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Validity of the Emotional Attachment Zones Evaluation (EA-Z): Assessing Attachment Style Across a Developmental Spectrum

Hannah E. Wurster and Zeynep Biringen

Abstract

Sensitive, consistent caregiving and a secure attachment style are important to healthy child development. However, the lack of continuity in measures from infancy into adulthood limits conclusions regarding the stability of attachment styles across the lifespan. A new measure, the Emotional Attachment Zones Evaluation (EA-Z), derived from the Emotional Availability Scales (Biringen, 2008; Biringen, Robinson, & Emde, 1998), offers a tool to assess attachment style across a broad developmental spectrum. In order to validate this measure as an attachment style measure, we used three studies to compare the EA-Z to empirically validated attachment tools. In study 1, we compared the EA-Z to the Strange Situation Procedure. There was moderate concordance between these two measures for both mother and infant. In study 2, we compared the EA-Z to the Attachment Q-Sort in an infant/toddler childcare setting. Child EA-Z scores related to child attachment security, whereas teacher EA-Z scores did not relate to child attachment security. Finally, in study 3, we compared the EA-Z to the mother's Adult Attachment Interview. Results indicated moderate concordance between these measures, both for the adult mother and the preschool child. All three of these studies offer promising evidence for the validity of the EA-Z as an attachment tool, as well as future directions for research and practice using the EA System.

Keywords: *Attachment, Emotional Availability, Measurement, Validation, Child Development, Family Relationships*

Introduction

Attachment Theory

Attachment theory posits that the bond between a primary caregiver and child serves not only to ensure the survival of an otherwise vulnerable infant but also to offer the developing child an internal working model of herself and her social world (Bowlby, 1969; Bretherton, 1990). Further, this attachment bond grants infants a secure base from which to explore the world safely and a safe haven that offers comfort when distressed. However, the degree to which children explore comfortably versus seek out their caregiver varies based on the nature of the parent-child relationship (Ainsworth, 1967; Ainsworth, Blehar, Waters, & Wall, 1978). Caregivers who are consistently responsive to child cues, yet supportive of autonomy and exploration, promote a secure caregiver-child attachment, which is characterized by the child showing a balance of exploration and caregiver-seeking behaviors.

In contrast, caregivers who are inconsistently responsive and less supportive of autonomy-seeking behaviors promote an insecure-resistant/anxious attachment, in which children explore minimally and often use negative emotions to maintain a connection with the caregiver. Caregivers who reject a child's bids for connection, are consistently unresponsive, and emphasize autonomy without connection foster an insecure-avoidant attachment. Children with this attachment seek little connection with a caregiver and appear to explore, yet are less comfortable doing so (Ainsworth et al., 1978). Finally, in the context of abuse, chaotic family life, or parental unresolved trauma, children are at risk for a disorganized attachment. Caregivers may show frightening behaviors, fearful emotions, dissociation, or highly intrusive behaviors, and children display contradictory behaviors, approaching a caregiver for comfort while also avoiding him or her out of fear or uncertainty (Main & Solomon, 1986).

Child attachment style predicts later outcomes. A child's attachment style to her primary caregiver is reflective of the quality of that relationship, yet it also predicts the individual's sense of

self and social-emotional development. In line with the concept of internal working models, an individual's attachment style influences the way he processes social information (Dykas & Cassidy, 2011). Across the lifespan, individuals with a secure attachment process social information with a positive bias, whereas those with an insecure attachment are more likely to process social information with a negative bias (Dykas & Cassidy, 2011).

A child's secure attachment predicts greater emotional regulation, self-esteem, and school engagement later in childhood (Drake, Belsky, & Fearon, 2014; Sroufe, 1983; 2000). It is also associated with greater social competence, fewer externalizing behaviors, and fewer internalizing symptoms (Groh, Fearon, van IJzendoorn, Bakermans-Kranenberg, Roisman, 2017). Moreover, the ability of a child's primary caregivers to be consistently and sensitively responsive predicts later child functioning. In other words, not only does a parent's sensitivity predict the child's attachment style, but it also directly relates to the child's later positive social-emotional and cognitive outcomes (Friedman & Boyle, 2007; NICHD Early Child Care Research Network, 2006; Roelofs, Meesters, ter Huurne, Bamelis, & Muris, 2006).

In contrast, children with an insecure attachment style during infancy are at a greater risk for relational challenges and social-emotional problems during later childhood (Groh et al., 2017; Sroufe, 1983; 2000). Specifically, insecure-avoidant children are at a heightened risk for poorer social competence, greater externalizing problems, and more internalizing symptoms (Groh et al., 2017). Children with an insecure-resistant/anxious style are likely to have lower social competence (Groh, 2017). A disorganized attachment in infancy poses a unique risk for hostility, aggression, and other externalizing problems (Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley, & Roisman, 2010; Groh et al., 2017).

The predictive value of early attachment relationships extends into adolescence and adulthood. A history of secure attachment is associated with greater social competence and more efficient emotional regulation during adolescence (Carlson, 1998; Sroufe,

1997; 2000; Warren, Huston, Egeland, & Sroufe, 1997). In contrast, adolescents with a history of insecure attachment continue to be at risk for negative social-emotional outcomes (Carlson, 1998; Groh et al., 2017; Ogawa, Sroufe, Weinfield, Carlson, & Egeland, 1997; Sroufe, 2000). Finally, a disorganized attachment during infancy predicts dissociative symptomatology during adolescence, and disorganization is a partial mediator between an individual's early trauma and later dissociative symptoms (Lyons-Ruth, 2015). Into adulthood, early insecure attachment contributes to a cognitive coping style that puts individuals at risk for depressive symptomatology following stressful situations (Morley & Moran, 2011). Further, a history of an insecure attachment style relates to anxiety, excessive reassurance seeking, and lower relationship quality with one's romantic partner during adulthood (Shaver, Shachner, & Mikulincer, 2005).

It is important to note that many of the effect sizes linking a child's attachment style to later outcomes are small or moderate in size (Friedman & Boyle, 2007; Groh et al., 2017). Further, it is difficult to determine whether long-term effects are due to early attachment relationships or to continuity in the caregiving experience or family-level variables (Groh et al., 2017). Therefore, many researchers have examined how attachment interacts with other child and family-level factors. Its effect on school engagement is mediated by improvements in self-regulation (Drake et al., 2014). Child temperament and family-level risk also play a role. For example, children who have both an uninhibited temperament and an avoidant attachment style are at a particularly elevated risk for externalizing behaviors in early childhood (Burgess, Marshall, Rubin, & Fox, 2003). Further, secure mother-child attachment can also serve as a protective factor against the development of anxiety in the context of stressful life events (Dallaire & Weinraub, 2007). Next, a secure attachment with one parent can serve as a protective factor against later negative outcomes, even when the child has insecure attachment with the other parent (Boldt, Kochanska, Yoon, & Nordling, 2014; Kochanska & Kim, 2013). In summary, although a child's attachment style is an

important predictor of later outcomes, it is not a sufficient or necessary cause. Rather, it interacts with many other risk and protective factors in driving development (Friedman & Boyle, 2007; Groh, 2017).

Individual differences in attachment. In sum, the literature on attachment theory supports the argument that a child's early attachment style contributes to his or her later social and emotional development, even into adolescence and adulthood. However, longitudinal studies tracing these specific pathways have been mixed, with some studies supporting the stability and predictive value of infant attachment style for later development (Hamilton, 2000; Main, Hesse, & Kaplan, 2005), and others finding low stability in attachment security (Fraley, 2002; Groh et al., 2014; Lewis, Feiring, & Rosenthal, 2000). What remains unclear from these mixed findings is whether an individual's true attachment style actually changes across the lifespan, due to relational changes or psychosocial stress, or whether the measurement tools used in these studies lack continuity (Groh et al., 2014).

Attachment assessment tools vary in whether they assess attachment security in a categorical or continuous manner, and the methods used vary from observational to questionnaires and semi-structured interviews. Such changes are often necessary, for methods used to measure an infant's experience of a caregiving relationship (i.e., brief separation and reunion) are often not the same as those used for an older child. Additionally, as individuals grow older, it becomes possible to learn about their internal representations of attachment relationships, rather than their dyadic attachment style in the context of one specific relationship (Bretherton & Oppenheim, 2003; Robinson, 2007). For these reasons, many studies examining attachment longitudinally use a variety of different tools. However, this can create challenges in determining the stability of an individual's dyadic attachment relationships or internal working model over time (Groh et al., 2014).

The Strange Situation Procedure (SSP; Ainsworth et al., 1978) is considered the gold standard tool for assessing an infant's (12 to

24 months) attachment style with one caregiver. The SSP consists of a series of separations and reunions between a primary caregiver and infant; these separations are designed to cause stress to the infant, activating the attachment system. With the system activated, an observer can note how effectively an infant uses his caregiver to soothe distress, which is indicative of the infant's attachment style (Ainsworth et al., 1978). This tool has been adapted for use among preschool aged children (Britner, Marvin, & Pianta, 2005) and 6-year-olds (Main & Cassidy, 1977), and the procedure is modified. The length of separation is increased; characteristics of the stranger are changed (e.g., a male instead of a female); or the reunion with the stranger is eliminated (Solomon & George, 1999). These modifications are implemented in order to introduce sufficient stress and activate an older child's attachment system.

Although the SSP can be adapted for preschool aged children, the Attachment Q-Sort (AQS; Waters & Deane, 1985), a tool that can be used with children ranging from 12 months to 5 years, is often the assessment of choice for this age group. The AQS is also an observational method, but it takes place in a naturalistic setting, most often the home. A trained observer watches how the child behaves, expresses emotions, and interacts with a target caregiver. The observer then categorizes 90 statements about a child's behavior. For example, one statement reads, "When child finds something new to play with, he carries it to mother or shows it to her from across the room." The observer ranks the statements from "most descriptive of child" to "least descriptive of child." The resulting description of the child is then correlated with a behavioral profile of a stereotypical secure child, as described by attachment experts. Using the same process, observers also assign each child a dependency score. This tool does not discriminate among the insecure styles (Waters & Deane, 1985). In addition to the home, studies also have used the AQS successfully in child care settings (e.g., Biringen et al., 2012; Cassibba, van IJzendoorn, & D'Odorico, 2000).

As children grow older and internalize their relational experiences as internal working models, it becomes possible to measure these inner representations. This is done through a variety of story-stem methods that use fictional stories (e.g., Bretherton & Oppenheim, 2003; Robinson, 2007). Children are asked to complete an emotionally charged or attachment-related story through play or words. Their responses are coded based on content, coherence, and the child's behavior. Children's storytelling can offer insight into the ways in which they represent relationships and their social world. Children with secure attachment relationships tend to tell stories with pro-social content and positive resolutions (Laible et al., 2004).

During adolescence and adulthood, attachment representations and behaviors are assessed through self-report measures (Bartholomew & Horowitz, 1991; Brennan et al., 1998; Fraley, Waller, & Brennan, 2000; Hazan & Shaver, 1987) or through the Adult Attachment Interview (AAI; George et al., 1984; 1985; 1986; Hesse, 2008). Self-report measures assess an individual's conscious thoughts and behaviors in current and past relationships. The AAI, in contrast, assesses emotionally-charged implicit memories regarding early attachment relationships. Therefore, unsurprisingly, the overlap between these approaches is small (Roisman et al., 2007). Further, attachment styles gleaned from self-report measures predict different behaviors and psychosocial factors than do styles gleaned from the AAI (Roisman et al., 2007). Thus, it seems that self-report measures of attachment style and the AAI may measure different constructs. Finally, neither tool uses behavioral observation to determine attachment style.

Therefore, although attachment is relevant to an individual's well-being and mental health across the lifespan, there is not yet a single assessment tool that can provide a consistent measure over time. The concordance among various attachment measures tends to be moderate to high, yet not high enough to feel confident that they measure exactly the same construct. Security scores on the AQS are related to SSP-measured attachment security at $r = .31$

(van IJzendoorn et al., 2004). Attachment security assessed by the AQS is a strong predictor of children's security score on representational story-stem tasks, $r = .54$ (Waters, Rodrigues, & Ridgeway, 1998). As mentioned above, the overlap between self-report attachment measures and the AAI is very small, $r = .09$ (Roisman et al., 2007). The moderate and inconsistent concordance among these various measures may partially explain the limited stability in attachment style that is often found in longitudinal studies (e.g., Groh et al., 2014)

A New Approach: Attachment Measured with the Emotional Availability (EA) System

Given the lack of continuity in attachment measurement tools across the lifespan, as well as mixed conclusions about the stability of attachment styles, there is a need for a tool that can measure attachment across a broad developmental spectrum. The Emotional Attachment Zones Evaluation (EA-Z; previously called Clinical Screener; Baker, Biringen, Meyer-Parsons, & Schneider, 2015; Biringen, 2008; Espinet, Jeong, Motz, Racine, Major, & Pepler, 2013) is relatively new tool used in conjunction with the Emotional Availability Scales (EA Scales; Biringen, 2008; Biringen, Robinson, & Emde, 1998).

The EA Scales examine six dyadic qualities of relationships using semi-continuous/ dimensional observational scales: adult sensitivity, adult structuring, adult non-intrusiveness, adult non-hostility, child responsiveness, and child involvement. In doing so, the EA Scales move beyond attachment behaviors demonstrated by the adult and child in order to include qualities relating to affective expression and control-related aspects of the relationship. This includes the capacity of an adult to express a healthy range of mostly positive emotions (sensitivity), to support learning and autonomy (structuring and non-intrusiveness), and to regulate the expression of his or her own negative emotions (non-hostility). This is important, for the correlation between measures of sensitivity and attachment security is sometimes fairly small, $r(1,097) = .24$ (De Wolff & van IJzendoorn, 1997). Also, other aspects of parent-child relationship

quality, such as structuring and autonomy support, are relevant to child development (Bernier, Carlson, & Whipple, 2010; Saunders, Sarche, Trucksess, Morse, & Biringen, under review).

Further, the EA System considers both the parent and child side of the same relationship. The system takes into account not only the child's ability to use the caregiver to manage distress, but also the child's range of emotional expression, autonomy-seeking behaviors, and proclivity to involve the adult in his or her world (Biringen, 2008; Biringen et al., 1998). Thus, the EA Scales can be considered a broad view of the adult-child relationship, one that considers not only attachment-related behaviors, but also emotional expression and behaviors that occur outside of stressful contexts (Biringen et al., 2014). In fact, the assessment of EA can be completed in a variety of observational settings, including play, center-based care, separation-reunion contexts, and with multiple caregivers or with multiple children in the same context (Biringen et al., 2014). Furthermore, the EA Scales were theoretically conceptualized as a life-span construct and for use in parent-child relationships across infancy, childhood, and adolescence (Biringen et al., 2014). The scales were developed some time ago and were designed and empirically validated for caregivers and children between 0 and 14 years old (Biringen et al., 2014; Biringen, Robinson, & Emde, 1993; 1998). They are currently the most commonly used measurement tool of caregiver-infant relationship quality (Lotzin et al., 2015) and have been used in over 20 varied cultural contexts including western as well as non-western societies (Biringen et al., 2014) and caregivers, including mothers, fathers, child care providers (Biringen et al., 2014), therapists (Söderberg et al. 2013), and adult caregivers of those with dementia (Cohen, Palgi, & Sher-Censor, 2019). Although they have mostly been examined for parents and infants and young children, the system has also been used with parents and older children (e.g., Easterbrooks, Bureau, & Lyons-Ruth, 2012), parents and adolescents (e.g. Benton, 2017; Biringen et al., 2010) adolescent mothers and young children (Easterbrooks, Chaudhuri, & Gestsdottir, 2005), and expectant mothers as they speak to and

about their unborn fetus using specific prompts (Salo et al., 2019). They are also being further explored for use in relationships between a parent and his or her adult child (Flykt & Biringen, 2016). The wide use of the EA Scales suggests promise in the system's applicability across a wide developmental spectrum.

Emotional Attachment Zones Evaluation. Whereas the EA Scales have been described in close to 300 research publications and in approximately 25 cultures (Biringen et al., 2014), the Emotional Attachment Zones Evaluation (EA-Z) is fairly new. It relies heavily on two of the EA Scales, adult sensitivity and child responsiveness, to classify each member of the dyad into four continuous attachment-like zones: emotionally available (secure), complicated (insecure-resistant/ambivalent), detached (insecure-avoidant), and problematic/disturbed (insecure-disorganized). When the adult expresses mostly positive emotions, is consistently responsive to child cues, and is accepting of the child, he or she is rated as emotionally available. An adult who demonstrates inconsistencies in emotional expression and responsiveness to the child is categorized as complicated. An adult who is emotionally withdrawn or harsh and often unresponsive to child cues is classified as detached. Finally, an adult who appears traumatized, frightening, and/or blatantly unresponsive to child cues is categorized as problematic/disturbed.

Similarly, a child who shows positive emotions, responds appropriately to the adult, and pursues autonomy is classified as emotionally available. A child who is often distressed, overconnected, and/or dependent on the adult is classified as complicated. A child who is distant, emotionally shut down, and avoidant of the adult is classified as detached. Finally, a child who appears traumatized, dissociative, highly emotionally dysregulated, and/or exhibits contradictory approach/withdraw behaviors (e.g., approaching parent with hands held upward and face turned away) toward the adult is considered problematic (Biringen, 2008; Main & Solomon; 1986).

When directly scored, the EA-Z is coded using specific guidelines that describe each of the four zones of attachment, yet it is

not coded in isolation (Biringen, 2008). Rather, an observer codes the EA Scales and the EA-Z in conjunction in order to incorporate all relevant information. In doing so, the coder relies heavily on the sensitivity and child responsiveness EA dimensions. However, the observer also incorporates a degree of judgment based on other aspects of the interaction. For example, a child who displays high levels of anxiety toward the caregiver yet responds in a secure manner to a separation-reunion paradigm may nonetheless be categorized in the "emotionally available" zone of the EA-Z, albeit on the lower end of that zone. Additionally, a caregiver who displays high levels of hostility and intrusiveness but appears competent in responding to basic child cues may still be categorized as "problematic." Thus, an observer uses the sensitivity and responsiveness EA scores as a starting point for determining EA-Z score, yet can flexibly consider other aspects of the interaction to most accurately assign a score.

Further, the EA-Z offers an advantage in that it provides both a categorical and continuous/dimensional score for attachment security. Interventions targeting the attachment relationship are often more successful at enhancing caregiver sensitivity than changing child attachment classification (Bakermans-Kranenberg, van IJzendoorn, Juffer, 2003). Using a more fine-tuned, continuous measure of child attachment security may offer more sensitivity to change following intervention (Bakermans-Kranenberg et al., 2003). For example, even if a child classified as "complicated" is not classified as "emotionally available" following an intervention, his EA-Z score may have improved within the "complicated" zone.

In summary, the EA-Z offers a tool to assess caregiver-child attachment style across a wide developmental spectrum, and in a variety of observational contexts. This tool has the potential to address the discontinuity in measurement tools that are used to assess attachment style longitudinally. Therefore, it is important to determine whether the EA-Z is indeed an empirically valid tool to measure attachment style. Espinet and colleagues (2013) compared EA-Z scores to dyadic scores on the Parent-Infant Relationship

Global Assessment Scales (PIR-GAS; ZERO TO THREE, 2005), a validated measurement of overall parent-child relationship quality, and their results indicated a moderate association between the two tools. However, studies have not yet examined the link between the EA-Z and observed attachment.

Further, numerous studies have demonstrated significant links between dimensions of the EA Scales and child or parent attachment security, with children ranging from 1 month to 8 years (e.g., Altenhofen, Clyman, Little, Baker, & Biringen, 2013; Biringen et al., 2012; Kim, Chow, Bray & Teti, 2017; Sagi, Koren-Karie, Gini, Ziv, & Joels, 2005). Although these studies did not directly use the EA-Z, this tool is derived from the sensitivity and responsiveness dimensions of the EA Scales (Biringen, 2008), and many of these studies found relations between attachment-based measures and those two dimensions.

Taken together, several characteristics of the EA System set it apart from other observational systems (Saunders, Krause, Barone, & Biringen, 2015). The EA Scales and the EA-Z can be coded in short time intervals, with any age group, and in any observational setting; this sets them apart from longer observations, such as the AQS and Maternal Behavioural Q-Sort (MBQS; Pederson, Moran, & Bento, 1999), as well as from more structured and age-limited assessments, such as the SSP. Next, the EA Scales and EA-Z code the adult and child simultaneously, yet separately (Biringen, 2008). This means that the parent and child are can (potentially) have differing perspectives of the same relationship. The separation of the parent and child side of the relationship is especially important as the child grows older and has outside experiences that differ markedly from the experiences the child has with a specific parent. It is also relevant when a child comes into a specific parent-child relationship with prior significant experiences (e.g., foster care, adoption). Such experiences may affect or “be brought into” the target parent-child relationship (Biringen, Harman, Saunders, & Emde, 2017).

Further, the EA Scales and EA-Z place a priority on affect, coding not only behavioral responsiveness, but also emotional responsiveness

and regulation. This sets the system apart from more behaviorally-focused attachment measures, such as the MBQS, SSP, and AQS. Finally, EA considers multiple aspects of parent and child emotions and behaviors that extend beyond a sole focus on sensitivity or on general relationship quality (e.g., Parent-Infant Relationship Global Assessment; PIR-GAS; ZERO TO THREE, 2005). This is informative not only for obtaining a multidimensional view of the relationship, but also in determining attachment style (Saunders et al., 2015).

Hypotheses

Therefore, although many studies have found relevant relations among dimensions of EA and measures of attachment style, there has yet to be a study that explicitly examines the validity of the EA-Z in assessing child and parent attachment styles across a broad developmental spectrum. Here, we present a series of studies in which we aim to validate the EA-Z as an attachment tool by comparing it to a range of empirically-validated attachment tools, the Strange Situation Procedure (SSP; Ainsworth, 1978), the Attachment Q-Sort (AQS; Waters & Deane, 1985), and the Adult Attachment Interview (AAI; George et al., 1984; 1985; 1986). As such, we hypothesize that:

1. Child attachment security, as assessed through the SSP and the Attachment Q-Sort, will be associated with caregiver score on the EA-Z.
2. Child attachment security, as assessed through the SSP and the Attachment Q-Sort, will be associated with child score on the EA-Z.
3. Parent attachment security, as assessed through the AAI, will be associated with parent score on the EA-Z.
4. Parent attachment security, as assessed through the AAI, will be associated with child score on the EA-Z.

Study 1: EA-Z and The Strange Situation Procedure

Participants

Participants consisted of 36 mother-infant dyads living in the Western U.S., recruited via telephone through local newspaper birth announcements in 1998-1999. Over 90% of mothers contacted consented to participate in the study.

Table 1:
Basic descriptives for study 1

	Minimum	Maximum	Mean	Standard Deviation (SD)
Mother's age	23.00	42.00	32.56	5.00
Father's age	25.00	43.00	34.28	4.61
Child's age (months/rounded up or rounded down as half months)	1.70	12.00	13.70	0.49
Family income	3.00	7.00	6.46	0.95
Mother's education	3.00	7.00	5.08	1.02

Note. Family income: (1= less than \$5,000, 4=\$15,000-\$20,000, 7=greater than \$50,000); Mother's education (1=less than 7 years, 4=up to 3 years of college, 7=beyond master's degree)

As shown above in Table 1, both mothers and fathers on average were in their early thirties. Mothers were highly educated, with nearly all holding a bachelor's degree or beyond. Infants ranged from 12 to almost 14 months at the time of informed consent, and 15 (41.67%) were female. Infants were a combination of first- and later-born. Additionally, mothers reported on ethnicity, with all being non-Hispanic White (Caucasian), with the exception of nine who did not respond to this question.

Procedure

Prior to recruitment and data collection, this study was reviewed and approved by the university's institutional review board. Data collection was conducted over three years ago, so the protocol has been archived by the institutional review board. When infants were between 12 and 14 months old, mother-infant dyads were observed in their homes for a total of two hours, one hour on two separate days. Mothers were instructed to go about their regular routine, but to avoid having visitors or other family around and to avoid going outdoors. Home observations were videotaped and coded using the EA Scales (3rd ed., Biringen et al., 1998). The week after home observations, mother-infant dyads were invited into the laboratory to complete the Strange Situation Procedure (SSP; Ainsworth et al., 1978). The SSP was scored by different coders than the EA Scales, and both sets of coders were blind to other aspects of the data.

Measures

Emotional Availability Scales. The EA Scales (3rd ed., Biringen et al., 1998) consist of four adult scales (sensitivity, structuring, non-intrusiveness, and nonhostility) and two child scales (responsiveness and involvement). For the purposes of this study, only adult sensitivity and child responsiveness were included in analyses, for they offer the most salient information regarding attachment, especially when using secondary data analysis. Adult sensitivity encompasses the caregivers' positive emotional expression, ability to read child cues, timing and flexibility of responsiveness, and acceptance of the child. Highly sensitive adults demonstrate a wide range of mostly positive emotions, read cues effectively, and respond consistently and effectively. Sensitivity was scored on a 9-point semi-continuous scale, where 1 is least sensitive and 9 is most sensitive. It is important to note that, in the 4th edition of the EA Scales, sensitivity was revised to a 7-point scale. In the 3rd edition, scores between 5.5 and 9 were considered on the upper end of sensitive, and scores between 7 and 9 only indicated differences in positive emotional

expression. Therefore, for the purposes of this study, scores between 7 and 9 will be considered “highly sensitive” and transformed to the highest score on the EA-Z.

Child responsiveness refers to the child’s positive emotions, responsiveness to the adult’s bids for connection, and tendency to seek age-appropriate autonomy. Highly responsive children express mostly positive emotions, use the adult to help regulate negative emotions, respond often to the adult, and seek autonomy. Child responsiveness was scored on a 7-point semi-continuous scale, where 1 is lowest and 7 is highest. The EA Scales have been used in a wide variety of settings, with many ages, and in many cultural contexts. Evidence of their validity can be found in Biringen et al. (2014). For this study and all other studies presented here, EA coders were centrally trained by the developer of the scales. Training consists of a 3 day (live or online) seminar, followed by a rigorous reliability training in which the trainees code seven parent-child interaction videos until they are reliable with the EA System (Biringen, 2008).

For this study, coders scored the EA Scales after every 15 minutes of observation, resulting in 8 sets of EA scores for each dyad (i.e., a set of scores after initial 15 minutes, a set after 30 minutes, a set after 45 minutes, and so forth). To check inter-rater reliability, the first 15 minutes of the initial 10 cases were coded by two coders and intraclass correlations for each scale were: sensitivity (.97, $p < .001$), structuring (.95, $p < .001$), nonintrusiveness (.37, $p = .25$), nonhostility (.96, $p < .001$), child responsiveness (.90, $p = .001$), and child involvement (.99, $p < .001$). The intraclass correlation for the nonintrusiveness scale is low partially due to low variability in scores (Coder 1: $M = 4.95$, $SD = .16$; Coder 2: $M = 4.6$, $SD = .52$). Percent agreement between the two coders was 70% within 0.5 point and 100% within 1 point. For this study, after an initial reliability check on the first 10 cases, the second author (blind to the outsourced SSP coding) scored all home observations. Please note that data analysis is based on the full two hour observations.

Emotional Attachment Zones Evaluation. The 3rd edition of the EA Scales did not include guidelines for scoring the EA-Z. Therefore, for

the purposes of this study, EA-Z zones and scores were derived directly from the sensitivity and responsiveness EA Scale codes using a standardized algorithm (see Table 2). These two scales were used because they consider the most salient attachment-relevant information for the parent and for the child. Further, in the later development of the EA-Z for the 4th edition of the EA Scales, these two scales are considered the primary sources of information. In general, we recommend directly coding the EA-Z whenever possible so that coders can consider additional EA qualities besides sensitivity and responsiveness when assigning scores and zones. However, when the EA-Z has not been directly coded, it is appropriate to use sensitivity and responsiveness from previously coded EA Scales in order to derive EA-Z codes with the standard algorithm provided here.

In order to transform adult sensitivity and child responsiveness scores into EA-Z scores, a simple algorithm was applied (see Table 2), for the parent and then for the child. The algorithm matched the EA-Z continuous scores, which range from 1 to 100, with scores on the EA Scales. The algorithm also categorized EA scores into the four EA-Z zones, “emotionally available,” “complicated,” “detached,” and “problematic/disturbed.” On the EA Scales, a score between 5.5 and 9 on sensitivity and between 5.5 and 7 on responsiveness is “emotionally available.” Scores between 3.5 and 5 on sensitivity/responsiveness are “complicated,” scores between 2.5 and 3 are “detached,” and scores 2 and below are “problematic/disturbed.” Please note that the adult and the child each receive their own EA-Z score and zone. This permits large or small differences between parent and child, such as a child who is highly emotionally available, with a score of a 100, and a parent who is emotionally available but slightly less sensitive, with a score of 85. Further, a child and parent may even be scored in different attachment zones, such as a complicated parent and a detached child. However, it is challenging to conceptualize one member of the relationship as “emotionally available,” while the other is not, given EA is a relationship construct. Yet, such disparate zones can happen in adoptive or foster families, or other contexts that are especially challenging.

Table 2.
EA Scale Direct Scores Converted to EA-Z Scores and Zones

Sensitivity	Responsiveness	EA-Z Score	EA-Z Zone
7-9 ¹	7	100	Emotionally Available
6.5	6.5	95	
6	6	90	
5.5	5.5	81	
5	5	80	Complicated
4.5	4.5	75	
4	4	61	
3.5	3.5	60	Detached
3	3	55	
2.5	2.5	41	
2	2	40	Problematic/ Disturbed
1.5	1.5	25	
1	1	1	

¹ When using Version 4 of EA Scales (Biringen, 2008), 7 = 100. All other sensitivity conversions are the same.

Strange Situation Procedure. Mother-child attachment security was assessed using the Strange Situation Procedure (SSP; Ainsworth et al., 1978). The SSP is a standardized 20-minute procedure that includes two infant-mother separations and two infant-mother reunions. During the first separation, the infant is left in the room with a stranger, and during the second, the infant is left alone in the room. Trained independent observers classified infants into four attachment styles based on their responses to the mother upon reunion. Infants classified as secure happily greeted their mother and resumed connection; infants classified as insecure-ambivalent/resistant sought out the mother but were not soothed by her presence; infants classified as secure-avoidant did not seek out the mother upon reunion or even moved away; and, finally, infants classified as insecure-disorganized showed contradictory or fearful behaviors upon the mother's return.

The SSP is a widely used instrument for measuring attachment style, and evidence of its validity and of the resulting classifications can be found in Ainsworth et al. (1978) and in Main and Solomon (1986). The SSP was completed by a coder who was centrally trained and certified at the University of Minnesota and was experienced in coding the SSP. Previous study kappas were at or greater than .70.

Results

Descriptive statistics. After the two hours of home observation, five mothers were coded as “detached,” seven as “complicated,” and 24 (66.67%) as “emotionally available.” Six children were scored as “detached,” nine as “complicated,” and 21 (58.33%) as “emotionally available.” For the purposes of primary data analyses, scores from the two hour observations will be used.

Among 36 total infants in the study, 24 (66.67%) were classified in the SSP as secure (Group B), five (13.89%) as insecure-resistant/ambivalent (Group C), two (5.56%) as insecure-avoidant (Group A), and five (13.89%) as insecure-disorganized (Group D). Due to the limited sample size, all infants in groups A, C, and D were grouped into one category, “insecure,” and compared to infants classified as secure. Independent-samples t-tests and correlations were used to examine whether SSP classification or EA-Z scores related to child gender, child age, or mothers' education. None were significant, indicating that attachment style, assessed through either the SSP or the EA-Z, was not related to these demographic variables.

Data analyses. Chi-square analyses and logistic regression were used to compare attachment classifications based on the SSP and EA-Z zones. Continuous EA-Z data were transformed so that the mothers and infants with a score of 85 or above were categorized as “emotionally available” (i.e., secure), and those with a score of 80 or below were categorized as “not emotionally available” (i.e., insecure). A chi-square test examining crosstabs of child EA-Z zones and SSP classifications was significant, $\chi^2(1, N = 36) = 18.51, p < .001$. Of 24

infants classified as secure based on the SSP, four were inaccurately scored as “not emotionally available” based on the EA-Z. Among the 12 infants classified as insecure on the SSP, one was inaccurately scored as “emotionally available” on the EA-Z.

A chi-square test examining crosstabs of mother EA-Z zones and SSP classifications was also significant, $\chi^2(1, N = 36) = 14.06$, $p < .001$. Of 24 infants classified as secure on the SSP, three were classified as “not emotionally available” based on the mother’s EA-Z scores. Of 12 infants classified as insecure on the SSP, three were classified as “emotionally available” based on the mother’s EA-Z scores.¹ Binary logistic regression with the child’s continuous EA-Z score as the predictor variable and SSP classification as the dependent variable offered similar results. The overall model tested against a constant-only model was significant, $\chi^2(1, N = 36) = 13.89$, $p < .001$, indicating that EA-Z significantly distinguished between insecure and secure classifications. Further, as an independent predictor, EA-Z score was significant, $Wald = 8.78$, $p = .003$. Specifically, for every one unit increase in child EA-Z score, children had a 10.4% increased likelihood of being classified as secure on the SSP. The overall sensitivity was high, with 91.7% of children accurately classified as secure based on EA-Z score, yet the specificity was low, with only 50% of children accurately classified as insecure on the SSP based on EA-Z score.

A model testing binary logistic regression, with the mother’s continuous EA-Z as the predictor and SSP classification as the dependent variable, was also significant. Compared to a constant-only model, the model with mother EA-Z scores was significant, $\chi^2(1, N = 36) = 7.62$, $p = .006$, and EA-Z was a significant predictor, $Wald = 6.32$, $p = .012$. Specifically, for every one unit increase in a mother’s EA-Z score, children had a 6.5% increased likelihood of being classified as secure on the SSP. However, although sensitivity in classifying secure infants was high, at 87.5%, specificity in classifying insecure infants was low, at 41.7%.²

1. Chi-square analyses using the first 15 minutes and first 30 minutes of EA observation also revealed a significant, yet smaller, association between EA-Z and SSP for both the child and mother side.

Discussion

This study compared infants’ and mothers’ EA-Z scores to attachment style classifications derived from the Strange Situation Procedure. Results indicate partial support for the EA-Z as a tool for assessing attachment style. Chi-square analyses indicated that both infants’ and mothers’ scores on the EA-Z aligned well with SSP classifications, with only five and six infants incorrectly classified, respectively. Further, logistic regression using the EA-Z continuous scores as a predictor of SSP classification indicated that both infant and mother scores were effective in predicting attachment classification. These results support hypotheses 1 and 2, which predicted that EA-Z scores of the child and mother would be associated with attachment style.

It is interesting to note that EA-Z scores derived from the full 2-hour period of observation did not appear to be vastly more accurate in predicting attachment classification than scores derived from shorter observation periods. This suggests that relatively short observational periods can be informative regarding caregiver-child relationship quality and attachment style, and this conclusion is consistent with de Wolff and van IJzendoorn (1997). However, longer observational periods of at least 20 to 30 minutes are generally recommended when coding EA (Biringen, 2008). Further, other nuances of a caregiver-child relationship quality, such as the adults’ ability to regulate negative emotions (nonhostility) and to remain accepting toward the child (sensitivity) often are missed during shorter observational periods. Although these may not seem as relevant as sensitivity and responsiveness when considering a child’s attachment

2. Binary logistic regression using the first 15 minutes and 30 of EA observation also showed significant results with both mother and child EA-Z scores as predictor variables of SSP classification. Child EA-Z scores based on 15 and 30 minute observations were equally predictive of SSP classification when compared to EA-Z scores from the 2 hour observation. Compared to the 2 hour observational period, mother EA-Z scores from 15 minutes were most accurate in predicting SSP classification, and mother EA-Z scores from 30 minutes were least accurate. Zero-order correlations using the first 15 mins also indicated strong correlations with SSP (mother EA zone at 15 min $-.54$, $p < .001$ and child EA zone at 15 mins at $-.61$, $p < .001$).

style, caregiver hostility can be a precursor of disorganized attachment (Lyons-Ruth, Melnick, Bronfman, Sherry, & Llanas, 2004). Therefore, although shorter observational periods may be necessary and appropriate sometimes, it is generally recommended that EA and EA-Z scores be derived from periods no shorter than 20 minutes, and the longest possible observation is recommended.

Several limitations of this study exist. The small sample size did not permit a more detailed analysis of insecure styles, and all three styles were combined as “insecure.” Ideally, future studies with larger sample sizes will aim to align EA-Z zones with their respective insecure attachment styles in order to more thoroughly validate the tool. Further, although five infants were classified using the SSP as insecure-disorganized, no infants or mothers were placed in the “problematic” zone of the EA-Z. This calls for a more detailed description of disorganized interactions from the perspective of the EA framework. Finally, not only was the sample small, but it also lacked socioeconomic and ethnic diversity. The sample consisted largely of Caucasian, highly educated mothers. In order to generalize these findings to a wider population, further research with a more diverse sample will be necessary.

Study 2: EA-Z and the Attachment Q-Sort

Participants

Participants were infant/toddler-child care professional dyads. Fifty-four children participated, and each was paired with one of 33 child care professionals. Professionals could be paired with between one and four children, and they were observed separately with each target child (51.5% of providers were paired with one child; 27.3% were paired with two children; 18.2% were paired with three, and 3% were paired with four). This resulted in a total of 57 dyads. Children were included in the study if they spent at least 20 hours per week at the child care center, had been attending the center for at least one month, and had been under the care of the target child care professional for at least one month.

Children ranged from 10 to 31 months at the start of the study ($M = 18.78$, $SD = 5.06$), and 37% ($n = 20$) were female. In terms of ethnicity, 89% of children were Caucasian. Approximately 70% of children came from two-parent households, and 54% were first-born. Family income of children ranged from less than \$15,000 a year to over \$75,000 a year. Approximately half of families reported the highest income bracket, and five families reported an annual income below \$30,000. Further, a majority of parents had achieved at least a college degree. The age of child care professionals ranged from 19 to 54 ($M = 32$), and all were female. Child care providers were almost all Caucasian, with approximately 10% Hispanic/Latino. The majority of child care professionals had 1-3 years of college or beyond. Data were collected between 2005 and 2008.

Procedure

This study used data from an intervention study that tested the efficacy of a child care center-based emotional availability program. Prior to recruitment and data collection, this study was reviewed and approved by the university's institutional review board (protocol number 02-071H, renewal number 04-320H). Ten child care sites were contacted to participate in an intervention, and eleven were contacted to participate as a control group. All centers provided baseline data prior to the intervention implementation data, and, in order to maximize sample size, only baseline data were used for this study. Center directors from each site provided letters of support, and child care professionals and parents of participating children completed informed consent procedures. Over 70% of child care directors, professionals, and parents expressed interest in the study and consented to participate. When completing the informed consent procedure, parents and child care professionals also provided demographic information.

Child care professionals were paired with between one and four participating children in their classroom, meaning that some professionals were observed more than once with separate children. At baseline, professional-child dyads were observed for two hours in

order to assess the Attachment Q-Sort (AQS; Waters, 1987; Waters & Deane, 1985) and the EA Scales (3rd ed., Biringen et al., 1998). Two observers were present for the full two hour observations in order to take notes and score the AQS. The first 30-minutes of this observational period were filmed in order to be coded using the EA Scales at a later time by an independent coder. Over 90% of observations occurred between 9:00 and 11:30 a.m., after the child was dropped off and before morning naptime. Child care professionals were instructed to go about their normal activities and to interact as they normally would with all children. Observers avoided interfering with activities or interacting with children and professionals, with the exception of a few brief interactions to be coded for the AQS protocol (Waters, 1987; Waters & Deane, 1985). Finally, the EA Scales (3rd ed., Biringen et al., 1998) were coded by certified EA coders (see training details on p. 13) using the initial 30-minute filmed portion of the 2-hour observation at child care sites.

Measures

Attachment Q-Sort. The AQS (Version 3.0, Waters, 1987), includes 90 items describing the child's attachment-related behaviors toward the adult. Most items describe aspects of secure based behavior, and some include other attachment-related behaviors. An example item reads, "If held in caregiver's arms, child stops crying and quickly recovers after being frightened or upset" (Waters, 1987, p. 21). The AQS was developed for use with a mother or parent, so although it has been used in child care contexts in previous studies (Cassibba et al., 2000), a detailed manual was not available. Thus, we developed a manual to guide observers in coding the child care context. Everett Waters and German Posada provided guidance during this process (personal communication, 2005); the child care manual developed for this project can be requested from Everett Waters.

All AQS observations were direct and did not involve videotaping, and they lasted at least two hours, for prior research indicates that this is the minimum time period to reliably code the AQS (Howes

& Smith, 1995). If an observation needed to end before the full two hours, a separate observation was scheduled in order to ensure all observations were two hours. After the two hours, coders ranked the child's behavior using the AQS items from "most descriptive of the child" to "least descriptive of that child." Items not seen that day were placed in the middle pile, as instructed by Waters and Posada (2005, personal communication).

In order to score the AQS, the resulting profile of the child was correlated with a behavioral profile of a stereotypical secure child, as described by attachment experts and provided by Waters and Deane (1985). This process results in a security score ranging from -1.0 to +1.0, where -1.0 is a perfect negative correlation with the prototypical secure child and +1.0 is a perfect positive correlation (van IJzendoorn, Veriejken, Bakermans-Kranenburg, & Riksen-Walraven, 2004; Waters & Deane, 1985). The AQS does not classify children into specific attachment styles, but instead offers a continuous measure of the child's attachment security. However, in typical samples of children, a score of 0.3 or above indicates the child is securely attached, and a score below 0.3 indicates the child has an insecure attachment (personal communication, E. Waters, 10 November 2016). More details on the AQS and its scoring process are available at Everett Waters' website: www.psychology.sunysb.edu/attachment.

Observers were trained in the AQS over several months, during which a trainee first watched videotapes coded by a master trainer and then later accompanied the master trainer to child care observations. Following each observation, both completed the AQS and checked agreement. There were two AQS observers at every single observation session in the child care sites, and after completion of the sorting, observers went to an off-site location near these sites so that they could quickly and independently finalize their AQS sorts, then check their agreement and discrepancies. Interrater reliability was above .70 for most visits. Whenever reliability (percent agreement) was lower than .80, the project coordinator contacted each of the

observers to recommend supplemental training, as necessary, prior to the next site visit. In all cases, the conferenced code was entered into the data files for analysis purposes. AQS observers were blind to study condition, and EA scores. There were numerous AQS teams on the project so that observers could also be blind to time points of observation.

A meta-analysis of studies using the AQS supports the validity of the observer AQS, demonstrating its convergent validity with the SSP ($r = .31$), predictive validity with sensitivity ($r = .39$), and divergent validity with measures of temperament. Further, the AQS demonstrates stability over time ($r = .28$) (van IJzendoorn et al., 2004). The observer version of the AQS is superior to the self-report version in terms of validity and stability, both for parents and child care providers (Cassibba et al., 2000; van IJzendoorn et al., 2004).

EA Scores and EA-Z. The 3rd edition of the EA Scales (Biringen et al., 1998) was used to code the first videotaped 30-minutes of the 2-hour observations in child care sites (see Study 1). The first 8 cases were double coded by the second author and a trained graduate student. Intraclass correlations for each scale were: sensitivity (.93, $p = .001$), structuring (.89, $p = .005$), nonintrusiveness (.95, $p < .001$), nonhostility (.96, $p < .001$), child responsiveness (.78, $p = .03$), and child involvement (.74, $p = .049$). Once interrater reliability was established, the EA coding for baseline data was done by one research assistant who was blind to other information, including AQS scores, study condition, and time point. Additional reliability checks were done for post-intervention data. The same algorithm was used to transform scores on the sensitivity and responsiveness scales to EA-Z scores (see Study 1).

Results

Child AQS baseline security scores ranged from -0.05 to 0.66 ($M = 0.38$, $SD = .17$), and child EA-Z scores ranged from 30 to 100 ($M = 85.70$, $SD = 11.86$). One child was classified in the “problematic” zone of the EA-Z, one in the “detached zone,” 20 in the “complicated

zone,” and 35 in the “emotionally available zone.” Adult EA-Z scores ranged from 30 to 100 ($M = 87.46$, $SD = 13.57$). Of the 57 dyads (consisting of 33 professionals) one adult score was classified in the “problematic” zone, two scores were in the “detached zone,” 20 in the “complicated” zone, and 34 in the “emotionally available” zone. Among providers who were observed with two or more children ($n = 16$), the mean standard deviation of providers’ sensitivity scores was $SD = 0.48$. Correlations between AQS security score and EA-Z score are presented in Table 3. AQS security was significantly related to child EA-Z score, $r = .32$, $p = .014$, but AQS security and adult EA-Z scores were not significantly correlated.

Table 3
Correlations among AQS security and EA-Z scores.

	AQS Security	Child EA-Z
Child EA-Z	.32*	
Adult EA-Z	.21	.75**

* $p < .05$, ** $p < .001$

In order to examine dichotomous secure vs. insecure classifications with both measures, a defined cutoff of 0.3 on the AQS security score was used. Using this cutoff, 30.4% of children were classified as insecure on the AQS, and 69.6% were classified as secure. On the EA-Z, 37% of children were classified as insecure, and 63% were classified as secure. Using adult EA-Z scores, 38.9% were classified as insecure, and 61.1% were classified as secure. Next, chi-square analysis examined the crosstabs of the AQS attachment security classification and the EA-Z attachment security classification. Neither child EA-Z classification nor adult EA-Z classification were significantly associated with AQS attachment security classification.

Discussion

The results of this study offer some preliminary evidence of the validity of the EA-Z in assessing child attachment style. Continuous/dimensional child EA-Z scores were significantly, albeit modestly,

correlated with child security scores on the AQS. This supported hypothesis 2, which predicted that child EA-Z would be related to attachment security. However, adult EA-Z was not significantly correlated with child AQS security, contradicting hypothesis 1. Nevertheless, this makes sense, given the assessment tools and the context of observation. The AQS focuses solely on child behavior, both toward the target caregiver and toward other adults. Further, children in a child care setting likely interact with several caregivers, including their own parents and other child care professionals. Therefore, one particular child care professional's sensitivity toward a particular child may be less relevant for that child's attachment-relevant behaviors. For example, a child who is securely attached to a parent but paired with a less sensitive child care provider may still be observed as securely attached in the child care context, given the protective nature of a secure attachment with one primary caregiver (Boldt et al., 2014; Kochanska & Kim, 2013). This may also explain the modest size of the correlation between child EA-Z score and child AQS security score. Emotional Availability is inherently a dyadic context, so a child who is securely attached to one caregiver is not expected to be optimally responsive to other caregivers, particularly if other caregivers are less sensitive. Therefore, although the AQS observations were focused almost entirely on interactions between the target caregiver and target child, the children's attachment-relevant behaviors may still have been influenced by other relationships.

In addition, although the AQS and EA were both coded from the same observational period, the EA Scales were coded based on the first 30 minutes only. AQS observers had a longer observational period from which to derive scores. With the full 2 hours, AQS observers had a higher likelihood of witnessing caregiver-child separations, discipline situations, or other stressful contexts that may have been informative to the child's attachment security. If the EA Scales had been coded from the full observational context, the concordance between measures may have been higher. Finally, about half of caregivers were observed with more than one child, which likely

led to nonindependence in the dyads' EA-Z scores and zones. Due to the small sample size and the small number of children paired with each provider (between 1 and 4), we were unable to address this possibility in analyses.

Future studies should examine the relations among EA-Z and AQS in other contexts, such as parent-child, in order to determine whether this enhances the validity of the EA-Z. Additionally, this sample was fairly small and homogenous, with a vast majority of parents and teachers being Caucasian and well-educated. In order to better validate the EA-Z and generalize it to a wider population, future studies should examine its validity in larger and more diverse samples. Finally, as with the other two studies, only one caregiver and one child were classified in the lowest, "problematic" zone of the EA-Z. This suggests that, either the sample was low-risk and did not exhibit problematic behaviors, or the coding using the EA Scales did not capture the lowest zone. Thus, future studies should both examine EA-Z and AQS in more at-risk samples and, potentially, clarify the EA-Z in order to better detect problematic interactions.

Study 3: EA-Z and The Adult Attachment Interview

Participants

Participants consisted of 35 mother-child dyads, recruited from the two most economically diverse elementary schools in a county in the Western U.S. between 1997 and 1999. Mothers ranged from age 25 to 48 ($M = 35.35$, $SD = 5.69$), and they were relatively diverse in terms of educational attainment; 27.8% of mothers had a high school degree or less; 16.67% had attended some college; and 52.8% had a bachelor's degree or higher. Mothers also reported on income; 5.6% reported an annual family income below \$15,000; 66.7% reported an income between \$15,000 and \$50,000; and 25% reported an income above \$50,000. Approximately 20% of mothers were single parents. Children ranged from 50 to 72 months old ($M = 62.31$, $SD = 4.55$), and 16 were female. The sample consisted both of first-born ($n = 16$) and later-born ($n = 19$) children.

Procedure

Prior to recruitment and data collection, this study was reviewed and approved by the university's institutional review board. Data collection was conducted over three years ago, between 1997 and 1999, so the protocol has been archived by the institutional review board. Parents were recruited during registration for kindergarten at two schools that served socioeconomically diverse populations in rural Colorado. All parents expressed interest in the project, and when contacted via telephone, 80% agreed to participate. Data were collected in the months prior to kindergarten entry.

Mothers and children came to a research lab at a large state university. A research assistant explained the study and obtained informed consent. Next, mother-child dyads played in a room together for a total of 20 minutes. For the first 5 minutes, dyads were instructed to work together with an Etch-A-Sketch to copy images of a house and a boat that were on the table. For the remaining 15 minutes, dyads were given a set of toys (princesses and knights) and instructed to "play as you normally would." Following the play interaction, mothers were interviewed about their attachment history and family-of-origin using the Adult Attachment Interview (AAI; George et al., 1984; 1985; 1986). During the administration of the AAI, the child completed a developmental assessment in a separate room.

Measures

EA Scales and the EA-Z. EA Scales were coded using the 3rd edition (Biringen et al., 1998). The first 10 cases of this sample were double coded by the second author and a EA certified graduate student (see training details on p. 13), and intraclass correlations for each scale were: sensitivity (.96, $p < .001$), structuring (.91, $p = .001$), nonintrusiveness (.95, $p < .001$), nonhostility (.86, $p = .003$), child responsiveness (.83, $p < .001$), and child involvement (.96, $p < .001$). Following this, the remainder of the sample was coded by the graduate assistant. Sensitivity and responsiveness were transformed to EA-Z scores using the algorithm from Study 1 (see Table 2).

Adult Attachment Interview. The Adult Attachment Interview (AAI; George et al., 1984; 1985; 1986) assesses an adult's representations of his or her early attachment relationships. In order to assess the adult's state of mind regarding relational experiences in his or her family-of-origin, the AAI elicits a variety of information. The interviewer asks about general and specific experiences with each parent, separation and loss issues, perspectives on why attachment figures behaved in a certain way, and views on whether relationships have changed over time.

Based on the content and coherence of the AAI, participants are classified into one of four categories: Autonomous/Free to Evaluate/Secure, Preoccupied, Dismissing, or Unresolved. An Autonomous/Free to Evaluate/Secure individual expressed a balanced and integrated view of his or her attachment history. A Preoccupied adult expresses anger and resistance about his or her attachment figures, and he or she has not worked toward integration or resolution of such feelings. A Dismissing adult ignores attachment-related issues and experiences, or he or she may idealize a parent without specific experiences to support such positive ideals. Finally, an Unresolved individual may show confusion, seem disorganized, or express unresolved mourning (George et al., 1984; 1985; 1986). In addition to classifying adults into one of these four categories, the scoring of the AAI also offers continuous scores on many scales. For the purposes of this study, only the AAI coherence scale will be used.

Two coders were trained and certified by Mary Main and/or Deborah Jacobvitz. Approximately 10 cases were coded by the first coder and the remaining cases were coded by the second. No cases were double coded, since these coders were certified at an acceptable level of agreement in prior work. The AAI demonstrates stability over time and across interviewers, and its discriminant validity is evidenced by independence from non-attachment related memories, intelligence, and social desirability (Bakermans-Kranenburg & van IJzendoorn, 1993; Crowell et al., 1996).

Results

Descriptive statistics. Based on EA-Z scores, one mother was in the “Problematic” zone, one was in the “Detached” zone, five were in the “Complicated” zone, and 28 were in the “Emotionally Available” zone. Based on AAI scores, four mothers were “Unresolved”, three were “Dismissing”, two were “Preoccupied”, and 26 were “Autonomous/Free to Evaluate/Secure” (see Table 4). In regard to child EA-Z scores, three children were in the “Detached” zone, 11 were in the “Complicated” zone, and 21 were in the “Emotionally Available” zone. No children were categorized as “Problematic” with the EA-Z (see Table 5).

Table 4
Mother EA-Z Zone and Mother AAI Category

Mother AAI Category	Mother EA-Z Zone				Total
	Problematic	Detached	Complicated	Emot. Avail.	
Unresolved	1	0	1	2	4
Dismissing	0	1	0	2	3
Preoccupied	0	0	1	1	2
Secure	0	0	3	23	26
Total	1	1	5	28	35

Table 5
Child EA-Z Zone and Mother AAI Category

Mother AAI Category	Child EA-Z Zone				Total
	Problematic	Detached	Complicated	Emot. Avail.	
Unresolved	0	1	2	1	4
Dismissing	0	1	0	2	3
Preoccupied	0	0	2	0	2
Secure	0	1	7	18	26
Total	0	3	11	21	35

Data analysis. Chi square analyses were used to examine whether AAI classifications and EA-Z zones were related. Because cell sizes were too small to conduct a 4x4 chi-square based on

attachment classifications, 2x2 chi-square analyses were conducted using binary secure-insecure classifications based on the EA-Z and the AAI. EA-Z scores were transformed so that a score of 85 or above was labeled “emotionally available” or “secure,” and a score of 80 or below was labeled as “not emotionally available” or “insecure.” The chi-square examining mother EA-Z security and AAI security was significant, $\chi^2(1, N = 35) = 4.53, p = .033$, yet when child EA-Z security was compared to AAI security, it was only marginally significant, $\chi^2(1, N = 35) = 3.57, p = .058$.

Binary logistic regression was also used to determine whether mother and child continuous EA-Z scores significantly predicted mothers’ AAI classification. With mother EA-Z score as a predictor, the overall model tested against a constant-only model was significant, $\chi^2(1, N = 35) = 7.74, p = .005$, indicating that mother EA-Z score significantly distinguished between insecure and secure AAI classifications. Further, as an independent predictor, mother EA-Z score was significant, $Wald = 4.48, p = .034$. Specifically, for every one unit increase in mother EA-Z score, mothers had a 9.2% increased likelihood of being classified as secure on the AAI. The overall sensitivity was high, with 96.2% of mothers accurately classified as secure based on EA-Z score, yet the specificity was low, with only 22.2% of mothers accurately classified as insecure on the AAI based on their EA-Z score.

Binary logistic regression was run with child EA-Z score as the predictor and mother AAI classification as the dependent variable. Compared to a constant-only model, the model with child EA-Z scores was also significant, $\chi^2(1, N = 35) = 5.44, p = .02$, and child EA-Z score was a significant predictor of AAI classification, $Wald = 4.54, p = .033$. For every one unit increase in a child’s EA-Z score, mothers had a 8.6% increased likelihood of being classified as secure on the AAI. However, as with the model using mother EA-Z, sensitivity in classifying secure infants was high, 96.2%, but specificity in classifying insecure infants was low, 22.2%.

Finally, bivariate correlations examined associations among AAI continuous coherence score, continuous mother EA-Z score, and

continuous child EA-Z score. Mother EA-Z scores were significantly correlated with continuous AAI security, $r = .37$, $p = .03$, but child EA-Z scores were not, $r = .22$, $p = .21$ (see Table 6).

Table 6
Correlations among AAI coherence and EA-Z score

	AAI Coherence	Child EA-Z
Mother EA-Z	.37*	.84**
Child EA-Z	.22	

* $p < .05$, ** $p < .001$

Discussion

This study compared mothers' AAI classifications to mother and child EA-Z scores in order to begin validating the EA-Z as an attachment style measurement tool across a broad developmental spectrum. The results of this study offer some evidence for the validity of the EA-Z in assessing attachment. Both chi-square analyses and logistic regression analyses demonstrated significant relations between mothers' attachment classification based on EA-Z zones and their attachment classification based on the AAI. Bivariate correlations between continuous AAI security and mothers' EA-Z scores were also significant. These results are particularly interesting, for the AAI assessed mothers' states of minds in regard to their family-of-origin attachment history, whereas the EA-Z derives from direct observation of maternal behaviors and emotional expression. Thus, these results not only offer a starting point for validating the EA-Z as an attachment measurement tool, but they also demonstrate links between mothers' internal working models and their concurrent interactional styles. Although cell sizes were too small to statistically examine EA-Z zones and specific AAI categories, Table 3 offers insight into the accuracy of the EA-Z in comparison to the AAI. Nine out of 35 mothers were classified into mismatched zones between the AAI and EA-Z.

Further, child EA-Z scores were also related to mothers AAI classification. Although the chi-square test was only marginally significant,

the logistic regression significantly predicted maternal attachment security from child EA-Z scores. Although these results certainly need to be replicated with a larger sample size, they offer preliminary evidence that caregivers' internal working models impact their child's behavioral and emotional responsiveness to that caregiver. In terms of specific attachment classifications, 14 out of 35 children were classified into mismatched zones between maternal AAI and child EA-Z. However, it is to be expected that children are less accurately classified based on their mothers' AAI category. Therefore, these results can offer preliminary evidence of the validity of the EA-Z as an attachment assessment tool. Further, results support hypotheses 3 and 4, which predicted that maternal AAI would be related to both mother EA-Z and child EA-Z scores.

Several characteristics of this study limit its generalizability and conclusiveness. First, the sample size was small and relatively ethnically homogeneous. This meant that data analyses were restricted to examining secure and insecure, rather than a more rich examination of the various insecure subtypes, particularly because so few participants were in each category of insecure. Additionally, the sample limits the generalizability of results due to its size and homogeneity. Finally, in this sample, only one mother was placed in the "problematic" zone of the EA-Z, and no children were. Therefore, a closer look at this attachment zone will help inform whether the EA-Z can effectively capture it. Future studies and secondary data analyses should use larger samples, recruit more diverse participants, and include at-risk families in order to continue validating the EA-Z as a tool for assessing attachment style in both adults and children.

General Discussion

All three studies presented here offer promising evidence for the validity of the EA-Z as an attachment tool. We predicted that both caregiver and child EA-Z scores would relate to two empirically validated observational measures of child attachment security, the SSP and the AQS (hypotheses 1 and 2) These hypotheses were mostly

supported. In studies 1 and 2, child EA-Z scores related as expected to child attachment security. Moreover, these studies were conducted in different contexts (home vs. child care) and with different caregivers (parent vs. child care provider). This suggests that the EA-Z can accurately assess child attachment security, even across caregiving contexts. Adult EA-Z score was also related to child attachment security, but only in study 1, which used the SSP in a sample of infants and their mothers. In contrast, the results of study 2 did not show a relation between the EA-Z scores of child care providers and the attachment security of children, as measured by the AQS. This may be due to the effects of multiple caregivers and a limited observational context to measure the EA-Z.

Next, we predicted that child and parent EA-Z scores would also relate to parent attachment security, as measured by the AAI (hypotheses 3 and 4). These hypotheses were supported in study 3. These findings were particularly promising, given the fact that the AAI is not an observational measure. Whereas the SSP, the AQS, and the EA-Z all utilize behavioral observation to measure attachment security, the AAI uses an interview format and assesses an individual's states of mind related to attachment. Thus, the results of Study 3, demonstrating links between AAI and EA-Z security, seem to further support the EA-Z as a theoretically-relevant tool. Finally, although the degree of concordance between the EA-Z and all three of these attachment measures was small to moderate, it was similar to the degree of concordance found among well-established attachment measures, such as between the SSP and the AQS (van IJzendoorn et al., 2004).

A consistent theme across the three studies was greater sensitivity and lower specificity in the logistic regression model. This suggests that there is relatively stronger concordance between the EA-Z and other attachment tools when children were securely attached than when they were insecure. The EA-Z, in its current form, may be most accurate in identifying secure children and less sensitive to indicators of insecure attachment. It is possible that the low-stress contexts used to assess the EA-Z in these studies made

it more challenging to see the behaviors associated with insecure attachment and that studies using separation/reunion or other stress contexts may be useful in this regard. Additionally, there are many challenges in recognizing the subtler signs of disorganized attachment among low-risk dyads (Lyons & Spielman, 2004). Thus, it could be that the EA-Z failed to identify disorganized dyads due to the low-risk nature of our sample. Ongoing work in our lab is aiming to clarify the subtle signs of disorganization from the EA perspective.

Nevertheless, more studies and secondary data analyses are needed to further demonstrate the validity of the EA-Z as an attachment assessment. First, all three studies used Version 3 of the EA Scales (Biringen et al., 1998). Although the current version (Version 4, Biringen, 2008) can also be used to derive EA-Z scores, it is important to examine the validity of EA-Z scores derived from both versions. Next, all three studies used relatively small and homogenous samples. As discussed previously, it will be imperative to validate the EA-Z with large, ethnically diverse, and socioeconomically diverse samples in order to generalize its use. Larger and more diverse samples will likely also provide better variety in terms of EA-Z zones and specific attachment styles, allowing a more detailed analysis of these two constructs. Finally, although Study 3 examined adult attachment, all three studies used EA-Z data from young children between the ages of zero and five. In order to empirically validate the EA-Z as a tool to be used across the lifespan (as theorized by Biringen et al., 2014), research will need to utilize it with parents and a wider range of child, adolescent, and young adult ages.

Finally, the use of the arithmetic rubric in these studies, although necessary based on the use of secondary data analyses, limits the validity of the EA-Z classifications. A trained EA-Z coder, watching the same videos, may have assigned different EA-Z codes for some dyads, due to information from other scales or attachment-based observations. Thus, it will be important to continue validating the EA-Z using direct observation by trained EA-Z coders in order to replicate and expand upon the findings presented here.

As the EA-Z is validated as a tool for assessing attachment, its promise as a valuable lifespan measure will continue to be evaluated. To date, no other attachment measurement tool can be used beyond a limited age range. For example, the Strange Situation Procedure (Ainsworth et al., 1978) can only be used with children between the ages of 12 and 24 months, and the Attachment Q-Sort (Waters & Deane, 1985) can be used with children between one and five years old. Without a tool that can be used across a wide range of ages, it becomes difficult to examine the long-term stability and predictability of attachment style. Therefore, the EA-Z offers a measurement tool that can be used longitudinally to examine both the long-term stability of individuals' attachment styles, as well as the predictive value of attachment styles over time.

Suggestions for Research and Practice

From a conceptual standpoint, there is a benefit to using both the EA Scales and the EA-Z when assessing the quality of caregiver-child interactions. The EA Scales offer a multifaceted view of this quality, with dimensions that are often not utilized when using other attachment measurement tools. For example, using the EA Scales, a researcher or practitioner can also determine a caregiver's ability to guide learning, to resist interfering, and to effectively regulate negative emotions. These qualities add depth in understanding a parent-child relationship, yet they are also relevant in considering attachment style. For example, high levels of parent intrusiveness and hostility are often used indicators of disorganized attachment (Lyons-Ruth et al., 2004), and such qualities also provide information that is not specifically about attachment. Similarly, child involvement is rarely taken into account in any measure of attachment, and yet a child's ability and interest in taking initiative during interactions provides important information about the relational capacities of that child.

Also from a conceptual vantage point, the EA Scales and the EA-Z provide information about relationship qualities and about attachment

from the perspective of the parent as well as the perspective of the child. In some samples, parents and children may not share the same views of their relationship. For example, Barone, Lionetti, Dellagiulia, Alagna, and Rigobello (2015) reported that in 22% of adoptive mother-child dyads, the child scored in a different EA-Z zone from his or her adoptive mother. In an interview-based study on parental alienation in the context of high-conflict divorce, investigators found that many parents (mothers as well as fathers) who described themselves as loving, caring, and sensitive in their interactions with their children described also that their children became alienated from them after divorce (Biringen et al., 2017; Harman & Biringen, 2016). Although observations may be more objective than interviews, and certainly only a subset of children become alienated from a parent after divorce, nonetheless such research paves the way for thinking about nonconcordance in the parental and child side of the same relationship.

The EA System, and the EA-Z specifically, provides a new conceptualization and method for addressing that a child and parent may have differing views of the same relationship. Although there may be limits to how far away these zones may be in a two-parent home with biological parents, the EA framework may help us to better understand and measure a wider range of families and relationships, children of different ages in the same family, as well as real-world conditions that may contribute to such complexities (e.g., immigrant or refugee families).

Furthermore, when using the EA Scales and the EA-Z to directly code interactions, we recommend starting with the algorithm (shown in Table 2) to convert sensitivity and responsiveness scores to EA-Z scores. This can offer consistency both within research or practice settings and across these settings. However, it is far better for coders to make a judgment call based on other EA qualities. An observer might rate sensitivity or responsiveness near the "border" of two zones but feel confident that the EA-Z zone is different, or the coder may observe that an individual's attachment security is slightly lower or higher than the score granted by his or her EA Scales score. For example, in some

cases, a child rated in the middle range of the responsiveness scale may nonetheless appear to belong in the “emotionally available” zone of the EA-Z due to his or her response to a stressful situation. Also, a caregiver may display qualities inherent in both the detached and complicated zones. In this case, a coder will need to decide which zone best characterizes this caregiver based on his or her overall demeanor and behavior. However, when conducting secondary data analysis on previously coded EA interactions, we recommend using the more strict algorithm (Table 2) in order to ensure consistency and to reduce error.

Next, in order to best categorize dyads into EA-Z zones, it is important to ensure that the length and context of observation are sufficient. In general, contexts that elicit stress, such as separation-reunion contexts or challenging situations, are better than those that are entirely play. For young infants, this may consist of a still-face paradigm (Weinberg & Tronick, 1996). However, we caution researchers and practitioners when conceptualizing and/or scoring the EA-Z with very young infants. Although the EA Scales can certainly be used with very young infants, the EA-Z may not yet be valid in assessing attachment style *per se* with this age group. Instead, the EA Scales could be used in early infancy, or even during pregnancy (Salo et al., 2016), to predict an infant’s later EA-Z score or zone or the EA-Z scores for young infants may be referred to as “attachment in the making” (Bowlby, 1969). For older infants, toddlers, and young children, a separation-reunion may be best to elicit stress. Among young or middle age children, the caregiver and child could be instructed to clean up toys or to follow a specific rule (e.g. not playing with toys on a certain shelf). Finally, with older children, adolescents, and couples, a challenging situation could consist of discussing a recent or ongoing conflict (Gottman, Coan, Carrere, & Swanson, 1988).

Additionally, longer observational periods are generally most adequate in assessing EA and attachment style, particularly if the context is low-stress. The attachment system is activated by

stress (Ainsworth & Bell, 1970), so either stressful situations or long periods of time seem to be necessary to accurately assess a child’s attachment style. Further, other important indicators, both of EA and of attachment-related constructs, are often more observable in stressful or long-lasting interactions. Caregiver nonhostility, which can be important in identifying disorganized attachment, can often be masked in shorter observational periods by a self-conscious caregiver. Additionally, certain behaviors, such as clinging, whining, and fussing are signs of an insecure-resistant/ambivalent attachment style or the middle zone of the responsiveness scale (Biringen, 2008), and an observer is more likely to witness these behaviors in longer or stressful situations.

However, having some portion of the observational context still contain play or another form of “everyday” interaction will also be beneficial, especially when coding the EA Scales. Dimensions, such as structuring and nonintrusiveness, may not be evident during a Strange Situation context, for caregivers tend to guide learning and grant autonomy in low-stress contexts (Biringen, 2008). Therefore, EA and EA-Z observations would ideally assess interactions no shorter than 20 minutes and that contain both a play or “everyday” interaction and some sort of stressful situation, such as a separation and reunion.

In closing, the EA-Z offers potential as a valid tool to assess attachment security across the lifespan. Further, its source, the EA Scales, can assess other characteristics of dyadic relationships that are relevant for child development and adult well-being that are “larger” than attachment (see Biringen et al., 2014). Therefore, continuing to validate the EA Scales and EA-Z can establish them as effective measures of both attachment security and the overall quality of dyadic relationships. We hope that these three studies, which examine caregiver-child relationships from infancy to kindergarten, as well as adult mothers’ attachment states of mind, will be a starting point for further inquiry across a broader age range.

Compliance with Ethical Standards

The studies presented here were funded by First Bohemian Foundation ("Project Secure Child in Child Care Grant") and the Temple Buell Foundation ("Project Secure Child in Child Care Grant," #535470 and #535230).

The procedures and methods for all three studies were reviewed by the Institutional Review Board at the authors' university. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional review board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Participants for each study were thoroughly briefed on the study procedures. Informed consent was obtained from all individual participants included in the studies.

Finally, the second author discloses a potential conflict of interest in that she developed the Emotional Availability Scales and the Emotional Attachment Zones Evaluation. However, she reports no financial conflict of interest with the participants of these three studies.

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