Outcomes in Infants with Autism Traits. *Res Child Adolesc Psychopathol*, *49*(12), 1669-1681. https://doi.org/10.1007/s10802-021-00838-5

Choi, B. (2019). Early Behavioral and Environmental Predictors of Language Skills in Infants at High and Low Risk for Autism Spectrum Disorder.

Choi, B., Nelson, C. A., Rowe, M. L., & Tager-Flusberg, H. (2020). Reciprocal Influences Between Parent Input and Child Language Skills in Dyads Involving High- and Low-Risk Infants for Autism Spectrum Disorder. *Autism Res*, *13*(7), 1168-1183. https://doi.org/10.1002/aur.2270

Cohn, J. F., & Tronick, E. Z. (1988). Mother-infant face-to-face interaction: Influence is bidirectional and unrelated to periodic cycles in either partner's behavior. *Developmental Psychology*, *24*, 386-392. https://doi.org/10.1037/0012-1649.24.3.386

Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression: Development of the 10-item Edinburgh Postnatal Depression Scale. The British Journal of Psychiatry. 1987; 150(6):782-786. BC Reproductive Mental Health Program and Perinatal Services BC. (2014), Best Practice Guidelines for Mental Health Disorders in the Perinatal Period.

Dawson, G. (2008). Early behavioral intervention, brain plasticity, and the prevention of autism spectrum disorder. *Dev Psychopathol*, *20*(3), 775-803. https://doi.org/10.1017/S0954579408000370

Di Giorgio, E., Rosa-Salva, O., Frasnelli, E., Calcagni, A., Lunghi, M., Scattoni, M. L., Simion, F., & Vallortigara, G. (2021). Abnormal visual attention to simple social stimuli in 4-month-old infants at high risk for Autism. *Sci Rep*, *11*(1), 15785. https://doi.org/10.1038/s41598-021-95418-4

Egmose, I., Cordes, K., Smith-Nielsen, J., Vaever, M. S., & Koppe, S. (2018). Mutual regulation between infant facial affect and maternal touch in depressed and nondepressed dyads. *Infant Behav Dev*, *50*, 274-283. https://doi.org/10.1016/j.infbeh.2017.05.007

Feldman, R. (2007). Parent-infant synchrony and the construction of shared timing; physiological precursors, developmental outcomes, and risk conditions. *J Child Psychol Psychiatry*, *48*(3-4), 329-354. https://doi.org/10.1111/j.1469-7610.2006.01701.x

Feldman, R., & Eidelman, A. I. (2004). Parent-infant synchrony and the social-emotional development of triplets. *Dev Psychol*, *40*(6), 1133-1147. https://doi.org/10.1037/0012-1649.40.6.1133

Feldman, R., Masalha, S., & Alony, D. (2006). Microregulatory patterns of family interactions: cultural pathways to toddlers' self-regulation. *J Fam Psychol*, *20*(4), 614-623. https://doi.org/10.1037/0893-3200.20.4.614

Frank, M. C., Alcock, K. J., Arias-Trejo, N., Aschersleben, G., Baldwin, D., Barbu, S., Bergelson, E., Bergmann, C., Black, A. K., Blything, R., Böhland, M. P., Bolitho, P., Borovsky, A., Brady, S. M., Braun, B., Brown, A., Byers-Heinlein, K., Campbell, L. E., Cashon, C., . . . Soderstrom, M. (2020). Quantifying Sources of Variability in Infancy Research Using the Infant-Directed-Speech Preference. *Advances in Methods and Practices in Psychological Science*, *3*(1), 24-52. https://doi.org/10.1177/2515245919900809

Goodman, S. H., Simon, H. F. M., Shamblaw, A. L., & Kim, C. Y. (2020). Parenting as a Mediator of Associations between Depression in Mothers and Children's Functioning: A Systematic Review and Meta-Analysis. *Clin Child Fam Psychol Rev*, *23*(4), 427-460. https://doi.org/10.1007/s10567-020-00322-4

Granat, A., Gadassi, R., Gilboa-Schechtman, E., & Feldman, R. (2017). Maternal depression and anxiety, social synchrony, and infant regulation of negative and positive emotions. *Emotion*, *17*(1), 11-27. https://doi.org/10.1037/emo0000204

Guillon, Q., Hadjikhani, N., Baduel, S., & Roge, B. (2014). Visual social attention in autism spectrum disorder: insights from eye tracking studies. *Neurosci Biobehav Rev*, *42*, 279-297. https://doi.org/10.1016/j.neubiorev.2014.03.013

Harrop, C., Jones, D., Zheng, S., Nowell, S. W., Boyd, B. A., & Sasson, N. (2018). Sex differences in social attention in autism spectrum disorder. *Autism Research*, *11*(9), 1264-1275.

Hernandez-Reif, M., Field, T., Diego, M., Vera, Y., & Pickens, J. (2006). Happy faces are habituated more slowly by infants of depressed mothers. *Infant Behav Dev*, *29*(1), 131-135. https://doi.org/10.1016/j.infbeh.2005.07.003

Ibanez, L. V., Messinger, D. S., Newell, L., Lambert, B., & Sheskin, M. (2008). Visual disengagement in the infant siblings of children with an autism spectrum disorder (ASD). *Autism : the international journal of research and practice*, 12(5), 473–485. https://doi.org/10.1177/1362361308094504

Jiang, M., Francis, S. M., Srishyla, D., Conelea, C., Zhao, Q., & Jacob, S. (2019). *Classifying Individuals with ASD Through Facial Emotion Recognition and Eye-Tracking* (Vol. 2019). https://doi.org/10.1109/EMBC.2019.8857005

Jones, W., Carr, K., & Klin, A. (2008). Absence of preferential looking to the eyes of approaching adults predicts level of social disability in 2-year-old toddlers with autism spectrum disorder. *Arch Gen Psychiatry*, *65*(8), 946-954. https://doi.org/10.1001/archpsyc.65.8.946

Jones, W., & Klin, A. (2013). Attention to eyes is present but in decline in 2-6-month-old infants later diagnosed with autism. *Nature*, *504*(7480), 427-431. https://doi.org/10.1038/nature12715

Kataja, E. L., Karlsson, L., Leppanen, J. M., Pelto, J., Haikio, T., Nolvi, S., Pesonen, H., Parsons, C. E., Hyona, J., & Karlsson, H. (2020). Maternal Depressive Symptoms During the Pre- and Postnatal Periods and Infant Attention to Emotional Faces. *Child Dev*, *91*(2), e475-e480. https://doi.org/10.1111/cdev.13152

Kellerman, A.M., Schwichtenberg, A.J., Abu-Zhaya, R., Miller, M., Young, G.S. and Ozonoff, S. (2020), Dyadic Synchrony and Responsiveness in the First Year: Associations with Autism Risk. *Autism Research*, 13: 2190-2201. https://doi-org.proxy.library.emory.edu/10.1002/aur.2373

Kim, I., Ekas, N. V., & Hock, R. (2016). Associations between child behavior problems, family management, and depressive symptoms for mothers of children with autism spectrum disorder. *Research in Autism Spectrum Disorders*, *26*, 80-90. https://doi.org/10.1016/j.rasd.2016.03.009

Kleberg, J. L., Nyström, P., Bölte, S., & Falck-Ytter, T. (2019). Sex differences in social attention in infants at risk for autism. *Journal of autism and developmental disorders*, *49*, 1342-1351.

Klin, A., Shultz, S., & Jones, W. (2015). Social visual engagement in infants and toddlers with autism: early developmental transitions and a model of pathogenesis. *Neurosci Biobehav Rev*, *50*, 189-203. https://doi.org/10.1016/j.neubiorev.2014.10.006

Letourneau, N., Dewey, D., Kaplan, B. J., Ntanda, H., Novick, J., Thomas, J. C., ... & APrON Study Team. (2019). Intergenerational transmission of adverse childhood experiences via maternal depression and anxiety and moderation by child sex. *Journal of developmental origins of health and disease*, 10(1), 88-99.

Lotzin, A., Romer, G., Schiborr, J., Noga, B., Schulte-Markwort, M., & Ramsauer, B. (2015). Gaze Synchrony between Mothers with Mood Disorders and Their Infants: Maternal Emotion Dysregulation Matters. *PLoS One*, *10*(12), e0144417. https://doi.org/10.1371/journal.pone.0144417

Lowinger, S. (1999). Infant irritability and early mother–infant reciprocity patterns. *Infant and Child Development*, *8*(2), 71-84. https://doi.org/https://doi.org/10.1002/(SICI)1522-7219(199906)8:2<71::AID-ICD191>3.0.CO;2-1

Lozano, I., López Pérez, D., Laudańska, Z., Malinowska-Korczak, A., Szmytke, M., Radkowska, A., & Tomalski, P. (2022). Changes in selective attention to articulating mouth across infancy: Sex differences and associations with language outcomes. *Infancy*, 27(6), 1132-1153.

Maenner, M. J., Shaw, K. A., Bakian, A. V., Bilder, D. A., Durkin, M. S., Esler, A., Furnier, S. M., Hallas, L., Hall-Lande, J., … Cogswell, M. E. (2021). Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2018. Morbidity and mortality weekly report. *Surveillance summaries* (Washington, D.C. : 2002), 70(11), 1–16. https://doi-org.proxy.library.emory.edu/10.15585/mmwr.ss7011a1

Manian, N., & Bornstein, M. H. (2009). Dynamics of emotion regulation in infants of clinically depressed and nondepressed mothers. *J Child Psychol Psychiatry*, *50*(11), 1410-1418. https://doi.org/10.1111/j.1469-7610.2009.02166.x

Mcquaid, N. E., Bibok, M. B., & Carpendale, J. I. (2009). Relation between maternal contingent responsiveness and infant social expectations. *Infancy*, 14(3), 390-401.

Merin, N., Young, G. S., Ozonoff, S., & Rogers, S. J. (2007). Visual Fixation Patterns during Reciprocal Social Interaction Distinguish a Subgroup of 6-Month-Old Infants At-Risk for Autism from Comparison Infants. *J Autism Dev Disord*, *37*(1), 108-121. https://doi.org/10.1007/s10803-006-0342-4

Mertesacker, B., Bade, U., Haverkock, A., & Pauli-Pott, U. (2004). Predicting maternal reactivity/sensitivity: The role of infant emotionality, maternal depressiveness/anxiety, and social support. *Infant Mental Health Journal: Official Publication of The World Association for Infant Mental Health*, 25(1), 47-61.

Marrus, N., Hall, L. P., Paterson, S. J., Elison, J. T., Wolff, J. J., Swanson, M. R., … Zwaigenbaum, L. (2018). Language delay aggregates in toddler siblings of children with autism spectrum disorder. *Journal of Neurodevelopmental Disorders*, 10(1), 29.

Niedzwiecka, A., Ramotowska, S., & Tomalski, P. (2018). Mutual Gaze During Early Mother-Infant Interactions Promotes Attention Control Development. *Child Dev*, *89*(6), 2230-2244. https://doi.org/10.1111/cdev.12830

Northrup, J. B., & Iverson, J. M. (2020). The development of mother-infant coordination across the first year of life. *Dev Psychol*, *56*(2), 221-236. https://doi.org/10.1037/dev0000867

Nystrom, P., Bolte, S., Falck-Ytter, T., & Team, E. (2017). Responding to Other People's Direct Gaze: Alterations in Gaze Behavior in Infants at Risk for Autism Occur on Very Short Timescales. *J Autism Dev Disord*, *47*(11), 3498-3509. https://doi.org/10.1007/s10803-017-3253-7

Ostlund, B. D., Measelle, J. R., Laurent, H. K., Conradt, E., & Ablow, J. C. (2017). Shaping emotion regulation: attunement, symptomatology, and stress recovery within mother-infant dyads. *Dev Psychobiol*, *59*(1), 15-25. https://doi.org/10.1002/dev.21448

Outters, V., Schreiner, M. S., Behne, T., & Mani, N. (2020). Maternal input and infants' response to infant-directed speech. *Infancy*, *25*(4), 478-499. https://doi.org/10.1111/infa.12334

Ozonoff, S., Iosif, A.-M., Baguio, F., Cook, I. C., Hill, M. M., Hutman, T., Rogers, S. J., Rozga, A., Sangha, S., Sigman, M., Steinfeld, M. B., & Young, G. S. (2010). A Prospective Study of the Emergence of Early Behavioral Signs of Autism. *Journal of the American Academy of Child & Adolescent Psychiatry*, *49*(3), 256-266.e252. https://doi.org/10.1016/j.jaac.2009.11.009

Piven, J., Palmer, P., Jacobi, D., Childress, D., & Arndt, S. (1997). Broader autism phenotype: evidence from a family history study of multiple-incidence autism families. *Am J Psychiatry*, *154*(2), 185-190. https://doi.org/10.1176/ajp.154.2.185

Porto, J. A., Bick, J., Perdue, K. L., Richards, J. E., Nunes, M. L., & Nelson, C. A. (2020). The influence of maternal anxiety and depression symptoms on FNIRS brain responses to emotional faces in 5- and 7-month-old infants. *Infant Behavior and Development*, *59*, 101447. https://doi.org/10.1016/j.infbeh.2020.101447

Propper, C., & Moore, G. A. (2006). The influence of parenting on infant emotionality: A multi-level psychobiological perspective. *Developmental Review*, *26*(4), 427-460. https://doi.org/10.1016/j.dr.2006.06.003

Romeo, R. R., Choi, B., Gabard-Durnam, L. J., Wilkinson, C. L., Levin, A. R., Rowe, M. L., ... & Nelson III, C. A. (2022). Parental language input predicts neuroscillatory patterns associated with language development in toddlers at risk of autism. *Journal of Autism and Developmental Disorders*, 52(6), 2717-2731.

Safyer, P., Volling, B. L., Wagley, N., Hu, X., Swain, J. E., Arredondo, M. M., & Kovelman, I. (2020). More than meets the eye: The neural development of emotion face processing during infancy. *Infant Behav Dev*, *59*, 101430. https://doi.org/10.1016/j.infbeh.2020.101430

Shultz, S., Klin, A., & Jones, W. (2018). Neonatal Transitions in Social Behavior and Their Implications for Autism. *Trends Cogn Sci*, *22*(5), 452-469. https://doi.org/10.1016/j.tics.2018.02.012

Siller, M., & Sigman, M. (2002). The behaviors of parents of children with autism predict the subsequent development of their children's communication. *J Autism Dev Disord*, *32*(2), 77-89. https://doi.org/10.1023/a:1014884404276

Skotheim, S., Braarud, H. C., Hoie, K., Markhus, M. W., Malde, M. K., Graff, I. E., Berle, J. O., & Stormark, K. M. (2013). Subclinical levels of maternal depression and infant sensitivity to social contingency. *Infant Behav Dev*, *36*(3), 419-426. https://doi.org/10.1016/j.infbeh.2013.03.009

Slomian, J., Honvo, G., Emonts, P., Reginster, J.-Y., & Bruyère, O. (2019). Consequences of maternal postpartum depression: A systematic review of maternal and infant outcomes. *Women's Health*, *15*, 1745506519844044. https://doi.org/10.1177/1745506519844044

Somers, J. A., Luecken, L. J., McNeish, D., Lemery-Chalfant, K., & Spinrad, T. L. (2021). Second-by-second infant and mother emotion regulation and coregulation processes. *Dev Psychopathol*, 1-14. https://doi.org/10.1017/S0954579421000389

Startsev, M., & Dorr, M. (2019). Classifying Autism Spectrum Disorder Based on Scanpaths and Saliency. *2019 IEEE International Conference on Multimedia & Expo Workshops (ICMEW)*, 633-636.

Steiner, A. M., Gengoux, G. W., Smith, A., & Chawarska, K. (2018). Parent-Child Interaction Synchrony for Infants At-Risk for Autism Spectrum Disorder. *J Autism Dev Disord*, *48*(10), 3562-3572. https://doi.org/10.1007/s10803-018-3624-8

Stewart, D. E., & Vigod, S. N. (2019). Postpartum Depression: Pathophysiology, Treatment, and Emerging Therapeutics. Annu Rev Med, 70, 183-196. https://doi.org/10.1146/annurev-med-041217-011106

Tanner, A., & Dounavi, K. (2021). The Emergence of Autism Symptoms Prior to 18 Months of Age: A Systematic Literature Review. *J Autism Dev Disord*, *51*(3), 973-993. https://doi.org/10.1007/s10803-020-04618-w

Thomas, J. C., Letourneau, N., Campbell, T. S., Tomfohr-Madsen, L., Giesbrecht, G. F., & Team, A. P. S. (2017). Developmental origins of infant emotion regulation: Mediation by temperamental negativity and moderation by maternal sensitivity. *Dev Psychol*, *53*(4), 611-628. https://doi.org/10.1037/dev0000279

Tiede, G. M., & Walton, K. M. (2021). Social endophenotypes in autism spectrum disorder: A scoping review. *Development and psychopathology*, 33(4), 1381–1409. https://doi-org.proxy.library.emory.edu/10.1017/S0954579420000577

Tomasello, M., & Farrar, M. J. (1986). Joint attention and early language. *Child Development*, *57*, 1454-1463. https://doi.org/10.2307/1130423

Tronick, E. D., Als, H., & Brazelton, T. B. (1977). Mutuality in mother–infant interaction. Journal of Communication, 27(2), 74–79. https://doi-org.proxy.library.emory.edu/10.1111/j.1460-2466.1977.tb01829.x

Vaever, M. S., Krogh, M. T., Smith-Nielsen, J., Christensen, T. T., & Tharner, A. (2015). Infants of Depressed Mothers Show Reduced Gaze Activity During Mother-Infant Interaction at 4 Months. *Infancy*, *20*(4), 445-454. https://doi.org/10.1111/infa.12082

Wan, M. W., Green, J., Elsabbagh, M., Johnson, M., Charman, T., Plummer, F., & Team, B. (2013). Quality of interaction between at-risk infants and caregiver at 12-15 months is associated with 3-year autism outcome. *J Child Psychol Psychiatry*, *54*(7), 763-771. https://doi.org/10.1111/jcpp.12032

Wan, M. W., Green, J., & Scott, J. (2019). A systematic review of parent-infant interaction in infants at risk of autism. *Autism*, *23*(4), 811-820. https://doi.org/10.1177/1362361318777484

Young, G. S., Merin, N., Rogers, S. J., & Ozonoff, S. (2009). Gaze behavior and affect at 6 months: predicting clinical outcomes and language development in typically developing infants and infants at risk for autism. *Dev Sci*, *12*(5), 798-814. https://doi.org/10.1111/j.1467-7687.2009.00833.x

Zablotsky, B., Black, L. I., Maenner, M. J., Schieve, L. A., Danielson, M. L., Bitsko, R. H., Blumberg, S. J., Kogan, M. D., & Boyle, C. A. (2019). Prevalence and Trends of Developmental Disabilities among Children in the United States: 2009-2017. *Pediatrics*, *144*(4). https://doi.org/10.1542/peds.2019-0811

Zablotsky, B., Bradshaw, C. P., & Stuart, E. A. (2013). The association between mental health, stress, and coping supports in mothers of children with autism spectrum disorders. *J Autism Dev Disord*, *43*(6), 1380-1393. https://doi.org/10.1007/s10803-012-1693-7

Appendix

Figure 1: ***General Eye-Tracking Procedure***

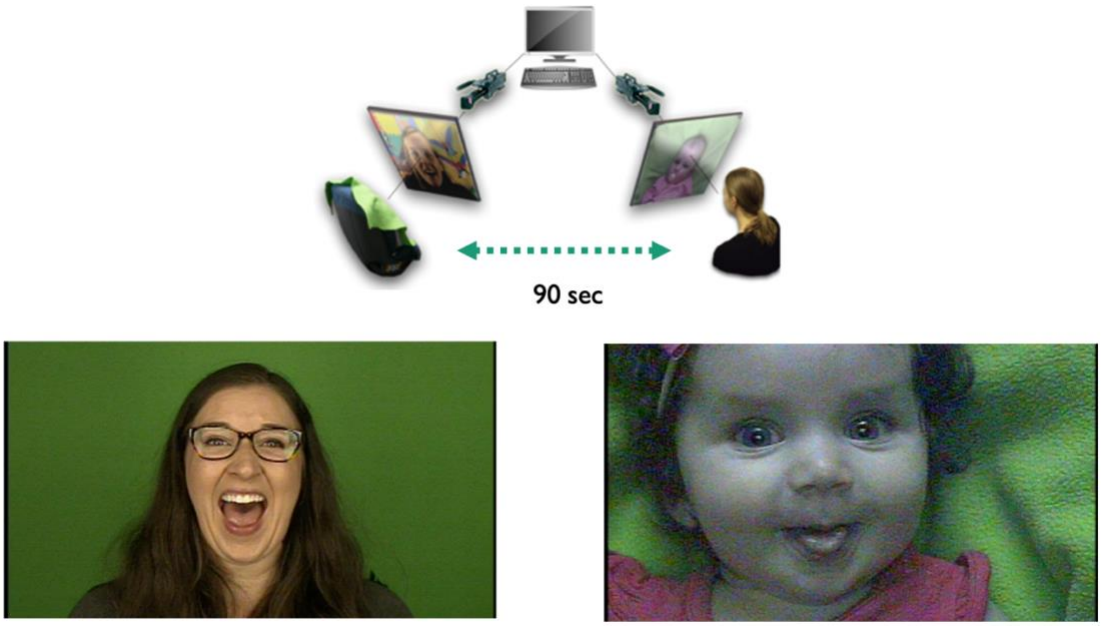

Figure 2: ***Caregiver Region of Interest Encoding Procedure***

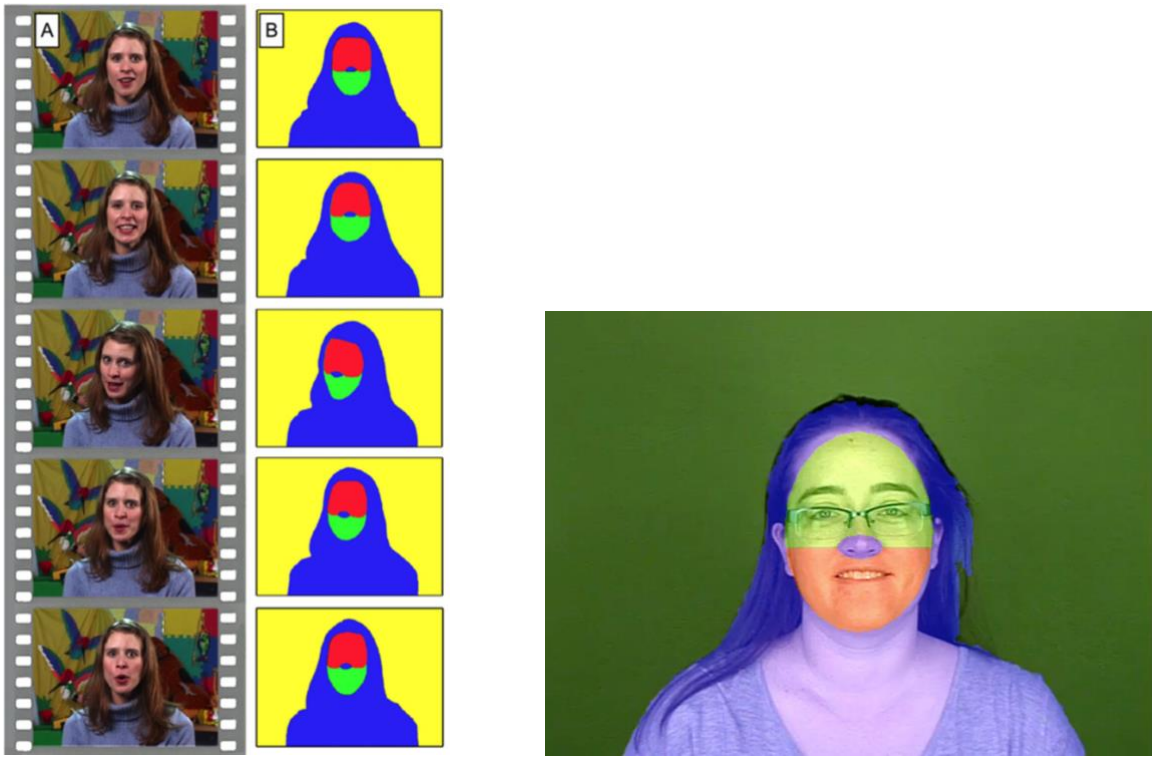

Figure 3: ***Overall Eye-Looking by Continuous Mothers' PPD & Infants' ASD Likelihood***

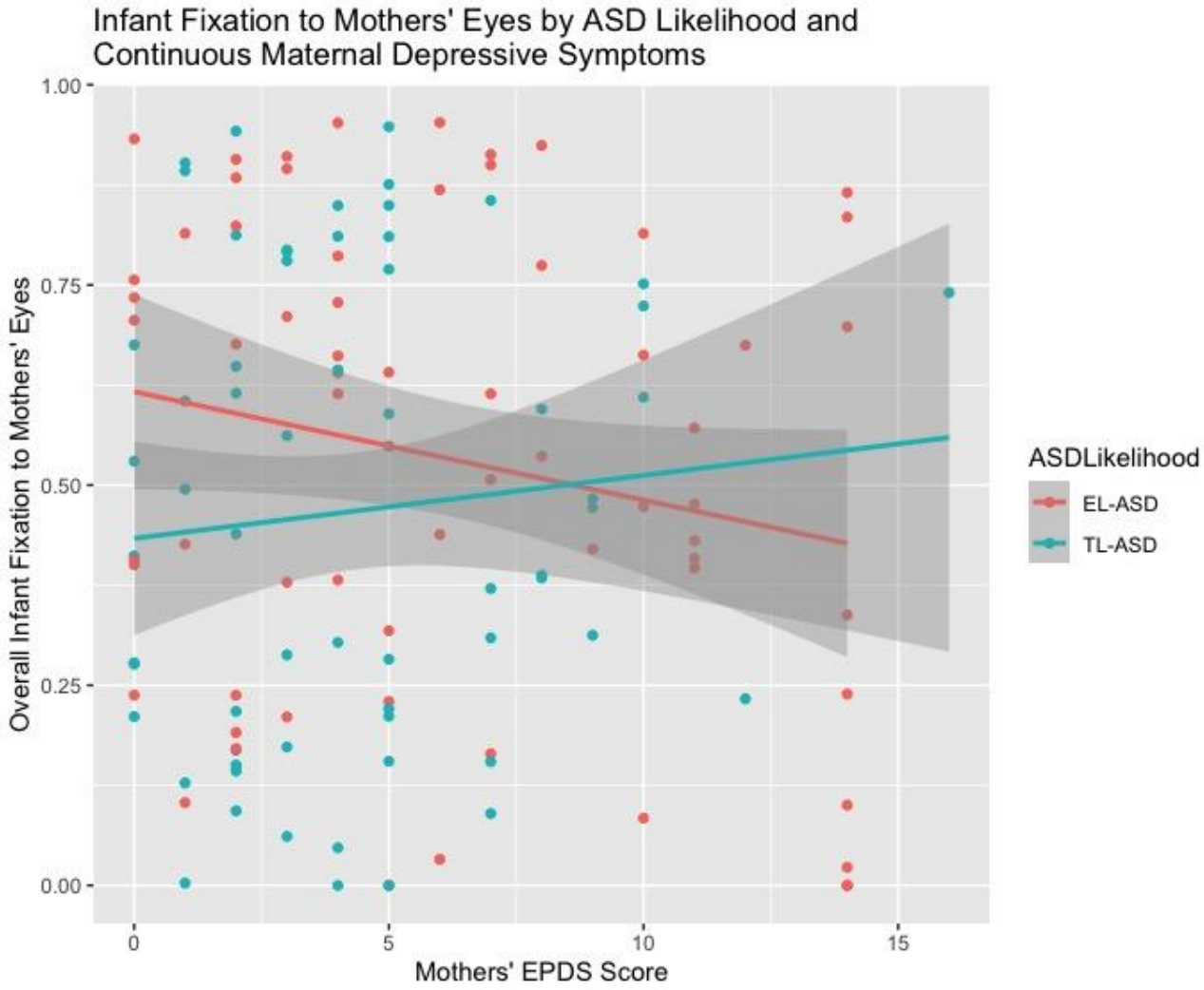

Figure 4: ***Overall Eye-Looking by Dichotomized Mothers' PPD & Infants' ASD Likelihood***

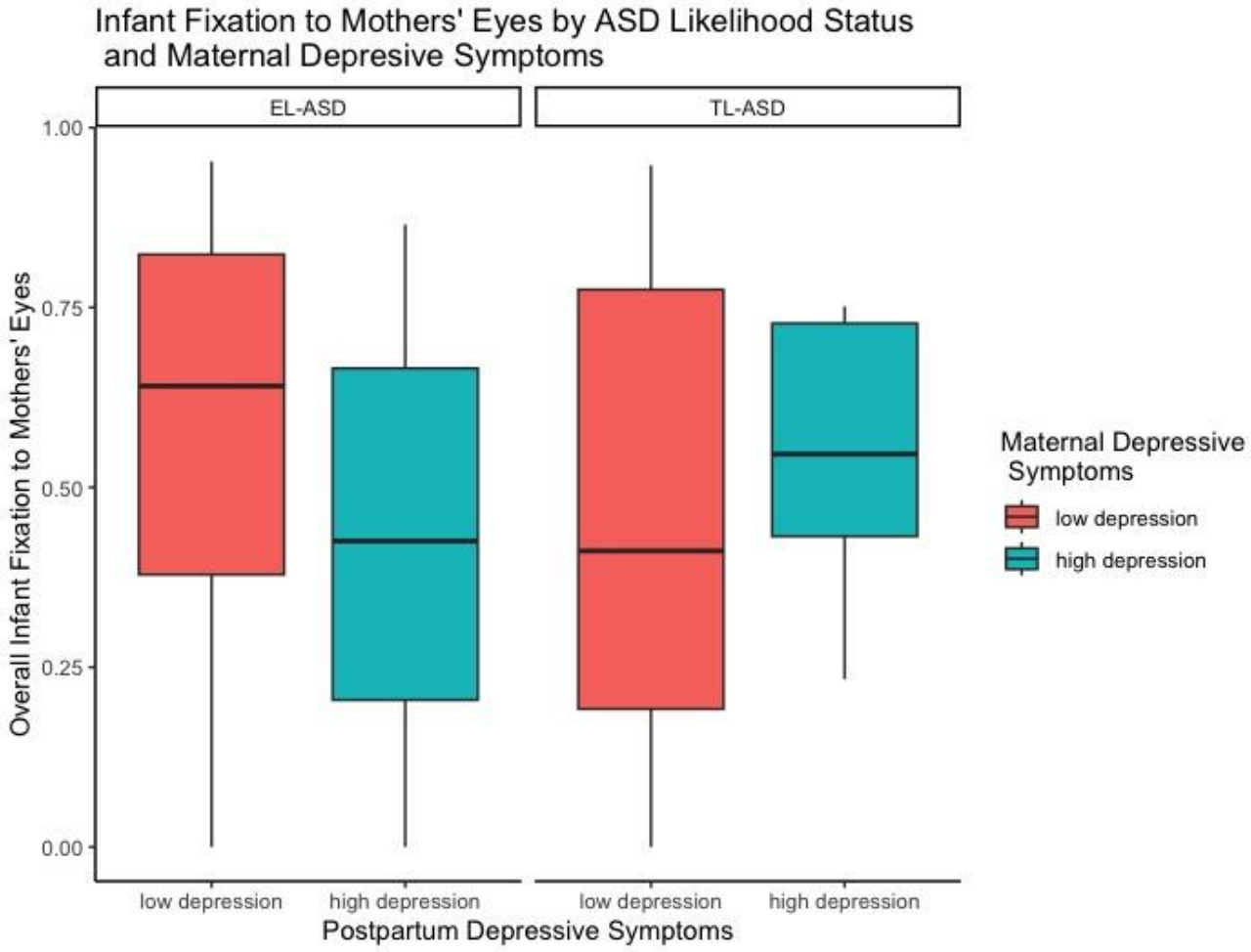

Table 1

Participant Demographics by ASD Likelihood Status

	EL-ASD (n=28)	TL-ASD (n=26)	Full Sample (n=54)
Mother's Age at Enrollment (years)	33.1 (5.13)	33.1 (3.73)	33.1 (4.48)
Mother's Education			
High School or GED	14.29%	0.00%	7.41%
Some College	21.43%	19.23%	20.37%
College Degree	42.86%	15.38%	29.63%
Professional Degree	10.71%	57.69%	33.33%
Unknown or Unreported	10.71%	7.69%	9.26%
Infant Race			
Asian	3.57%	3.85%	3.70%
Black or African-American	7.14%	15.38%	11.11%
White	85.71%	65.38%	75.93%
Other / More than one	3.57%	7.69%	5.56%
Unknown or Unreported	0.00%	7.69%	3.70%
Infant Sex			
Female	57.14%	53.85%	55.55%
Male	42.86%	46.15%	44.44%

Note. EL-ASD = Elevated Likelihood for Autism; TL-ASD = Typical Likelihood for Autism

Table 2

Group Characterization of Maternal Depression Across Sessions

	EL-ASD (n=28)	TL-ASD (n=26)	Full Sample (n=54)
Maternal Depressive Symptoms (EPDS Score)			
Mean (SD)	6.36 (4.52)	4.87 (4.02)	5.64 (4.31)
Range	0 - 14	0 - 16	0 - 16
% Scoring 9+ on EPDS	32.14% (n=9)	19.23% (n=5)	25.93% (n=14)
Overall Percentage Infant Eye-Looking			
Mean (SD)	0.4588 (0.232)	0.5117 (0.261)	0.4862 (0.246)
Range	0.0075 - 0.9525	0.1180 - 0.8606	0.0075 - 0.9525
Lab Sessions Attended			
Mean (SD)	2.29 (1.01)	2.46 (1.30)	2.37 (1.15)
Range	1 - 4	1 - 6	1 - 6

Note. EL-ASD = Elevated Likelihoood for Autism; TL-ASD= Typical Likelihood for Autism; EPDS = Edinburgh Postnatal Depression Scale

Table 3

Eye-Looking Regression with Continuous Depression Variable

	EyePct		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.60	0.45 – 0.75	**<0.001**
ASDLikelihood [low]	-0.18	-0.39 – 0.03	0.097
EPDS Score	-0.01	-0.03 – 0.01	0.228
ASDLikelihood [low] × EPDS Score	0.02	-0.01 – 0.05	0.182
Random Effects			
σ^2	0.05		
$\tau_{00\ Individual}$	0.03		
ICC	0.40		
$N_{\ Individual}$	54		
Observations	128		
Marginal R^2 / Conditional R^2	0.035 / 0.418		

Table 4

Eye-Looking Regression with Dichotomized Depression Variable

	EyePct		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.43	0.27 – 0.58	**<0.001**
ASDLikelihood [low]	0.13	-0.15 – 0.41	0.373
Caregiver Depression [low depression]	0.14	-0.05 – 0.33	0.146
ASDLikelihood [low] × Caregiver Depression [low depression]	-0.25	-0.57 – 0.07	0.121
Random Effects			
σ^2	0.05		
$\tau_{00\ Individual}$	0.03		
ICC	0.40		
$N_{\ Individual}$	54		
Observations	128		
Marginal R^2 / Conditional R^2	0.045 / 0.425		