ATTACHMENT & HUMAN DEVELOPMENT
2024, VOL. 26 NO. 3, 233–252
https://doi.org/10.1080/14616734.2024.2367328

Routledge
Taylor & Francis Group

RESEARCH ARTICLE

Deactivation, hyperactivation, and anomalous content in the attachment script assessment: stability over time and significance for parenting behavior and physiology

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KEYWORDS

Attachment script assessment; attachment stability; parenting; respiratory sinus arrhythmia; parent-child interaction

ABSTRACT

This study examined the stability of Attachment Script Assessment (ASA) deactivation, hyperactivation, and anomalous content and their significance for parenting outcomes in mothers (*M*age = 31 years; 78% White/European American) and 6-month-old infants. Comparable to ASA secure base script knowledge (SBSK), mothers' ASA deactivation, hyperactivation, and anomalous content were significantly, moderately stable over two years (*r*'s = .40 - .43). Mothers' ASA hyperactivation and anomalous content were associated with greater maternal intrusiveness, whereas ASA deactivation was associated with greater detachment and less intrusiveness. Only ASA anomalous content was associated with lower maternal sensitivity. Mothers' ASA deactivation was associated with less dynamic change in respiratory sinus arrhythmia during the Still- Face Procedure—reflective of limited mobilization of physiological resources to support responding to infants. Findings support the validity of ASA deactivation, hyperactivation, and anomalous content scripts, and demonstrate their utility in examining adult attachment stability and predictive significance for parent-child outcomes.

According to attachment theory (Bowlby, 1973), early experiences with parents become internalized as cognitive-affective representations that are carried forward and serve as a prototype for subsequent close relationships. Thus, attachment variation is expected to exhibit stability (to some extent) over time and to be associated with interpersonal functioning within close relationships established across the life course. Research on adult attachment representations has provided evidence in support of both of these predictions, demonstrating the short- and long-term stability of adult attachment security and the predictive significance of secure adult attachment representations for functioning within close relationships, particularly those established with offspring (Pinquart et al., 2013; Verhage et al., 2016). However, extant research primarily focuses on variation in

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/14616734.2024.2367328

attachment security, despite expectations that insecure and disorganized patterns of attachment are also stable over time and have differential significance for interpersonal functioning. Groh and Haydon (2021) developed a coding system to evaluate variation in insecure and disorganized adult attachment as indexed by deactivation, hyperactivation, and anomalous content in the Attachment Script Assessment (ASA) – a time- and cost- efficient alternative to the Adult Attachment Interview (AAI; Main et al., 2003–2008). Given that these dimensions conceptually and empirically converge with AAI dismissing, preoccupied, and unresolved states of mind, respectively (Groh & Haydon, this issue; Groh et al., this issue), the novel ASA coding system stands to advance knowledge of attachment stability in adulthood and the distinctive caregiving correlates of adult attachment. Thus, we examined the stability of ASA deactivation, hyperactivation, and anomalous content over time and the predictive significance of these ASA dimensions for parenting outcomes.

Stability of attachment in adolescence and adulthood

Bowlby (1973) theorized that although attachment representations are open to revision given subsequent experience, attachment representations become increasingly resistant to change and thus are expected to be stable over time. In line with attachment theory, studies leveraging the AAI have demonstrated strong stability in secure-autonomous (vs. insecure) states of mind over a two-year period in normative-risk, adolescent samples (r = .56–.61; Allen et al., 2004; Zimmermann & Becker-Stoll, 2002), and moderate stability in AAI coherence over seven years in a high-risk, adult sample (r = .36; T. E. A. Waters et al., 2017). Findings from studies examining stability in secure base script knowledge (SBSK) assessed via the ASA and AAI have produced evidence for moderate to strong stability over periods spanning from one to twenty years in normative- and high-risk, adolescent and adult samples (r = .40–.65; Vaughn et al., 2006; T. E. A. Waters et al., 2017, 2019, 2020). Despite such evidence, little is known about the stability of other patterns of attachment. Indeed, only one study to date has reported on continuity of dismissing, preoccupied, and unresolved states of mind. Findings indicated continuity in 4-way (secure, dismissing, preoccupied, unresolved; 67%) attachment classifications (Zimmermann & Becker-Stoll, 2002). However, this study comprised a sample of adolescents, leaving open questions about the extent to which insecure and disorganized patterns of attachment are stable in adulthood.

Significance of adult attachment for parenting behavior

Adult attachment representations are expected to guide functioning within close relationships (Bowlby, 1973; Main et al., 1985), and the relationships adults establish with offspring are among the most widely studied given the centrality of parent–child relationships to attachment theory (e.g. Verhage et al., 2016). In particular, attachment representations in adulthood as assessed via the AAI and ASA are informed by the quality of caregiving individuals experienced in childhood from their parents (Steele et al., 2014), and in turn, are expected to guide the quality of care adults provide their offspring (Van IJzendoorn, 1995). Indeed, meta-analytic evidence indicates that AAI secure-autonomous attachment is modestly associated with mothers' observed sensitivity during interactions with their children (Verhage et al., 2016). Although fewer studies have examined links between SBSK and

parenting behavior, research to date provides evidence that parents' SBSK assessed within the ASA and AAI is associated with more sensitive and supportive parenting (T. E. A. Waters & Roisman, 2019).

However, similar to research on attachment stability, few studies have examined the significance of patterns of adult attachment other than security in relation to parenting behavior, representing a significant limitation of the attachment and parenting literature given that specific patterns of insecurity and disorganization are expected to have differential correlates with interpersonal behavior. In the handful of studies that exist, AAI dismissing states of mind have been linked with lower levels of sensitivity and parenting behavior indicative of detachment, including being remote and less supportive during interactions with children (J. Crowell & Feldman, 1988; Whipple et al., 2011). In contrast, AAI preoccupied states of mind have been linked with parenting behavior indicative of intrusiveness, including anger, hostility, intrusiveness, and lower autonomy support (Adam et al., 2004; Bosquet & Egeland, 2001; Whipple et al., 2011). Although meta-analytic evidence indicates AAI unresolved states of mind are associated with anomalous caregiving behavior (Madigan et al., 2006), less is known about the significance of indicators of disorganized attachment in adulthood for caregiving behavior in the normative range. In the only study conducted to date, mothers who were unresolved exhibited more anger and authoritarian parenting behavior with their preschoolers (Busch et al., 2008).

Adult attachment and the psychophysiology of parenting

The increasingly interdisciplinary nature of attachment research has contributed to the extension of research beyond caregiving behavior to the psychophysiology of parenting. Given the significance of infant crying for parent–child attachment relationships, several studies have examined the significance of mothers' attachment for autonomic physiological responding, particularly respiratory sinus arrythmia (RSA), when listening to infant distress vocalizations or interacting with infants in distressing caregiving contexts. In the current study, we examined mothers' RSA responding during the Still-Face Procedure (SFP; Tronick et al., 1978). In anticipating the expected pattern of RSA responding during the SFP, it is useful to consider that the SFP presents an interpersonal challenge to mother-infant dyads who are hierarchical relationship partners. Within this context, mothers are expected to serve as an external source of regulation to support their infant's social interaction and alleviate distress elicited by the procedure. Specifically, during the normal play episode, mothers are tasked with engaging infants in social interaction. Next, mothers are asked to refrain from interacting with infants and to have a neutral facial expression during the still-face episode, presenting a social disruption that elicits infant distress (Mesman et al., 2009). During the reunion episode, mothers are tasked with re- engaging infants in social interaction following the distressing social disruption (Tronick et al., 1978; Weinberg & Tronick, 1996).

In terms of RSA responding, as detailed by Groh and colleagues (Groh et al., this issue) decreases in RSA reflect withdrawal of parasympathetic control of the heart that allows for cardiac output and facilitates active coping and behavioral responding to environmental challenges (Porges et al., 1994). Increases in RSA are implicated in interpersonal and emotional connection, as well as empathy (Miller et al., 2016; Porges, 2007). During the SFP, on average mothers exhibit a quadratic pattern of RSA responding. Specifically, mothers exhibit lower levels of RSA during the normal play and reunion episodes, thought to reflect

physiological self-regulation that supports behavioral responding to infants. During the stillface episode, mothers exhibit higher levels of RSA, consistent with the constraint that mothers refrain from responding behaviorally and thought to reflect empathic responding to infant distress typically elicited by the social disruption (Ham & Tronick, 2006; Moore et al., 2009; Ostlund et al., 2017).

In a prior study drawing on the current sample, mothers higher on SBSK exhibited this pattern of dynamic change in RSA over the course of the SFP (Xu & Groh, 2023), consistent with the expectation that attachment security supports flexible emotion regulation when confronted with attachment-relevant challenges (Cassidy, 1994). In contrast, mothers lower on SBSK exhibited a blunted pattern of RSA responding during the SFP characterized by little change in RSA according to SFP episode. These findings align with the larger literature on attachment and RSA responding to infant distress in which higher (v. lower) levels of ASA SBSK and AAI secure (v. dismissing) attachment have been linked with larger decreases from rest in RSA when listening to and viewing infant distress (Ablow et al., 2013; Schoenmaker et al., 2015; cf.; Leerkes et al., 2015), a pattern of physiological responding expected to support responding to infant distress.

However, a limitation of research to date is that studies have only been positioned to consider the role of attachment security in RSA responding to parent–child attachment-relevant challenges. Specifically, the current coding system for the ASA only produces a single security-like dimension of SBSK and low representation of preoccupied and unresolved attachment in prior research precluded evaluation of the specificity of findings. Thus, it remains unknown which pattern of insecurity drives the associations identified in prior research. Here, we address this gap by examining the significance of ASA deactivation, hyperactivation, and anomalous content for mothers' RSA responding during the SFP. In anticipating which attachment pattern might be associated with less dynamic shifts in RSA during the SFP, it is useful to consider what this pattern of autonomic responding reflects in this context. Little modulation of RSA over the course of the SFP reflects limited mobilization of physiological resources to support behavioral and empathic responding to infant needs (Mills-Koonce; Xu & Groh, 2023). Attachment deactivation is characterized by a tendency to avoid, ignore, and/or reject attachment-relevant signals (Cassidy, 1994), and thus mothers higher on ASA deactivation might not be expected to modulate their RSA responding in a manner that would support behavioral and empathic responding to their infant in a distressing caregiving context. Indeed, smaller decreases in RSA when confronted with infant distress have been linked with attachment deactivation in adulthood and infancy (Ablow et al., 2013; Groh et al., 2019), although as noted above, low base rates of other attachment patterns precluded their examination (Ablow et al., 2013).

Current study

Research has provided evidence in line with attachment theory for the stability of attachment in late adolescence and adulthood and the significance of attachment for parenting behavior and physiology. However, across these literatures there is a gap in knowledge regarding the stability and predictive significance of patterns of insecure and disorganized attachment in adulthood. Indeed, given the resources required to administer and code the AAI, samples tend to be small and underpowered to examine dismissing, preoccupied, and unresolved patterns separately. Moreover, although the ASA offers a time- and cost-effective alternative

to the AAI, the current coding system lacks scales to evaluate variation in specific patterns of insecure and disorganized attachment.

By providing a way to evaluate these patterns of attachment in the ASA, the deactivation, hyperactivation, and anomalous coding system developed by Groh and Haydon (2021) has the potential to advance research on attachment stability in adulthood and the significance of adult attachment for parent-child relationship outcomes. Within the context of ASA narratives, deactivation indexes the presence of a script in which attachment- relevant themes and emotions are minimized, ignored and/or disregarded; hyperactivation indexes the presence of a script in which attachment-relevant emotions and problems are exacerbated; and anomalous content indexes the presence of a script in which attachmentrelevant problems create fear and/or disorientation. Importantly, these dimensions conceptually and empirically converge with AAI dismissing, preoccupied, and unresolved states of minds (Groh & Haydon, this issue; Groh et al., this issue). As such, Groh and Haydon's (2021) ASA coding system supplements ASA SBSK by providing a resource-effective way of evaluating individual differences in insecure and disorganized attachment representations in adulthood. Moreover, because all individuals are scaled on each dimension, statistical issues pertaining to small cell sizes for specific attachment patterns are avoided.

In a sample of mothers and infants we examined the stability and significance of ASA deactivation, hyperactivation, and anomalous content for parenting behavior and physiology and evaluated several pre-registered hypotheses (Haydon & Groh, 2020). In line with attachment theory and stability estimates from prior research (Allen et al., 2004; T. E. A. Waters et al., 2017; Zimmermann & Becker-Stoll, 2002; see; T. E. A. Waters & Roisman, 2019), ASA deactivation, hyperactivation, and anomalous content were expected to be moderately stable over time. Stability of ASA SBSK was also examined, with the expectation of replicating prior evidence of moderate stability.

Consistent with the handful of prior studies on the parenting correlates of AAI dismissing and preoccupied states of mind (Adam et al., 2004; Bosquet & Egeland, 2001; J. Crowell & Feldman, 1988; Whipple et al., 2011), mothers' ASA deactivation was expected to associate with detached parenting, whereas ASA hyperactivation was expected to associate with intrusive parenting. Given that AAI insecure states of mind and lower levels of ASA SBSK have been linked with lower levels of sensitivity, ASA deactivation and hyperactivation were expected to be associated with lower sensitivity. Although a wealth of research has examined AAI unresolved states of mind with anomalous caregiving behavior (Madigan et al., 2006), there is a dearth of research on parenting behaviors within the normative range. Thus, the relation between ASA anomalous content and sensitivity, detachment, and intrusiveness was explored. We also examined the significance of mothers' SBSK for all parenting behaviors. Following prior evidence (see T. E. A. Waters & Roisman, 2019), SBSK was expected to be associated with higher levels of sensitivity. Given that the majority of research has focused on adult attachment security in relation to sensitivity, we did not make *a priori* predictions regarding links between SBSK and other parenting behaviors.

Extending the literature on the psychophysiology of parent–child relationships, we examined the significance of ASA deactivation, hyperactivation, and anomalous content for mothers' RSA responding during the SFP. ASA deactivation was expected to be associated with less dynamic change in RSA over the course of the SFP, reflective of less modulation of RSA responding to support active coping with and behavioral responding to infant needs. To

control for variation in infant distress elicited by the SFP (Mesman et al., 2009), we included infant negative affect during the SFP in analyses.

Demographic variables (i.e. mother age, race/ethnicity, family income) and infant temperament were also examined as potential covariates.

Method

Participants

At the first time point, the sample comprised 142 mothers (*M* = 31 years; *SD* = 4.67) and their infants (*M* = 6.27 months, *SD* = 0.52; 51% female). The ethnic make-up of mothers was consistent with the small, mid-western city from which participants were recruited (78% White/European American, 9% Asian, 6% Hispanic/Latino, 4% Black/African American, 3% mixed/other ethnic backgrounds). Median family income was $61,000– $70,000 (range <$10,000 - >$100,000), and mothers were well educated (48% advanced degree, 37% college degree, 15% 2-year degree/high school degree). Additional funding allowed for follow-up of participants two years later, and 62 mothers participated in the second time point. The primary reason for attrition was movement from the research area. Mothers who participated in the second timepoint did not differ from those who did not in terms of demographic variables or ASA dimensions, *p*'s > .05.

Procedure

At the first time point, mothers completed the ASA and completed (1) an interaction protocol with their infant to observe parenting behavior while video recorded and (2) the Still-Face Procedure with their infant while video recorded and physiologically monitored. At the second time point, mothers completed the ASA.

Measures Attachment script assessment

Mothers' attachment representations at the first and second time points were assessed using the ASA (H. S. Waters & Rodrigues-Doolabh, 2004). The two adult ("*Camping Trip*" and "*The Accident*") and two child ("*Baby's Morning*" and "*Doctor's Office*") attachment stories were coded using 7-point scales for SBSK (α = .74), deactivation (α = .61), hyperactivation (α = .59), and anomalous content (α = .63; Groh & Haydon, 2021; H. S. Waters & Rodrigues-Doolabh, 2004), and scores for each dimension were averaged across stories within timepoint. See (Groh & Haydon, this issue) for details about these scales, which are available online (https://asainsecurecoding.weebly.com). Coders (AMG, KCH, MMP) overlapped on 20% of stories, and interrater reliability was high (*M ICC* = .89, range = .72–.95).

Coders did not code ASAs from the same participant at different timepoints. ASA data were missing for one mother due to a problem with the audio-recording device.

Parenting behaviors

Mothers completed a free-play interaction without toys and a toy-play interaction (9 min) with their infant. They were instructed to play as they normally do with their infant. During the toy play, mothers were provided with two toys (rattle, shape sorter) to play with in series (2 min

each). Mothers' sensitivity to distress, sensitivity to non-distress, intrusiveness, and detachment were assessed during the free play and toy play (separately) using 5-point scales adapted from those developed for the NICHD Study of Early Child Care and Youth Development (Frosch & Owen, 2016). Sensitivity to distress reflects the extent to which mothers respond promptly and appropriately to infant distress signals in a manner that is soothing for the infant. Sensitivity to non-distress reflects the extent to which mothers promptly and appropriately respond to children's social gestures, expressions, and signals. Sensitivity to distress and non-distress within interaction type were averaged to create a composite sensitivity score. Intrusiveness reflects the extent to which parents impose their agenda on their child or control the interaction, despite child signals that a different activity or pace of interaction is needed. Detachment reflects the extent to which parents are emotionally uninvolved and unaware of the child's need for appropriate interaction to facilitate involvement with objects or people. Parenting behaviors were coded by two independent coders for each interaction separately, and interrater reliability calculated on 30% of the interactions was high (*M ICC* = .89, range = .84–.95). Sensitivity, intrusiveness, and detachment during the free play and toy play were significantly correlated (r's = .27–.35, p's < .001). Thus, composite scores were created by averaging scores across interactions separately for each parenting variable.

Still-face procedure

Mothers placed infants in an infant seat and sat in a chair across from infants. During the normal play episode, mothers were instructed to interact with their infant as they normally do (2 min). After turning away (15 sec), the still-face episode began in which mothers turned back to infants and had neutral facial expression (2 min). After turning away (15 sec), the reunion episode began in which mothers turned back toward infants and allowed to interact as they normally would (2 min; Tronick et al., 1978). Three mother- infant dyads did not complete the SFP.

Physiological monitoring

Continuous recordings of mothers' autonomic physiological responding were acquired with a system consisting of two PCs, BioLab (v. 3.3.0) acquisition software, mobile cardiograph device, and EPrime (v.2) software furnished by MindWare Technologies (Gahanna, OH). To assess mothers' cardiac activity, electrodes were applied in a bipolar configuration, with one positioned on the right subclavicular and one positioned in the left iliac region. A ground lead was placed in the right iliac region. A belt that monitored respiration was applied around mothers' diaphragms. Autonomic physiological data were sampled at a rate of 500 Hz and a bandpass filter of 40 and 250 Hz was applied. MindWare HRV analysis software (v.3.1.0) was used to estimate RSA. RSA was operationalized as the natural log integral of the 0.12 Hz to 0.42 Hz power band and was calculated in 30-second epochs during each episode of the SFP. For each episode (normal play, still-face, reunion), RSA values from the 4, 30-second epochs were averaged within each two- minute episode.

Infant negative affect

The SFP was video recorded, and infant negative affect during each episode was coded offline. Infant negative affect was coded at 1-second intervals and operationalized as the infant crying and/or having a contorted mouth and lowered or tightened brows. Interrater reliability calculated on a random sample of 40% of the interactions was κ = .81. The total amount of

time the infant displayed negative affect during each episode was calculated and infant negative affect was computed as a percentage of total valid interaction time. A composite score of infant negative affect was created by averaging scores across episodes.

Infant temperament

Mothers reported on infant temperament via the Infant Behavior Questionnaire-Revised (Gartstein & Rothbart, 2003). Broad band factors of negative emotionality (α = .71), surgency (α = .79), and orienting regulation (α = .60) were extracted.

Data preparation and planned analyses

Prior to conducting analyses, data were examined for the presence of outliers and missingness. One mother's RSA value during the still-face episode was three standard deviations below the mean. To reduce undue influence of this score while retaining all participant data, this value was Winsorized, preserving the original order of the data (Tabachnik & Fidell, 2001). Missing data on the sample ranged from 0.7% to 6.5%. RSA data were missing for four mothers during normal play, nine mothers during still-face, and nine mothers during reunion of the SFP due to artifact resulting in insufficient data to estimate RSA or due to the SFP being discontinued because the infant became overly distressed. Data for infant negative affect were missing for three infants because the infant became overly distressed and the SFP was discontinued. Missing RSA and infant negative affect values were imputed using a single-imputation expectation-maximization algorithm in SPSS (v.26).

In line with a prior report published on this sample examining links between mothers' SBSK and RSA during the SFP (Xu & Groh, 2023), latent growth curve modeling was used to examine change in mothers' RSA responding during the SFP using Amos v.25.[1] Prior findings indicated that the best fitting model was one in which there were two latent factors that were allowed to covary with latter residuals regressed on the prior residual (i.e. E1→E2, E2→E3). Factor one reflected overall RSA level (i.e. intercept) and factor two reflected change in RSA levels over the course of the SFP (i.e. slope) with loadings estimated at 0, 1, and −1 for the normal play, still-face, and reunion episodes, respectively. Infant negative affect was standardized and entered as a predictor of both factors as a control. Separate models were conducted in which each ASA dimension was standardized and entered as a predictor of the intercept and slope of RSA during the SFP.

Results

Preliminary analyses

Descriptive statistics and associations among study variables are in Table 1. Descriptive statistics by ASA story and associations between ASA attachment variation and infant temperament are in Tables S1 and S2. Supporting the discriminant validity of the ASA coding system, deactivation, hyperactivation, and anomalous content were not significantly associated with infant temperament, and thus not considered further. Correlations among demographic and study variables were examined to identify potential covariates. Mothers' age was significantly associated with RSA during still-face and reunion episodes and mothers' ethnicity was significantly associated with intrusiveness. These variables were included as covariates in RSA and parenting behavior analyses, respectively. Because the pattern and significance of the findings were not altered, these variables were dropped and the more

parsimonious model is presented below. Although infant negative affect was not significantly associated with mothers' RSA during the SFP, it was included as a covariate in RSA analyses in line with prior research on mothers' responding within distressing parenting contexts to rule out the possibility that associations among variables are due to differences in the extent to which infants express distress.

Stability of ASA SBSK, deactivation, hyperactivation, and anomalous content

Table 1 presents the correlations among the ASA dimensions assessed at the first and second timepoints. In line with hypotheses, variation in mothers' SBSK (r = .39, p < .01), deactivation (r = .43, p < .01), hyperactivation (r = .40, p < .01), and anomalous content (.43, p < .01) assessed at the first and second timepoints was significantly associated. Findings demonstrate moderate stability in ASA SBSK, deactivation, hyperactivation, and anomalous content over a two-year period.

Significance of ASA dimensions for parenting behavior

Table 1 presents correlations among ASA variables and mothers' parenting behaviors. In line with hypotheses, ASA hyperactivation was significantly associated with higher levels of maternal intrusiveness (r = .17, p < .05) and ASA deactivation was significantly associated with higher levels of maternal detachment (r = .17, p < .05). ASA deactivation was also significantly associated with lower levels of intrusiveness (r = −.21, p < .01). Paralleling hyperactivation, ASA anomalous content was significantly associated with higher levels of intrusiveness (r = .20, p < .05). Mothers' SBSK was not significantly associated with either intrusiveness or detachment. Moreover, unexpectedly, SBSK, hyperactivation, and deactivation were not significantly associated with mothers' sensitivity. However, greater ASA anomalous content was significantly associated with lower levels of maternal sensitivity (r = −.17, p < .05).

Table 1. Descriptive statistics and correlations among variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
1. Mom Age	–																		
2. Education	.28**	–																	
3. Income	.40**	.25**	–																
4. Ethnicity	.16†	.08	.28**	–															
5. SBSK T1	−.08	.10	−.05	.12	–														
6. Hyp. T1	−.06	.03	−.03	−.02	−.14†	–													
7. Anom. T1	−.09	−.14†	−.16†	−.09	−.30**	.50**	–												
8. Deact. T1	.11	−.05	.10†	.15†	−.56**	−.26**	−.03	–											
9. SBSK T2	−.10	.04	.14	−.01	.39**	−.13	−.15	−.33**	–										
10. Hyp. T2	−.15	−.14	−.03	.05	−.12	.40**	.24†	−.18	−.02	–									
11. Anom. T2	−.05	.02	−.10	.00	−.32*	.28*	.43**	.00	−.24†	.53**	–								
12. Deact T2	.15	−.04	−.12	−.07	−.37**	−.04	.01	.43**	−.86**	−.02	.11	–							
13. Sens.	.03	.13	.14†	.09	.11	−.12	−.17*	−.06	−.13	−.06	−.03	.12	–						
14. Intru.	−.08	−.03	−.01	−.17*	.01	.17*	.20*	−.21**	.17	.11	.10	−.23†	−.50**	–					
15. Detach.	.03	−.16†	−.11	.00	−.15†	−.10	.08	.17*	−.02	−.08	−.07	.12	−.51**	−.23**	–				
16. RSA NM	−.12	.02	−.10	.04	.07	.04	.09	−.04	.07	.00	.11	−.13	.01	−.01	.06	–			
17. RSA SF	−.21*	.03	−.10	−.06	.16†	.19*	.02	−.18*	.01	−.11	−.04	−.09	.01	.16†	−.07	.65**	–		
18. RSA RE	−.18*	.05	−.06	.04	−.01	.13	.07	−.03	.03	−.06	.11	−.04	−.02	.09	.02	.79**	.67**	–	
19. Infant NA	−.04	−.21*	−.05	−.04	−.01	−.07	.01	.04	.13	−.12	.04	−.25*	−.44**	.14†	.21**	−.06	−.05	−.06	–
Mean (*SD; N*)	30.75 (4.67;142)	4.21 (1.00; 142)	7.05 (3.08; 142)	0.77 (0.42; 142)	3.87 (0.90; 141)	2.36 (0.78; 141)	2.38 (0.87; 141)	4.17 (0.91; 141)	3.85 (0.99; 62)	2.28 (0.61; 62)	2.37 (0.71; 62)	4.14 (1.00; 62)	2.90 (0.59; 142)	2.20 (0.63; 142)	1.89 (0.62; 142)	6.16 (1.03; 139)	6.17 (1.27; 139)	6.05 (1.10; 139)	0.49 (0.28; 139)

†$p < .10$; *$p < .05$; **$p < .01$.

T1 = first timepoint; T2 = second timepoint; SBSK = secure base script knowledge, Hyp. = hyperactivation, Anom. = anomalous content, Deact. = deactivation; Sens. = sensitivity; Intru. = intrusiveness; Detach. = detachment; RSA = respiratory sinus arrhythmia, NM = normal episode, SF = still-face episode, RE = reunion episode, NA = negative affect.

Significance of ASA attachment for mothers' RSA responding during the still-face procedure

Prior to adding ASA dimensions to the latent growth curve model for mothers' RSA during the SFP, an unconditional model was estimated that showed excellent fit, $\chi 2$ (2) = 0.62, p = 0.43, RMSEA = 0.00, CFI = 1.00. The estimated means and variances for the intercept and slope for RSA scores were significant. The intercept represented overall RSA level during the SFP. The slope indicated mothers exhibited an increase in RSA from the normal play to the still-face and a decrease in RSA from the still-face to the reunion. The significant variability in the latent intercept (SD = 0.98, p < 0.001) and slope (SD = 0.46, p < 0.001) indicated there were meaningful individual differences in mothers' overall level of RSA and change in RSA during the SFP.

Next, a conditional model was estimated with mothers' ASA deactivation and infant negative affect entered as predictors of the latent intercept and slope (Figure 1). As expected, there was a significant effect of mothers' ASA deactivation on the latent slope (β = −0.17, p < 0.05), indicating that mothers with higher (vs. lower) levels of deactivation exhibited less dynamic change in RSA over the SFP. Simple slopes analysis (Preacher, Curran & Bauer, 2006) revealed that mothers one standard deviation below the

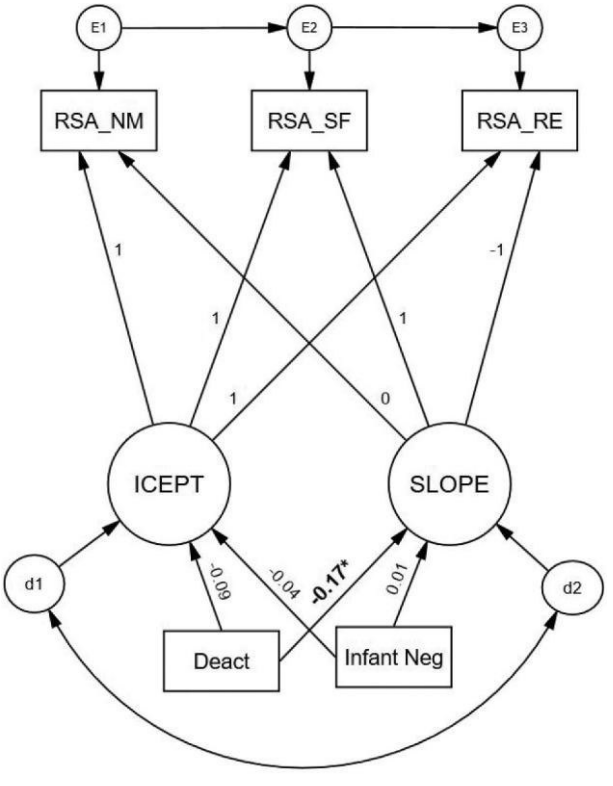

Figure 1. Model with standardized path coefficients for ASA deactivation (Deact) and infant negative affect (Infant Neg) predicting the intercept and the slope of mothers' RSA during the StillFace Procedure. *p < .05. *Note*. Model fit indexes: χ2 = 3.07, p = 0.55; CFI = 1.00; RMSEA = 0.00; RSA_NM = normal play RSA, RSA_SF = Still-Face RSA, RSA_RE = Reunion RSA.

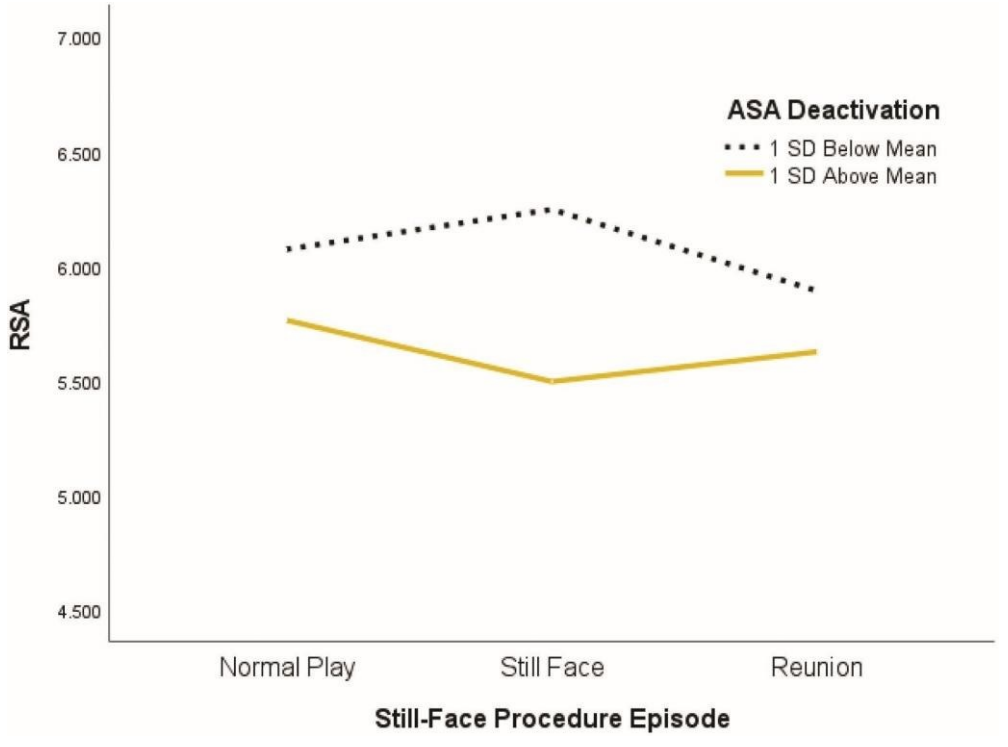

Figure 2. RSA during the Still-Face Procedure according to ASA deactivation.

mean on deactivation (n = 21) exhibited significant change in RSA over the course of SFP, b = 0.15, SE = 0.05, z = 2.82, $p < 0.01$, whereas mothers one standard deviation above the mean on deactivation (n = 21) did not, b = −0.01, SE = 0.05, z = −0.11, p = 0.91 (Figure 2). ASA hyperactivation and anomalous content were not significantly associated with the intercept or slope (see Figures S1 and S2). Note, sensitivity analyses with ASA deactivation, hyperactivation, and anomalous content added simultaneously to the model yielded the same pattern and significance of results (available upon request), but are not presented due to poor model fit.

Discussion

Two key questions in attachment research concern the extent to which attachment variation is stable and the significance of attachment for interpersonal functioning. These core questions were evaluated in this study by leveraging a novel coding system for the ASA to evaluate variation in deactivation, hyperactivation, and anomalous scripts (Groh & Haydon, 2021). Findings provide evidence for moderate stability in ASA variation over two years. Moreover, ASA dimensions exhibited theoretically anticipated correlates in parenting behavior and RSA responding during interactions with infants. Findings provide evidence supporting the validity of the ASA coding system, and indicate that it provides a useful tool for advancing research on attachment insecurity and disorganization in adulthood.

Stability of ASA deactivation, hyperactivation, and anomalous content

As expected, ASA deactivation, hyperactivation, and anomalous content exhibited moderate stability over a two-year period (r = .40–.43), consistent with the expectation that although attachment representations are open to revision, attachment variation is expected to exhibit some degree of stability over time. In addition to the novel ASA dimensions exhibiting comparable magnitudes of stability, the extent to which they were stable was also comparable to the magnitude of ASA SBSK stability in the sample (r = .39), as well as estimates of stability of SBSK assessed via the ASA and AAI established in prior reports (r = .40–.65; Vaughn et al., 2006; T. E. A. Waters et al., 2017, 2019, 2020).

These findings also extend the literature on attachment stability by documenting stability of patterns of attachment beyond those indexing attachment security in adulthood. Only a handful of studies to date have examined continuity of AAI dismissing and preoccupied states of mind (J. A. Crowell et al., 2002; Sagi et al., 1994), and even fewer have examined stability of unresolved states of mind (Zimmermann & Becker-Stoll, 2002). Although this research provided evidence for continuity, it comprised a sample of adolescents still living with their parents, which might account for the findings. Findings reported here indicate that insecure and disorganized attachment patterns captured by ASA deactivation, hyperactivation, and anomalous content exhibit moderate stability *in adulthood*, notably among women undergoing a period of significant life change (i.e. parenthood from infancy to toddlerhood). In light of such evidence, Groh and Haydon's (2021) ASA coding system, together with the established coding system for SBSK (H. S. Waters & Rodrigues-Doolabh, 2004), stands to advance research on attachment stability in adulthood. Indeed, in the short time since the introduction of the ASA, there are already several studies on SBSK stability (including 3 in the past 5 years; see T. E. A. Waters & Roisman, 2019). The resource-effectiveness of administering the ASA multiple times, coupled with coding systems that allow for evaluation of SBSK, deactivation, hyperactivation, and anomalous content, present an exciting opportunity to examine attachment stability across significant life transitions (e.g. transition to parenthood, marriage), the mechanisms that underlie such stability (e.g. Stern et al., 2018), and the experiences that contribute to lawful instability (e.g. Booth LaForce et al., 2014).

Significance of ASA attachment for parenting behaviors

Findings provided evidence that ASA hyperactivation, anomalous content, and deactivation hold significance for observations of mothers' parenting behaviors with infants. Mothers higher in hyperactivation exhibited more intrusive parenting behavior in free- and toy-play contexts, characterized by a tendency to control interactions despite signals of displeasure from the child. This finding converges with evidence from studies leveraging the AAI indicating that preoccupied states of mind are associated with intrusive and less autonomy supportive parenting (Adam et al., 2004; Whipple et al., 2011), supporting the predictive validity of ASA hyperactivation. Moreover, the hyperactivating attachment strategy thought to underlie AAI preoccupation and ASA hyperactivation is theorized to contribute to parenting behavior that draws the child's focus toward the parent, perhaps via prolonging negative emotionality to keep the child enmeshed with the parent
(Cassidy, 1994). Thus, AAI preoccupation and ASA hyperactivation might be linked with intrusive parenting because it draws attention toward parents' goals and desires and is likely

to elicit and prolong infant distress expressions, as it involves the parent continuing to engage in activities despite signals from the infant that a different activity or pace of play is needed (Frosch & Owen, 2016).

Findings also indicated that mothers exhibiting higher levels of ASA anomalous content were more intrusive when interacting with infants. Limited research has evaluated the significance of indicators of disorganized attachment in adulthood for parenting behaviors in the normative range. However, in one study, mothers classified as unresolved on the AAI exhibited more negative, authoritarian parenting towards their preschoolers (Busch et al., 2008). This evidence converges with findings presented here given that, similar to intrusive parenting, authoritarian parenting is characterized by behavioral control (Baumrind, 1966). Notably, findings from this study indicate that ASA hyperactivation and anomalous content are both implicated in intrusive parenting, in line with research on the latent structure of attachment indicating that unresolved and preoccupied states of mind load on the same latent factor (e.g. Raby et al., 2020).

In line with hypotheses, mothers' ASA deactivation was associated with higher levels of detachment when interacting with their infants. This finding converges with evidence from a prior study that mothers with dismissing states of mind exhibited more remote, less supportive parenting with their preschoolers (J. Crowell & Feldman, 1988). The deactivating strategy thought to underlie AAI dismissing attachment and ASA deactivation is theorized to be implicated in parenting that serves to minimize the child's expression of attachmentrelevant needs and emotions (Cassidy, 1994). In the free- and toy-play contexts examined here, detached parenting, characterized by emotional and behavioral unresponsiveness, might contribute to emotional minimization in children. This may occur via modeling, in which the child mirrors the limited affective displays of the parent, and via learning, in which the child decreases interaction bids over time given the parent's lack of responsiveness. Unexpectedly, ASA deactivation was also associated with lower levels of intrusive parenting, suggesting that mothers with higher levels of deactivation are less likely to be emotionally and behaviorally engaged with their infants, as manifested by fewer expressions of affect, limited provision of behavioral support, and little exertion of behavioral control.

A motivating factor in developing the ASA coding system for deactivation, hyperactivation, and anomalous content was to complement the established ASA SBSK coding system and facilitate the broader use of the ASA as a key narrative measure of adult attachment. Thus, we also examined the significance of SBSK for parenting behaviors to serve as a point of comparison. In contrast to the other ASA dimensions, mothers' SBSK was not associated with intrusive or detached parenting. Thus, these findings demonstrate the added value of the novel ASA coding system and its potential to extend attachment research beyond sensitive parenting to a broader range of parenting behaviors, a shift that would advance understanding of the differential significance of specific attachment patterns for parenting outcomes.

Regarding mothers' sensitivity during interactions with infants, ASA anomalous content was associated with lower levels of maternal sensitivity. Such evidence converges with metaanalytic evidence that AAI unresolved status is associated anomalous caregiving behaviors (Madigan et al., 2006), which can be characterized as extremely insensitive. Unexpectedly, ASA hyperactivation and deactivation were not associated with lower levels of sensitivity. Given that these attachment patterns were associated with intrusiveness and

detachment, findings might suggest that instead of contributing to lower quality parenting generally, ASA hyperactivation and deactivation contribute to specific forms of insensitive parenting behavior. Also unexpectedly, ASA SBSK was not associated with maternal sensitivity. Sensitivity in this study was observed while mothers interacted with infants in free- and toyplay contexts, and sensitivity in these contexts entails awareness of infant signals and facilitation of the child's engagement in play. Thus, ratings of maternal sensitivity in these contexts might not be particularly tied to mothers' SBSK because they do not require mothers' engagement in attachment-relevant secure base support. Indeed, in prior research linking mothers' SBSK with sensitive parenting, sensitivity was typically assessed in problemsolving/teaching tasks (Huth-Bocks et al., 2014; T. E. A. Waters et al., 2018).

ASA attachment variation and mothers' RSA responding during distressing interactions with infants

A growing body of research has demonstrated the significance of adult attachment for neural and autonomic physiological responding within attachment-relevant parenting contexts. Several studies have provided evidence that AAI insecurity and lower levels of SBSK are associated with less RSA reactivity – reflective of poorer self-regulation – to infant distress (Ablow et al., 2013; Schoenmaker et al., 2015; Xu & Groh, 2023). Findings from this study extend such evidence by providing insight into the specific pattern of insecure attachment driving such associations. Specifically, mothers' ASA deactivation, but not hyperactivation or anomalous content, was associated with less dynamic change in RSA over the course of the SFP. In interpreting this finding, it is noteworthy that in this report *deactivation* was linked with mothers' RSA responding, whereas Groh and colleageus (Groh et al., this issue) and Hayond and colleageus (Haydon & Groh, this issue) found that *hyperactivation* and/or *anomalous content* was associated with RSA responding during attachment-relevant challenges. These findings demonstrate that attachment variation is not tied to any one parameter of physiological responding, but instead that how attachment is associated with physiological responding depends on context. With that in mind, the SFP presents mothers with a challenging caregiving context that tasks mothers with re-engaging infants in interaction following a distressing social disruption (Ham & Tronick, 2006). In this context, the blunted pattern of RSA responding during the SFP exhibited by mothers' higher in ASA deactivation reflects limited recruitment of physiological resources to support responding to and empathy toward infants during this challenging context, converging with the expectation that attachment deactivation is characterized by a tendency to avoid, ignore, or reject infant attachment needs (Cassidy, 1994). Indeed, such evidence converges with findings reported here that ASA deactivation was associated with mothers' tendency to be detached when interacting with infants, as well as findings from prior research in which smaller decreases in mothers' RSA responding to infant distress have been documented among mothers with AAI dismissing (v. secure) states of mind and linked with greater infant avoidance (v. proximity seeking) in the Strange Situation Procedure (Ablow et al., 2013; Groh et al., 2019). ***Limitations***

We would be remiss if we did not note two limitations. First, because this study was not originally designed as a longitudinal study, attrition of mothers from the first to second time points is high. Notably, mothers who participated in the second time point did not differ from those who did not in terms of attachment variation or demographic variables. However, it is possible that other differences not evaluated here exist that may have affected the findings.

Second, although this study provided evidence for the significance of ASA anomalous content for parenting behavior in the normative range, given the nature of the sample and parenting behaviors assessed, this study was not well positioned to evaluate whether ASA hyperactivation and anomalous content have distinctive parenting correlates. Further research is needed leveraging higher-risk samples and parenting behaviors outside of the normative range that have been implicated in disorganized attachment (e.g. anomalous parenting).

Conclusion

Adult attachment research leveraging the AAI and ASA has yielded important insight into the legacy of attachment in adulthood (Hesse, 2008; T. E. A. Waters & Roisman, 2019). However, for a variety of reasons, research on adult attachment has been limited by a focus primarily on variation in (in)secure attachment representations. In addition to providing important validity evidence, findings from this study demonstrate the utility of Groh and Haydon's (2021) coding system for ASA deactivation, hyperactivation, and anomalous content in terms of evaluating core hypotheses in attachment theory with respect to patterns of insecure and disorganized adult attachment. Together with the coding system for ASA SBSK (H. S. Waters & Rodrigues-Doolabh, 2004), this novel coding system has the potential to advance attachment theory and research within and beyond the literatures on attachment stability and parent–child relationship functioning.

Note

1. The analytic strategy is informed by a prior report on this sample (Xu & Groh, 2023), and deviates from the pre-registered analytic plan that pre-dated the report. However, hypotheses are consistent with the pre-registration.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The authors were supported by funding from the NSF [AMG & MMP: 2017920; KCH: RUI 1650694] and the NIH [AMG & MMP: R01HD108218]; Research was supported by the University of Missouri's Research Board and Dr. Richard Wallace Faculty Incentive grants to AMG.

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Data deposition statement

A de-identified dataset and SPSS syntax are available by request from the first author.

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