Received: 22 August 2018 | Revised: 17 October 2019 | Accepted: 27 January 2020

DOI: 10.1111/desc.12953

SHORT REPORT

Developmental Science WILEY

Attachment security differs by later autism spectrum disorder: A prospective study

Katherine B. Martin[1] | John D. Haltigan[2] | Naomi Ekas[3] | Emily B. Prince[4] | Daniel S. Messinger[4]

[1]Tobii Pro, Reston, VA, USA

[2]Department of Psychiatry, Centre for Addiction and Mental Health, University of Toronto, Toronto, ON, Canada

[3]Department of Psychology, Texas Christian University, Fort Worth, TX, USA

[4]Department of Psychology, University of Miami, Coral Gables, FL, USA

Correspondence
Daniel S. Messinger, Department of Psychology, University of Miami, Coral Gables, FL, USA.
Email: dmessinger@miami.edu

Funding information
National Institute of General Medical Sciences, Grant/Award Number: 1R01GM105004; National Institute of Child Health and Human Development, Grant/Award Number: R01HD057284; National Science Foundation, Grant/Award Number: 10527360

Abstract

Although difficulties with social relationships are key to autism spectrum disorder (ASD), no previous study has examined infant attachment security prior to ASD diagnosis. We prospectively assessed attachment security at 15 months in high-risk infants with later ASD (high-risk/ASD, *n* = 16), high-risk infants without later ASD (high-risk/no-ASD, *n* = 40), and low-risk infants without later ASD (low-risk/no-ASD, *n* = 39) using the Strange Situation Procedure. High-risk/ASD infants were disproportionately more likely to be classified as insecure (versus secure) and more likely to be classified as insecure-resistant (versus secure or avoidant) than high-risk/no-ASD and low-risk/no-ASD infants. High-risk infants with insecure-resistant attachments were over nine times more likely to receive an ASD diagnosis than high-risk infants with secure attachments. Insecure-resistant attachment in high-risk infants suggests a propensity toward negative affect with the parent in conditions of stress. Insecure-resistant attachment may prove useful as a potential early index of propensity toward ASD diagnosis in high-risk siblings, while insecure-resistant attachment in the context of emergent autism may contribute to difficulties experienced by children with ASD and their families.

KEYWORDS

ASD, attachment, high-risk siblings, infant–parent, insecure-resistant, interaction

1 | INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by social-emotional impairments and restrictive, repetitive behaviors (Association, 2013). Social-emotional impairments in ASD include difficulties forming and maintaining social relationships. Attachment security is a pre-eminent measure of the infant–parent relationship, and researchers have investigated the quality of the attachment relationship between children already diagnosed with ASD and their parents (Rutgers, Bakermans-Kranenburg, Ijzendoorn, & Berckelaer-Onnes, 2004; Teague, Gray, Tonge, & Newman, 2017). However, no studies have assessed the security of attachment in infants at familial risk for ASD prior to ASD diagnosis, the focus of the current study.

Research in typically developing infants and children has demonstrated the influence of attachment security to social outcomes across the lifespan. Secure attachment is modestly associated with peer competence (Groh et al., 2016), while insecure and disorganized attachment status are associated with higher externalizing and internalizing behaviors, and later psychopathology (Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley, & Roisman, 2010). Higher levels of isolation, externalizing and internalizing behaviors, and psychopathology are also evidenced in children with ASD (Bauminger, Solomon, & Rogers, 2010). Examining attachment in infants at high

risk for ASD may improve our understanding of the role of attachment security in the development of ASD.

Attachment indexes an infant's expectations of parental availability and care, particularly during periods of stress. Early investigators suggested children with ASD did not exhibit attachment behaviors (e.g. proximity seeking, contact maintenance) and were unable to form affectionate bonds with parents (Kanner, 1943). Subsequent research indicated children with ASD demonstrated a clear preference for their parents over a stranger and increased proximity-seeking behaviors with their parent after separation (Shapiro, Sherman, Calamari, & Koch, 1987; Sigman & Mundy, 1989). However, children with ASD tended to exhibit fewer and less pronounced attachment behaviors than children without ASD (Dissanayake & Crossley, 1996; Rutgers, Van IJzendoorn, Bakermans-Kranenburg, & Swinkels, 2007; Sigman & Mundy, 1989).

Recent reviews indicate that children with ASD are able to form secure attachments but do so at lower rates than children without ASD (Rutgers et al., 2004; Teague et al., 2017). Aggregating seven samples using the Strange Situation Procedure (SSP), Teague et al. (2017) found that 47% of children with ASD were categorized as securely attached. This estimate is consonant with an earlier finding of 53% security by Rutgers et al. (2004) who found that children with ASD were less likely to be securely attached to their parents than children without ASD, a moderate effect size of $r = .24$. However, all of the research reviewed examined attachment security after ASD diagnosis (Rutgers et al., 2004; Teague et al., 2017). To our knowledge there have been no assessments of attachment *prior to an ASD diagnosis* in infants at heighted risk for an ASD (Fearon et al., 2010; Naber, Swinkels, Buitelaar, Bakermans-Kranenburg, et al., 2007; Oppenheim, Koren-Karie, Dolev, & Yirmiya, 2009; Rozga et al., 2018; Teague et al., 2017).

The gold standard assessment of attachment security in infants is the SSP (Ainsworth, Blehar, Waters, & Wall, 1978), which involves two brief separations from and reunions with the parent. During these reunions, trained coders rate infant attachment behaviors (i.e., proximity seeking, contact maintenance, resistance, avoidance, and disorganization). Ratings inform a gestalt classification of infant attachment status. Secure infants (B) use their parents as a safe base from which to explore the environment and seek proximity upon reunion. Insecure-avoidant (A) infants avoid their parents when reunited after separation. Insecure-resistant (C) infants seek contact upon reunion but are not easily comforted. Infants are also orthogonally classified as disorganized (D), which indicates the absence of an organized attachment strategy and indexes the presence of unusual or contradictory behaviors in the presence of the parent.

Unstandardized assessments of attachment make it difficult to understand the relative distribution of attachment classifications in children with and without ASD. Several studies have conducted the standard SSP in children with ASD (van IJzendoorn et al., 2007; Naber et al., 2008; Oppenheim et al., 2009). However, the majority of research on attachment in ASD has relied on modified versions of the SSP in which children were separated from their parents once or not at all (Capps, Sigman, & Mundy, 1994; Dissanayake & Crossley, 1996; Rogers, Ozonoff, & Maslin-Cole, 1993; Shapiro et al., 1987; Willemsen-Swinkels, Bakermans-Kranenburg, Buitelaar, IJzendoorn, & Engeland, 2000).

Research Highlights

- This is the first study to examine the differences in attachment status at 15 months of age in high-risk infants with and without a later autism spectrum disorder (ASD) outcome.
- A larger proportion of high-risk/ASD infants exhibited insecure-resistant classifications than high-risk/no-ASD or low-risk/no-ASD infants.
- High-risk infants with insecure-resistant attachments were over nine times more likely to receive an ASD diagnosis than high-risk infants with secure attachments.
- Insecure-resistant attachment in high-risk infants may index greater likelihood of later ASD and heightened risk for socioemotional difficulties.

High-risk infants, the infant siblings of children with ASD, offer an important opportunity to prospectively study the relation between attachment security in infancy and later ASD outcomes. Approximately 19% of longitudinally followed high-risk infants go on to develop the disorder themselves (Messinger et al., 2015; Ozonoff et al., 2011). Thus, high-risk infants enable researchers to characterize attachment security in infants who have high levels of familial-susceptibility to ASD. In a previous study of infant siblings of children with ASD, high-risk infant siblings were not more likely to be classified as insecurely attached to their parent than infant siblings of typically developing children (Haltigan, Ekas, Seifer, & Messinger, 2011). As diagnostic outcomes are now available in these infants, we sought to build upon this earlier study by examining attachment security in relation to later ASD outcome.

Research on high-risk infant siblings indicates that around 1 year of age those high-risk infants with later ASD outcome exhibit greater difficulties with social interaction than high those who do not (Ozonoff et al., 2010; Wan, Green, & Scott, 2019; Zwaigenbaum et al., 2005). High-risk infants with later ASD exhibit difficulties in gestural communication (Campbell, Leezenbaum, Mahoney, Day, & Schmidt, 2015), vocalization quality (Leezenbaum, Campbell, Butler, & Iverson, 2014; Paul, Fuerst, Ramsay, Chawarska, & Klin, 2011; Talbott, Nelson, & Tager-Flusberg, 2015), and communicatively integrating gestures and vocalizations (Parladé & Iverson, 2015). They show decreased social looking to their parents during free play (Rozga et al., 2011) and are rated as exhibiting lower levels of positive affect and attentiveness to the parent than high-risk infants without later ASD (Wan et al., 2013). Levels of parent–infant reciprocity and dyadic mutuality are also attenuated in infants with later ASD (Campbell et al., 2015; Wan et al., 2013). Lower levels of infant communication, attentiveness, and mutuality indicate difficulties in parent–infant interaction. Importantly, however, these findings do

not speak directly to the quality of the attachment relationship, the quintessential affective bond between the partners.

Attachment involves the expression and organization of infant social-communicative behaviors toward the parent. The assessment of attachment quality in infants at heightened risk for an ASD may provide an early window into disruptions in social communication that characterize the ASD phenotype. If insecure attachment is common in infants at high-risk for ASD, interventions designed to target attachment behaviors may improve later social-emotional functioning (Teague et al., 2017).

Currently, researchers investigating ASD do not possess a full understanding of the early disruption of interactive processes that may beinvolved in the emergence of ASD. To this end, we performed the gold standard SSP assessment of attachment security at 15 months and a clinical ASD diagnosis at 36 months. This prospective design allowed us to assess attachment security and its relation to ASD using the standardized SSP without modification at an age for which the procedure was designed. More crucially, our prospective design allowed to examine the emergence and development of the attachment relationship during infancy in children with later ASD.

2 | METHOD

2.1 | Participants and diagnostic procedure

Participants consisted of 95 infant–parent dyads enrolled in a larger longitudinal study examining the development of infants with and without an older sibling with ASD (Gangi, Ibañez, & Messinger, 2014). Infants were recruited in the metropolitan area of a large southern state. Recruitment strategies included referrals from a university-based autism center and mailings to parents whose addresses and names were obtained from county birth records. Infant–parent dyads completed the SSP at 15 months (M = 15.1 months, SD = 0.4 months) and were assessed for an ASD diagnosis at 36 months (M = 35.6, SD = 0.5 months). Ninety-one infants and their mothers and four infants and their fathers were seen in the SSP (see Table 1). The pattern of results was preserved if the four infant–father dyads were excluded. Parents were reimbursed for their child's participation in the study. Recruitment and procedures were approved by the university's Internal Review Board and written parental consent was obtained before participation.

TABLE 1 Infant sex by autism spectrum disorder (ASD) outcome group

	High-risk/ ASD	High-risk/ no-ASD	Low-risk/ no-ASD	Total
Males	11	24	19	54
Females	5	16	20	41
Total	16	40	39	95

Note: Sex did not vary significantly by group, $\chi^2(2, n = 95) = 2.14$, $p = .34$.

2.1.1 | ASD outcome

High-risk infants (n = 56) had at least one older sibling with a community diagnosis of ASD, which was confirmed at study entry by administration of the Autism Diagnostic Observation Schedule (ADOS, Lord et al., 2000) by a licensed clinical psychologist. Low-risk infants (n = 39) had one or more older siblings, none of whom had ASD, as confirmed by a score of 9 or lower on the Social Communication Questionnaire (Rutter, Bailey, & Lord, 2003). At 36 months, a DSM-IV-based clinical best-estimate diagnosis of ASD or of No-ASD was given to low- and high-risk infants by a licensed clinical psychologist. The diagnosis was informed by administration of the ADOS (Lord et al., 2000). The ADOS social affect (SA), restricted and repetitive behaviors (RRB; Hus, Gotham, & Lord, 2014), and overall calibrated severity scores (CSS; Gotham, Pickles, & Lord, 2009) are reported in Table 2. No low-risk infants received an ASD diagnosis. Of the 56 high-risk infants, 16 infants received an ASD diagnosis (see Figure 1). Consequently, we examined group differences in attachment security among three independent groups: high-risk infants with a later ASD outcome (high-risk/ASD, n = 16), high-risk infants without a later ASD outcome (high-risk/no-ASD, n = 40), and low-risk infants (low-risk/no-ASD, n = 39).

2.2 | Procedures

2.2.1 | Strange Situation Procedure

The SSP (Ainsworth et al., 1978) consists of eight 3-min episodes. These episodes include brief periods of interaction between the parent and child, interaction between the child and an unfamiliar experimenter, and two separations of the child from the parent, each followed by a reunion episode with the parent. Infant separation and stranger reunions were shortened if the infant displayed significant distress. Shortened separations or stranger reunions occurred in four cases (three low-risk/no-ASD and one high-risk/ASD). In no instance was a separation prolonged.

TABLE 2 Autism Diagnostic Observation Schedule severity scores

	SA, mean (*SD*)	RRB, mean (*SD*)	Overall, mean (*SD*)
Low-risk/no-ASD	2.13 (1.44)	2.69 (2.08)	1.59 (1.02)
High-risk/no-ASD	2.63 (1.63)	3.55 (2.44)	2.13 (1.30)
High-risk/ASD	5.73 (1.83)	6.73 (2.12)	5.93 (1.75)

Note: SA and RRB (Hus et al., 2014), and overall CSS (Gotham et al., 2009) are reported for 94 of the 95 infants. 34 infants received Module 1, 59 infants received Module 2, and module information was not available for two infants.

Abbreviations: ASD, autism spectrum disorder; CSS, calibrated severity scores; RRB, restricted and repetitive behaviors; SA, social affect.

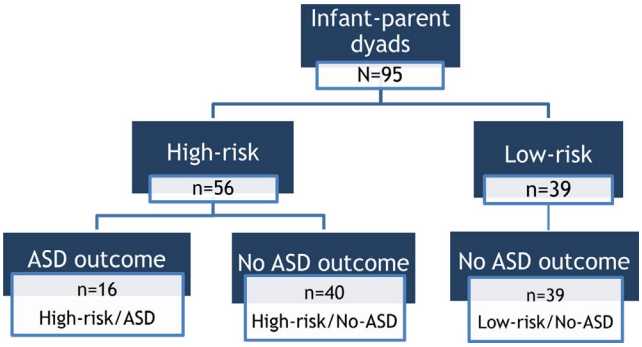

FIGURE 1 Diagnostic outcomes. No low-risk infants received an autism spectrum disorder (ASD) diagnosis. Of the 56 high-risk infants, 16 infants received an ASD diagnosis. Attachment security will be assessed in three independent, outcome groups: low-risk children (low-risk/no-ASD, n = 39), high-risk children without a later ASD outcome (high-risk/no-ASD, n = 40) and high-risk children with a later ASD outcome (high-risk/ASD, n = 16)

2.2.2 | Attachment classification

An expert rater trained by L. Alan Sroufe scored infants on proximity seeking, contact maintenance, resistance, and avoidance behaviors from 1 to 7 for each reunion as well as providing an overall disorganization score from 1 to 9 for the session overall. A score of 1 indicated the absence of the attachment behavior, while higher scores indicated the increasing presence and intensity of the attachment behavior. These scores informed the classification of infants as secure (B), insecure-avoidant (A), or insecure-resistant (C). Additionally, infants were orthogonally classified as disorganized (D) or not disorganized using the Main and Solomon (1990) scoring system. Initial coding of the sample conducted with attention to neurological indices of Disorganization using the system developed by Pipp-Siegel, Siegel, and Dean (1999) did not reveal differences between high-risk and low-risk infants (Haltigan et al. (2011). The primary expert rater and a secondary expert rater were both blind to ASD-risk status and outcome. The second rater double-coded 25% of the sample for reliability (four-way classification (A, B, C, D), 80% agreement, $\kappa = 0.63$). The intraclass correlation coefficient on the individual ratings of attachment behaviors ranged from 0.72 to 0.87.

2.3 | Analytic approach

Attachment security was assessed in two-way security analyses contrasting secure and insecure (combined resistant and avoidant) classifications, in three-way analyses contrasting secure, resistant, and avoidant classifications, and in orthogonal analyses contrasting disorganized and non-disorganized attachment. The two-way security analyses mirror the majority of studies of older children with ASD, the three-way analyses probe for differences in resistant and avoidant classifications, and the final analyses focus on the distribution of disorganized attachment. The two-way security, three-way, and disorganization analyses were each first conducted with the high-risk/ASD, high-risk/no-ASD, and low-risk/no-ASD groups. Next, for each type of analysis, we dropped the low-risk group and contrasted the high-risk/ASD and high-risk/no-ASD groups. Chi-squared tests of significance were supplemented by a Fisher's exact test in the 3 × 3 analysis as a conservative control against small cell sizes. The odds ratio (OR) was used to measure of the strength of effect in significant follow-up analyses of the high-risk/ASD and high-risk/no-ASD groups. As an example, the relative odds of ASD in the high-risk group given the presence of an insecure attachment was calculated as the odds (high-risk-ASD insecure)/(high-risk-ASD secure) divided by the odds (high-risk-no-ASD insecure)/(high-risk-no-ASD secure).

3 | RESULTS

3.1 | Secure, insecure (2-way)

A 2 (secure, insecure) by 3 (high-risk/ASD, high-risk/no-ASD, low-risk/no-ASD) chi-square test revealed a significant association, $\chi^2(2, N = 95) = 11.09$, $p < .01$ (see Figure 2). Standardized residuals suggested high-risk ASD infants were more likely to be classified as insecure than other infants (see Table 3). Eliminating the low-risk group, a follow-up 2 × 2 chi-square examined the secure and insecure attachment in the high-risk/ASD and high-risk/No-ASD groups. High-risk/ASD infants were disproportionately more likely to be classified as insecure than high-risk/no-ASD infants, $\chi^2(1, n = 56) = 9.92$, $p < .01$ (see Table 4). Specifically, high-risk infants with insecure attachments were 7.28 times more likely to receive an ASD diagnosis than high-risk infants with secure attachments, OR = 7.28, 95% CI (1.96, 27.1).

3.2 | Secure, resistant, avoidant (three-way)

A 3 (secure, resistant, avoidant) by 3 (group) Fisher's exact test indicated a significant association, $\chi^2(4, N = 95) = 12.15$, $p = .02$ (see Figure 3). Standardized residuals suggested that high-risk/ASD infants were more likely to receive resistant classifications than other infants (see Table 5). Eliminating the low-risk group, a follow-up 3 × 2 chi-square indicated that attachment classifications were distributed differently in the high-risk/ASD and the high-risk/no-ASD groups, $\chi^2(2, n = 56) = 10.41$, $p < .01$ (see Table 6). Standardized residuals suggested that high-risk/ASD infants were more likely to have a resistant attachment classification than high-risk/no-ASD infants. Specifically, high-risk infants with resistant attachments were 9.71 times more likely to receive an ASD diagnosis than high-risk infants with secure attachments, OR = 9.71, 95% CI (1.95, 48.45).

3.3 | Disorganization

A 2 (disorganized, not disorganized) by 3 (high-risk/ASD, high-risk/no-ASD, low-risk/no-ASD) chi-square test did not yield a significant

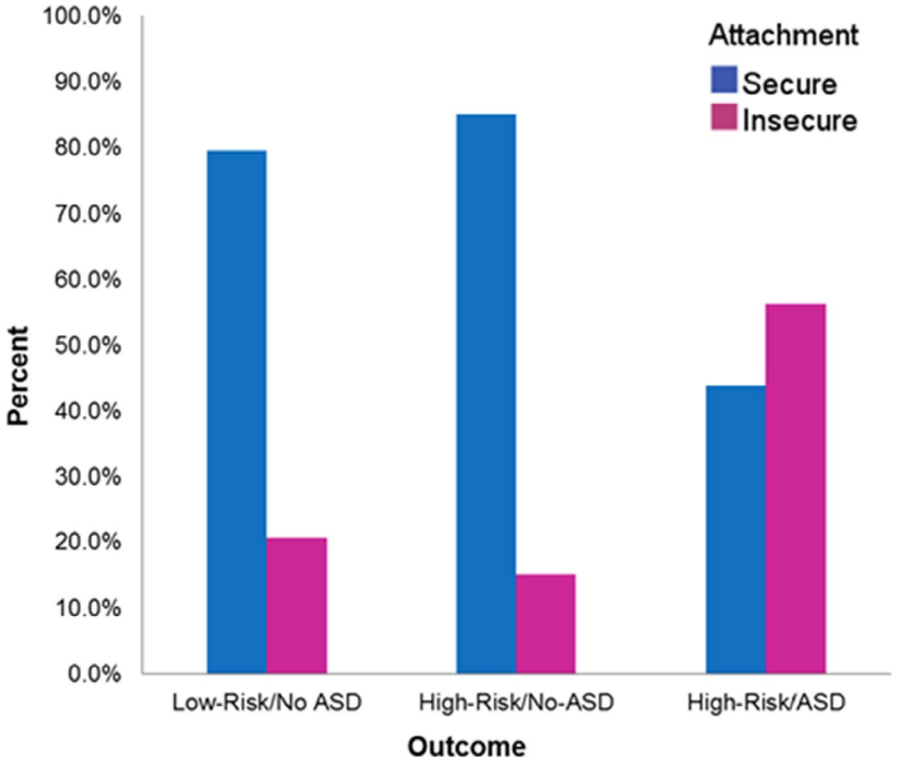

FIGURE 2 Secure versus insecure (two-way) attachment. 43.7% of infants with a later autism spectrum disorder (ASD) outcome were classified as securely attached compared to 82.3% of infants without a later ASD. 56.3% of infants with a later ASD outcome were classified as insecurely attached compared to 17.7% of infants without a later ASD outcome

TABLE 3 Secure versus insecure (two-way) attachment classification

	High-risk/ ASD	High-risk/ no-ASD	Low-risk/ no-ASD	Total
Secure				
Count (column %)	7 (43.8)	34 (85.0)	31 (79.5)	72
Expected count	12.1	30.3	29.6	
Standardized residual	−1.5	0.7	0.3	
Insecure				
Count (column %)	9 (56.2)	6 (15.0)	8 (20.5)	23
Expected count	3.9	9.7	9.4	
Standardized residual	2.6	−1.2	−0.5	
Total	16	40	39	95

Note: Frequency, proportions, expected count, and adjusted residuals of secure and insecure attachment classification by later ASD outcome.
Abbreviations: ASD, autism spectrum disorder.

TABLE 4 High-risk follow-up by two-way attachment classification

	High-risk/ ASD	High-risk/ no-ASD	Total
Secure			
Count (column %)	7 (43.8)	34 (85.0)	41
Expected count	11.7	29.3	
Standardized residual	−1.4	0.9	
Insecure			
Count (column %)	9 (56.2)	6 (15.0)	15
Expected count	4.3	10.7	
Standardized residual	2.3	−1.4	
Total	16	40	56

Note: Frequency, proportions, expected count, and adjusted residuals of secure and insecure attachment classification by high-risk/ASD and high-risk/no-ASD.
Abbreviations: ASD, autism spectrum disorder.

association, $\chi^2(2, N = 95) = 0.81$, $p > .65$ (see Table 7). Eliminating the low-risk group, a 2 × 2 chi-square did not indicate a difference in disorganization classifications between high-risk/ASD and high-risk/no-ASD infants, $\chi^2(1, n = 56) = 0.81$, $p = .40$.

4 | DISCUSSION

Although ASD is defined in part by impaired social relationships, there have been no direct assessments of the early attachment bond in infants at elevated risk for ASD. We conducted the first prospective examination of attachment security in high-risk infants with and without a later ASD outcome. High-risk siblings with later ASD were more likely to display insecure—specifically, insecure-resistant—attachment patterns than high- and low-risk infants without later ASD. High levels of resistant classifications indicate that infants with later ASD exhibited high levels of negative affect in the reunion episodes of the SSP, suggesting they had difficulty being comforted by their parents.

Early difficulties with interaction in high-risk infants with later ASD outcomes contextualize the current attachment findings.

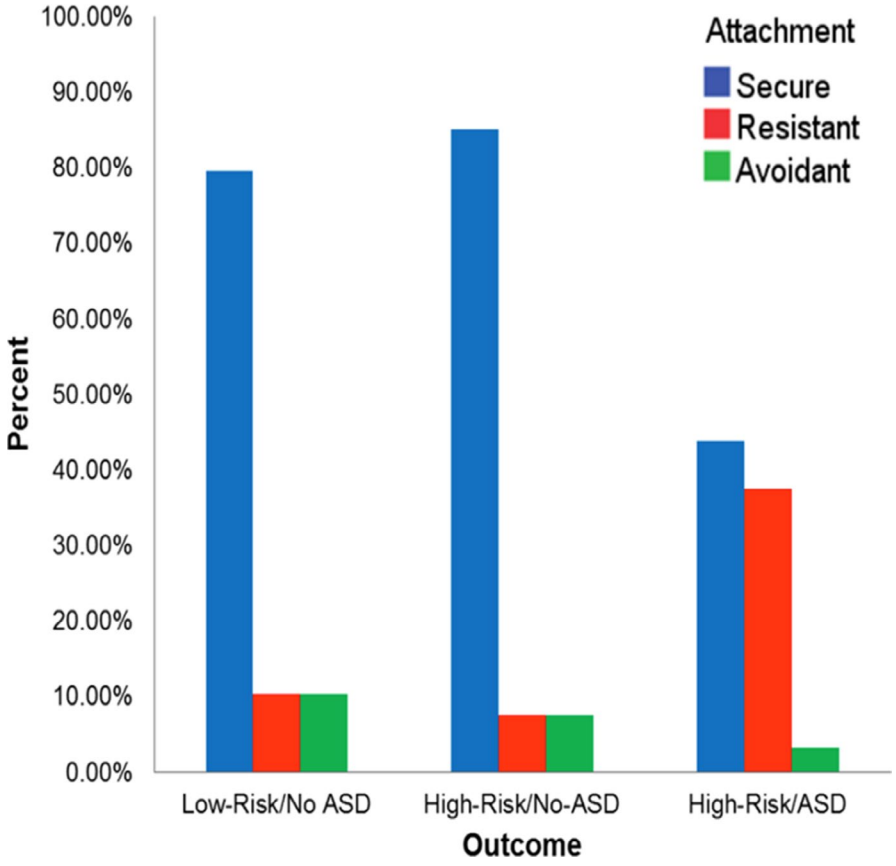

FIGURE 3 Secure, resistant, avoidant (three-way) attachment. 37.5% of infants with a later autism spectrum disorder (ASD) outcome displayed a resistant attachment compared to 8.9% of infants without a later ASD outcome

Around one year of age, high-risk infants with later ASD outcomes exhibit lower levels of positive affect, social reciprocity, and mutuality with their parents than high-risk infants without later ASD (Campbell et al., 2015; Wan et al., 2013). The current study indicates that these communication difficulties are mirrored by high levels of insecure-resistant attachment, suggesting a propensity toward negative affect and ambivalence in the context of interaction with the parent. In infancy, children with later ASD exhibit a temperamental profile distinguished by lower positive affect, higher negative affect and reactivity, and more difficulty controlling attention and behavior than children (both high- and low-risk) without later ASD (Bryson et al., 2007; Garon et al., 2009; Macari, Koller, Campbell, & Chawarska, 2017). Given the association between early temperament and resistant attachment (Groh et al., 2016), it is possible that high-risk infants with later ASD show early increases in negative affect that affect their ability to establish a secure attachment relationship.

Patterns of attachment reflect contributions from both infants and parents. All parents of high-risk infants are, by definition, parents of children with ASD. Parents of children with ASD report higher levels of stress, depression, and anxiety—and less use of an authoritative parenting style—than parents of children without ASD (Abbeduto et al., 2004; Dabrowska & Pisula, 2010; Rutgers, IJzendoorn, et al., 2007). It is possible that these differences might be accentuated among the parents of high-risk infants who were themselves developing ASD. Yet meta-analytic results do not indicate sensitivity differences—a key predictor of secure attachment—between parents of children with and without ASD (van IJzendoorn et al., 2007). Moreover, parental behavior observed during interaction typically does *not* distinguish high-risk infants with and without ASD outcomes (Baker, Messinger, Lyons, & Grantz, 2010; Campbell et al., 2015; Wan et al., 2013). Additional research is required to better understand the complex temporal associations between disturbed behavioral interactions and the emergence of stable patterns of attachment in children at high risk for ASD.

No group differences in disorganized attachment were noted between low-risk infants and high-risk infants with and without ASD outcomes. In studies where attachment was assessed after diagnosis, a higher percentage of children with ASD were classified as disorganized than children without ASD (Capps et al., 1994; Naber, Swinkels, Buitelaar, Dietz, et al., 2007; Willemsen-Swinkels et al., 2000). Given that disorganized behaviors, such as freezing, head banging, and motor stereotypies overlap with ASD symptoms, higher levels of disorganized attachment in children with ASD may be associated with concurrent ASD symptoms (Pipp-Siegel et al., 1999). Future longitudinal research might assess the possibility that indices of resistant attachment in high-risk infants prior to diagnosis manifest as indices of disorganization in older infants with ASD.

A developmental psychopathology perspective suggests that typical and disturbed developmental trajectories are mutually illuminating. In children without later ASD, resistant attachment is viewed as a difficulty associated with increased risk for poor social

TABLE 5 Secure, resistant, and avoidant (three-way) attachment classification

	High-risk/ ASD	High-risk/ no-ASD	Low-risk/ no-ASD	Total
Secure				
Count (column %)	7 (43.8)	34 (85.0)	31 (79.5)	72
Expected count	12.1	30.3	29.6	
Standardized residual	−1.5	0.7	0.3	
Resistant				
Count (column %)	6 (37.5)	3 (7.5)	4 (10.25)	13
Expected count	2.2	5.5	5.3	
Standardized residual	2.6	−1.1	−0.6	
Avoidant				
Count (column %)	3 (18.7)	3 (7.5)	4 (10.25)	10
Expected count	1.7	4.2	4.1	
Standardized residual	1.0	−0.6	−0.1	
Total	16	40	39	95

Note: Frequency, proportions, expected count, and adjusted residuals of secure, resistant, and avoidant attachment classification by later ASD outcome.

Abbreviations: ASD, autism spectrum disorder.

TABLE 6 High-risk follow-up by three-way attachment classification

	High-risk/ ASD	High-risk/ no-ASD	Total
Secure			
Count (column %)	7 (43.8)	34 (85.0)	41
Expected count	11.7	29.3	
Standardized residual	−1.4	0.9	
Resistant			
Count (column %)	6 (37.5)	3 (7.5)	9
Expected count	2.6	6.4	
Standardized residual	2.1	−1.4	
Avoidant			
Count (column %)	3 (18.7)	3 (7.5)	6
Expected count	1.7	4.3	
Standardized residual	1.0	−0.6	
Total	16	40	56

Note: Frequency, proportions, expected count, and adjusted residuals of secure, resistant, and avoidant attachment classification by high-risk/ASD and high-risk/no-ASD.

Abbreviations: ASD, autism spectrum disorder.

TABLE 7 Disorganization attachment classification

	High-risk/ ASD	High-risk/ no-ASD	Low-risk/ no-ASD	Total
D				
Count (column %)	5 (31.3)	8 (20.0)	9 (23.1)	22
Expected count	3.7	9.3	9	
Adjusted residual	0.7	−0.4	0.0	
Not D				
Count (column %)	11 (68.7)	32 (80.0)	30 (76.9)	73
Expected count	12.3	30.7	30	
Adjusted residual	−0.4	0.2	0.0	
Total	16	40	39	95

Note: Frequency, proportions, expected count, and adjusted residuals of disorganized attachment classification (D) by later ASD outcomes.

Abbreviations: ASD, autism spectrum disorder.

outcomes and behavior problems, but not as a debilitating deficit (Fearon et al., 2010; Madigan, Atkinson, Laurin, & Benoit, 2013). Behavior problems, however, are an area of concern in children with ASD (Bauminger et al., 2010), suggesting that insecure attachment may constitute an early, additional impediment to the acquisition of social competencies among children with later ASD.

Slightly more than half (56%) of high-risk infants with a later ASD outcome were classified as insecurely attached. This is consonant with estimates from the most recent quantitative review of insecurity in older children with ASD (53%) and a prior met-analysis (47%; Rutgers et al., 2004; Teague et al., 2017). Together these results indicate a proclivity toward insecure attachment among children with ASD that precedes diagnosis. While infants with later ASD in the current sample were more likely to be classified as insecure than infants without a later ASD, 44% of these infants were securely attached to the parent. In children with ASD, secure attachment is associated with higher levels of expressive and receptive language and higher levels of empathy (Rozga et al., 2018). Secure attachment in the context of ASD may serve as a protective factor for later social-emotional functioning, which may be associated with lower levels of distress in socially challenging situations.

High-risk infants with insecure attachments were seven times more likely to receive an ASD diagnosis than high-risk infants with secure attachments. High-risk infants with, specifically, resistant attachments were nine times more likely to receive an ASD diagnosis than high-risk infants with secure attachments. Replication of these findings in additional high-risk sibling samples would indicate that insecure attachment in general and insecure-resistant attachment in particular confer additional risk for later ASD.

From a therapeutic perspective, insecure-resistant attachment in high-risk infants may be a target for both ASD- and attachment-oriented interventions (Teague et al., 2017). Among children with ASD, interventions focused on enhancing parental sensitivity have yielded reductions in parental intrusiveness (Poslawsky et al., 2015)

and positive effects on children's attachment-related behaviors (Siller, Swanson, Gerber, Hutman, & Sigman, 2014), but were conducted with older children 1.5–6 years of age. Approaches such as Attachment and Biobehavioral Catch-Up (Dozier & Bernard, 2019), which aim to enhance parental sensitivity and nurturing behaviors, have yielded decreases in parental withdrawal that were associated with increases in the attachment quality of younger infants not at high risk for ASD (Yarger, Bronfman, Carlson, & Dozier, 2019). The current results suggest the need for interventions for infants at high risk for ASD that specifically target parent sensitivity in the face of infant negative affect, as a means to decreasing resistant attachment behaviors. This is of practical import because the externalizing behaviors associated with resistant attachment may accentuate a propensity toward disruptive behavior in some children with ASD.

4.1 | Limitations and strengths

As the study is concerned with high-risk infants, it does not address the early development of attachment in children with a later ASD who do not have an older sibling with the disorder. A number of methodological limitations also warrant mention. As data were collected before release of the DSM-5, diagnoses were based on the DSM-IV, and only ASD and No-ASD diagnoses were provided. Future work replicating these findings should use DSM-5 criteria and might be expanded to include other indices of atypical development. Finally, developmental evaluations of infants coterminous with their attachment assessments were not available, although 24-month evaluations are presented as Supporting Information. The study's key methodological strength was the prospective examination of attachment prior to ASD diagnosis. In addition, use of the standardized SSP to assess attachment security and disorganization provided a gold standard basis for comparison across studies.

5 | CONCLUSION

Standardized attachment assessment prior to ASD diagnosis suggested that an early manifestation of the disruptions in social communication that characterize the ASD phenotype manifests themselves in the attachment relationship between infant and parent. Infants with later ASD exhibited higher levels of insecure attachment, specifically insecure-resistant attachment, than low-risk infants and high-risk infants without later ASD. Replication with larger sample sizes will be necessary to determine the robustness of this association. The results, nevertheless, suggest that insecure and insecure-resistant attachments are noteworthy precursors of later diagnosis. As insecure attachments are associated with behavior problems, a salient difficulty for children with ASD, interventions targeting attachment security may serve to buttress social skills in infants at high risk for ASD.

ACKNOWLEDGEMENTS

This research was supported by the National Institute of Child Health and Human Development (R01HD057284), National Institute of General Medical Sciences (1R01GM105004), and the National Science Foundation (10527360).

CONFLICT OF INTEREST

The authors declare no conflict of interest for the work contained in this manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Katherine B. Martin https://orcid.org/0000-0002-5381-8450

REFERENCES

Abbeduto, L., Seltzer, M. M., Shattuck, P., Krauss, M. W., Orsmond, G., & Murphy, M. M. (2004). Psychological well-being and coping in mothers of youths with autism, down syndrome, orfragile X syndrome. *American Journal on Mental Retardation*, *109*(3), 237–254. https://doi.org/10.1352/0895-8017(2004)109<237:PWACIM>2.0.CO;2

Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). Patterns of attachment: A psychological study of the strange situation.

Association, A. P. (2013). Diagnostic and statistical manual of mental disorders: DSM-5. Retrieved from http://dsm.psychiatryonline.org/book.aspx?bookxml:id=556

Baker, J. K., Messinger, D. S., Lyons, K. K., & Grantz, C. J. (2010). A pilot study of maternal sensitivity in the context of emergent autism. *Journal of Autism and Developmental Disorders*, *40*(8), 988–999. https://doi.org/10.1007/s10803-010-0948-4

Bauminger, N., Solomon, M., & Rogers, S. J. (2010). Externalizing and internalizing behaviors in ASD. *Autism Research*, *3*(3), 101–112. https://doi.org/10.1002/aur.131

Rutter, M., Bailey, A., & Lord, C. (2003). *Social communications questionnaire (SCQ)*. Torrance, CA: Western Psychological Services.

Bryson, S. E., Zwaigenbaum, L., Brian, J., Roberts, W., Szatmari, P., Rombough, V., & McDermott, C. (2007). A prospective case series of high-risk infants who developed autism. *Journal of Autism and Developmental Disorders*, *37*(1), 12–24. https://doi.org/10.1007/s10803-006-0328-2

Campbell, S. B., Leezenbaum, N. B., Mahoney, A. S., Day, T. N., & Schmidt, E. N. (2015). Social engagement with parents in 11-month-old siblings at high and low genetic risk for autism spectrum disorder. *Autism*, *19*(8), 915–924. https://doi.org/10.1177/1362361314555146

Capps, L., Sigman, M., & Mundy, P. (1994). Attachment security in children with autism. *Development and Psychopathology*, *6*(02), 249–261. https://doi.org/10.1017/S0954579400004569

Dabrowska, A., & Pisula, E. (2010). Parenting stress and coping styles in mothers and fathers of pre-school children with autism and Down syndrome. *Journal of Intellectual Disability Research*, *54*(3), 266–280. https://doi.org/10.1111/j.1365-2788.2010.01258.x

Dissanayake, C., & Crossley, S. A. (1996). Proximity and sociable behaviours in autism: Evidence for attachment. *Journal of Child Psychology and Psychiatry*, *37*(2), 149–156. https://doi.org/10.1111/j.1469-7610.1996.tb01386.x

Dozier, M., & Bernard, K. (2019). *Coaching parents of vulnerable infants: The attachment and biobehavioral catch-up approach*. New York: Guilford Press.

Fearon, R. P., Bakermans-Kranenburg, M. J., van IJzendoorn, M. H., Lapsley, A.-M., & Roisman, G. I. (2010). The significance of insecure attachment and disorganization in the development of children's externalizing behavior: A meta-analytic study. *Child Development*, *81*(2), 435–456. https://doi.org/10.1111/j.1467-8624.2009.01405.x

Gangi, D. N., Ibañez, L. V., & Messinger, D. S. (2014). Joint attention initiation with and without positive affect: Risk group differences and associations with ASD symptoms. *Journal of Autism and Developmental Disorders*, *44*(6), 1414–1424. https://doi.org/10.1007/s10803-013-2002-9

Garon, N., Bryson, S. E., Zwaigenbaum, L., Smith, I. M., Brian, J., Roberts, W., & Szatmari, P. (2009). Temperament and its relationship to autistic symptoms in a high-risk infant sib cohort. *Journal of Abnormal Child Psychology*, *37*(1), 59–78. https://doi.org/10.1007/s10802-008-9258-0

Gotham, K., Pickles, A., & Lord, C. (2009). Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *39*(5), 693–705. https://doi.org/10.1007/s10803-008-0674-3

Groh, A. M., Narayan, A. J., Bakermans-Kranenburg, M. J., Roisman, G. I., Vaughn, B. E., Fearon, R., & van IJzendoorn, M. H. (2016). Attachment and temperament in the early life course: A meta-analytic review. *Child Development*, *88*(3), 770–795. https://doi.org/10.1111/cdev.12677

Haltigan, J. D., Ekas, N. V., Seifer, R., & Messinger, D. S. (2011). Brief report: Attachment security in infants at-risk for autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *41*(7), 962–967. https://doi.org/10.1007/s10803-010-1107-7

Hus, V., Gotham, K., & Lord, C. (2014). Standardizing ADOS domain scores: Separating severity of social affect and restricted and repetitive behaviors. *Journal of Autism and Developmental Disorders*, *44*(10), 2400–2412. https://doi.org/10.1007/s10803-012-1719-1

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous child*, *2*(3), 217–250.

Leezenbaum, N. B., Campbell, S. B., Butler, D., & Iverson, J. M. (2014). Maternal verbal responses to communication of infants at low and heightened risk of autism. *Autism*, *18*(6), 694–703.

Lord, C., Risi, S., Lambrecht, L., Cook, E. H. Jr, Leventhal, B. L., DiLavore, P. C., … Rutter, M. (2000). The autism diagnostic observation schedule—Generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders*, *30*(3), 205–223. https://doi.org/10.1023/a:1005592401947

Macari, S. L., Koller, J., Campbell, D. J., & Chawarska, K. (2017). Temperamental markers in toddlers with autism spectrum disorder. *Journal of Child Psychology & Psychiatry*, *58*(7), 819–828. https://doi.org/10.1111/jcpp.12710

Madigan, S., Atkinson, L., Laurin, K., & Benoit, D. (2013). Attachment and internalizing behavior in early childhood: A meta-analysis. *Developmental Psychology*, *49*(4), 672–689. https://doi.org/10.1037/a0028793

Main, M., & Solomon, J. (1990). Procedures for identifying infants as disorganized/disoriented during the Ainsworth Strange Situation. *Attachment in the Preschool Years: Theory, Research, and Intervention*, *1*, 121–160.

Messinger, D. S., Young, G. S., Webb, S. J., Ozonoff, S., Bryson, S. E., Carter, A., … Zwaigenbaum, L. (2015). Early sex differences are not autism-specific: A Baby Siblings Research Consortium (BSRC) study. *Molecular Autism*, *6*(1), 32. https://doi.org/10.1186/s13229-015-0027-y

Naber, F. B. A., Bakermans-Kranenburg, M. J., van IJzendoorn, M. H., Swinkels, S. H. N., Buitelaar, J. K., Dietz, C., … van Engeland, H. (2008). Play behavior and attachment in toddlers with autism. *Journal of Autism and Developmental Disorders*, *38*(5), 857–866. https://doi.org/10.1007/s10803-007-0454-5

Naber, F. B. A., Swinkels, S. H. N., Buitelaar, J. K., Bakermans-Kranenburg, M. J., van IJzendoorn, M. H., Dietz, C., … van Engeland, H. (2007). Attachment in toddlers with autism and other developmental disorders. *Journal of Autism and Developmental Disorders*, *37*(6), 1123–1138. https://doi.org/10.1007/s10803-006-0255-2

Naber, F. B. A., Swinkels, S. H. N., Buitelaar, J. K., Dietz, C., van Daalen, E., Bakermans-Kranenburg, M. J., … van Engeland, H. (2007). Joint attention and attachment in toddlers with autism. *Journal of Abnormal Child Psychology*, *35*(6), 899–911. https://doi.org/10.1007/s10802-007-9142-3

Oppenheim, D., Koren-Karie, N., Dolev, S., & Yirmiya, N. (2009). Maternal insightfulness and resolution of the diagnosis are associated with secure attachment in preschoolers with autism spectrum disorders. *Child Development*, *80*(2), 519–527. https://doi.org/10.1111/j.1467-8624.2009.01276.x

Ozonoff, S., Iosif, A.-M., Baguio, F., Cook, I. C., Hill, M. M., Hutman, T., … Sigman, M. (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.

Ozonoff, S., Young, G. S., Carter, A., Messinger, D., Yirmiya, N., Zwaigenbaum, L., … Stone, W. L. (2011). Recurrence risk for autism spectrum disorders: A Baby Siblings Research Consortium study. *Pediatrics*, *128*(3), e488–e495. https://doi.org/10.1542/peds.2010-2825

Parladé, M. V., & Iverson, J. M. (2015). The development of coordinated communication in infants at heightened risk for autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *45*(7), 2218–2234. https://doi.org/10.1007/s10803-015-2391-z

Paul, R., Fuerst, Y., Ramsay, G., Chawarska, K., & Klin, A. (2011). Out of the mouths of babes: Vocal production in infant siblings of children with ASD. *Journal of Child Psychology and Psychiatry*, *52*(5), 588–598. https://doi.org/10.1111/j.1469-7610.2010.02332.x

Pipp-Siegel, S., Siegel, C. H., & Dean, J. (1999). Neurological aspects of the disorganized/disoriented attachment classification system: Differentiating quality of the attachment relationship from neurological impairment. *Monographs of the Society for Research in Child Development*, *64*(3), 25–44.

Poslawsky, I. E., Naber, F. B., Bakermans-Kranenburg, M. J., van Daalen, E., van Engeland, H., & van IJzendoorn, M. H. (2015). Video-feedback Intervention to promote Positive Parenting adapted to Autism (VIPP-AUTI): A randomized controlled trial. *Autism*, *19*(5), 588–603. https://doi.org/10.1177/1362361314537124.

Rogers, S. J., Ozonoff, S., & Maslin-Cole, C. (1993). Developmental aspects of attachment behavior in young children with pervasive developmental disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, *32*(6), 1274–1282. https://doi.org/10.1097/00004583-199311000-00023

Rozga, A., Hesse, E., Main, M., Duschinsky, R., Beckwith, L., & Sigman, M. J. A. (2018). A short-term longitudinal study of correlates and sequelae of attachment security in autism. *Attachment & Human Development*, *20*(2), 160–180. https://doi.org/10.1080/14616734.2017.1383489

Rozga, A., Hutman, T., Young, G. S., Rogers, S. J., Ozonoff, S., Dapretto, M., & Sigman, M. (2011). Behavioral profiles of affected and unaffected siblings of children with autism: Contribution of measures of mother–infant interaction and nonverbal communication. *Journal of Autism and Developmental Disorders*, *41*(3), 287–301. https://doi.org/10.1007/s10803-010-1051-6

Rutgers, A. H., Bakermans-Kranenburg, M. J., Ijzendoorn, M. H., & Berckelaer-Onnes, I. A. (2004). Autism and attachment: A meta-analytic review. *Journal of Child Psychology and Psychiatry*, *45*(6), 1123–1134. https://doi.org/10.1111/j.1469-7610.2004.t01-1-00305.x

Rutgers, A. H., Van IJzendoorn, M. H., Bakermans-Kranenburg, M. J., & Swinkels, S. H. N. (2007). Autism and attachment. *Autism*, *11*(2), 187–200. https://doi.org/10.1177/1362361307075713

Rutgers, A. H., van IJzendoorn, M. H., Bakermans-Kranenburg, M. J., Swinkels, S. H. N., van Daalen, E., Dietz, C., … van Engeland, H.

(2007). Autism, attachment and parenting: A comparison of children with autism spectrum disorder, mental retardation, language disorder, and non-clinical children. *Journal of Abnormal Child Psychology*, *35*(5), 859–870. https://doi.org/10.1007/s10802-007-9139-y

Shapiro, T., Sherman, M., Calamari, G., & Koch, D. (1987). Attachment in autism and other developmental disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, *26*(4), 480–484. https://doi.org/10.1097/00004583-198707000-00003

Sigman, M., & Mundy, P. (1989). Social attachments in autistic children. *Journal of the American Academy of Child & Adolescent Psychiatry*, *28*(1), 74–81. https://doi.org/10.1097/00004583-198901000-00014

Siller, M., Swanson, M., Gerber, A., Hutman, T., & Sigman, M. (2014). A parent-mediated intervention that targets responsive parental behaviors increases attachment behaviors in children with ASD: Results from a randomized clinical trial. *Journal of Autism and Developmental Disorders*, *44*(7), 1720–1732. https://doi.org/10.1007/s10803-014-2049-2

Talbott, M. R., Nelson, C. A., & Tager-Flusberg, H. (2015). Maternal gesture use and language development in infant siblings of children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *45*(1), 4–14. https://doi.org/10.1007/s10803-013-1820-0

Teague, S. J., Gray, K. M., Tonge, B. J., & Newman, L. K. (2017). Attachment in children with autism spectrum disorder: A systematic review. *Research in Autism Spectrum Disorders*, *35*, 35–50. https://doi.org/10.1016/j.rasd.2016.12.002

van IJzendoorn, M. H., Rutgers, A. H., Bakermans-Kranenburg, M. J., Swinkels, S. H. N., van Daalen, E., Dietz, C., … van Engeland, H. (2007). Parental sensitivity and attachment in children with autism spectrum disorder: Comparison with children with mental retardation, with language delays, and with typical development. *Child Development*, *78*(2), 597–608. https://doi.org/10.1111/j.1467-8624.2007.01016.x

Wan, M. W., Green, J., Elsabbagh, M., Johnson, M., Charman, T., & Plummer, F. (2013). Quality of interaction between at-risk infants and caregiver at 12–15 months is associated with 3-year autism outcome. *Journal of Child Psychology & Psychiatry*, *54*(7), 763–771.

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

Willemsen-Swinkels, S. H. N., Bakermans-Kranenburg, M. J., Buitelaar, J. K., IJzendoorn, M. H. V., & Engeland, H. V. (2000). Insecure and disorganised attachment in children with a pervasive developmental disorder: Relationship with social interaction and heart rate. *Journal of Child Psychology and Psychiatry*, *41*(6), 759–767. https://doi.org/10.1111/1469-7610.00663

Yarger, H. A., Bronfman, E., Carlson, E., & Dozier, M. (2019). Intervening with attachment and biobehavioral catch-up to decrease disrupted parenting behavior and attachment disorganization: The role of parental withdrawal. *Development and Psychopathology*, 1–10. https://doi.org/10.1017/S0954579419000786

Zwaigenbaum, L., Bryson, S., Rogers, T., Roberts, W., Brian, J., & Szatmari, P. (2005). Behavioral manifestations of autism in the first year of life. *International Journal of Developmental Neuroscience*, *23*(2–3), 143–152. https://doi.org/10.1016/j.ijdevneu.2004.05.001

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Martin KB, Haltigan JD, Ekas N, Prince EB, Messinger DS. Attachment security differs by later autism spectrum disorder: A prospective study. *Dev Sci*. 2020;00:e12953. https://doi.org/10.1111/desc.12953