Maternal and paternal sensitivity: Key determinants of child attachment security examined through meta-analysis

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Abstract

Sensitive caregiving behavior, which involves the ability to notice, interpret, and quickly respond to a child's signals of need and/or interest, is a central determinant of secure child-caregiver attachment. Yet, significant heterogeneity in effect sizes exists across the literature, and sources of heterogeneity have yet to be explained. For all child-caregiver dyads, there was a significant and positive pooled association between caregiver sensitivity and parent-child attachment (r = .25, 95% CI [.22, .28], k = 174, 230 effect sizes, N = 22,914). We also found a positive association between maternal sensitivity and child attachment security (r = .26, 95% CI [.22, .29], k = 159, 202 effect sizes, N = 21,483), which was equivalent in magnitude to paternal sensitivity and child attachment security (r = .21, 95% CI [.14, 27], k = 22, 23 effect sizes, N = 1,626). Maternal sensitivity was also negatively associated with all three classifications of insecure attachment (avoidant: k = 43, r = -.24 [-.34, -.13]; resistant: k = 43, r = -.12 [-.19, -.06]; disorganized: k = 24, r = -.19 [-.27, -.11]). For maternal sensitivity, associations were larger in studies that used the Attachment Q-Sort (vs the Strange Situation), used the Maternal Behavior Q-Sort (vs Ainsworth or Emotional Availability Scales), had strong (vs poor) interrater measurement reliability, had a longer observation of sensitivity, and had less time elapse between assessments. For paternal sensitivity, associations were larger in older (vs younger) fathers and children. These findings confirm the importance of both maternal and paternal sensitivity for the development of child attachment security and add understanding of the methodological and substantive factors that allow this effect to be observed.

Keywords: attachment, sensitivity, responsiveness, caregiving, meta-analysis

Public Significance Statement

The quality of care children receive from caregivers can shape the foundations of a thriving society. Sensitive caregiver behavior involves the ability to notice, interpret, and quickly respond to a child's signals of need and/or interest. Findings from our research suggests that caregivers' sensitive behavior toward their child plays a pivotal role in fostering children's secure attachment. We found that associations were similar for both mothers and fathers. These findings stress the urgency of allocating resources and supports to enhance sensitive caregiver behavior, to in turn promote healthier child-parent relationships.

Maternal and paternal sensitivity: Key determinants of child attachment security examined through meta-analysis

The sensitive responsiveness of caregivers is a foundational construct within attachment theory. Generally referred to as 'sensitivity' as a shorthand, the construct is defined as the caregiver's ability to notice, interpret, and contingently respond to the infant's bids and signals (Ainsworth et al., 1978). Approximately 50 years ago, Ainsworth and her colleagues devised an observational rating scale for caregiving through repeated visits with a sample of 26 middle-class mother-infant dyads across their first 54 weeks of life. In this exploratory study, they found a large association between maternal sensitivity and secure child attachment, an association that has been replicated in larger, well-controlled studies. Researchers have also gone on to demonstrate that caregiver sensitivity has wide-ranging impacts beyond child attachment, including associations with child language (Madigan et al., 2019), cognitive functioning (Deneault et al., 2023), prosocial skills (Rodrigues et al., 2021), socio-emotional functioning (Cooke et al., 2022), executive functioning (Valcan et al., 2018), and academic achievement (Raby et al., 2015). Accordingly, interventions that target caregiver sensitivity have been developed and implemented worldwide, with evidence of effectiveness for sensitivity, attachment security, and child externalizing behaviors (Bakermans-Kranenburg et al., 2003; O'Farrelly et al., 2021; Van IJzendoorn et al., 2023). Thus, caregiver sensitivity is now viewed as one of the central environmental determinants of child development.

Following the introduction of the sensitivity construct by Ainsworth and colleagues, hundreds of studies on sensitivity and attachment have been undertaken across different sociocultural contexts and sociodemographic backgrounds. Many studies have confirmed a link between sensitivity and attachment; nonetheless, some have not, and few have replicated the

large correlation originally established by Ainsworth et al. (1978). One often-cited explanation for this discrepancy is methodological: Replication studies have generally assessed sensitivity over shorter periods (e.g., 5-10 minutes versus Ainsworth's ~16 hours), reducing the amount of information available to coders. Measures of caregiver sensitivity have also proliferated beyond Ainsworth's original rating scale, with more or less divergence from the original technical definition of sensitivity (De Wolff & Van IJzendoorn, 1997). The measurement of sensitivity has also stretched into the school-age period and beyond, and consistent with sociological shifts in family structures and responsibilities (see Cabrera et al., 2000), the sensitivity of other caregivers than mothers has been examined. Moreover, although initial studies recruited middle-class samples, efforts to study predictors of attachment security in diverse populations have been undertaken and now include research from around the globe. Yet, an overrepresentation of studies from North America and Europe remains. Studies have also recruited populations with medical (e.g., preterm birth) and family socio-demographic risks (e.g., low income, adolescent caregivers).

Although previous meta-analyses have been conducted on the association between caregiver sensitivity and child attachment (De Wolff & Van IJzendoorn, 1997; Lucassen et al., 2011; Zeegers et al., 2017), a number of theoretically and practically important questions remain unsettled regarding the role of moderators in accounting for the heterogeneity in effect sizes between studies. In particular, attempts have failed to identify any significant moderators of the association, possibly due to the small sample sizes included in previous meta-analyses. Given the breadth of research now available on this topic, which is three times larger than any previous meta-analysis, it is timely to re-examine the longstanding notion that caregiver sensitivity is a central parenting determinant of child attachment, and to determine when and for whom

associations are smaller or larger. We focus specifically on synthesizing studies that observed sensitivity in ways aligned with Ainsworth et al. (1978), in which the measured components include noticing the child's signals, interpreting them correctly, and responding to them promptly and appropriately. Ultimately, we aim for this comprehensive meta-analysis to inform future research and practice initiatives.

Individual Differences in Child Attachment

In an effort to capture individual differences in child-caregiver attachment, Ainsworth and her colleagues developed a coding system for infant behavior in the Strange Situation Procedure (SSP; Ainsworth et al., 1978), an experimental paradigm that contains a series of separations and reunions for a child aged ~12-20 months with their caregiver. The SSP is thought to tap into the child's expectations about the caregiver's availability and effectiveness in providing comfort and safety. Based on video recordings of this procedure, children are classified into one of four attachment categories (Ainsworth et al., 1978; Main & Solomon, 1986). Children with a *secure* attachment actively approach and seek comfort from their caregivers in times of distress and use their caregiver as a secure base for exploration. Infants with an *insecure-avoidant* attachment are less outwardly distressed by separations and are likely to direct attention away from the caregiver on reunion. Infants with *insecure-resistant* attachment are typically distressed by separations, unable to be comforted when the caregiver returns, and unlikely to explore their environment, even in the caregiver's presence.

Approximately 20 years after the initial development of the SSP, a fourth category, *insecure-disorganized* attachment, was introduced (Main & Solomon, 1990). Disorganized attachment is expected to develop when a child experiences alarming behavior by their caregiver; such behavior may include caregiver maltreatment, symptoms of severe mental

illness, and/or disruptive and frightening forms of caregiver behavior (Lyons-Ruth et al., 1999; Madigan et al., 2006; Main & Hesse, 1990; Van IJzendoorn et al., 1999). During the SSP, children with an insecure-disorganized attachment display conflict, confusion and/or apprehension towards their caregiver when their attachment system has been activated, interrupting their approach to the caregiver for comfort or the coherence of their direction of attention to the environment (Duschinsky, 2018; Main & Hesse, 1990). Children assigned a disorganized classification are also assigned a secondary "best fitting" classification of secure, avoidant, or resistant. The global distribution of attachment across more than 20,000 SSP's conducted worldwide to date is 51.6% secure, 14.7% insecure-avoidant, 10.2% insecure-resistant, and 23.5% insecure-disorganized (Madigan, Fearon et al., 2023).

Several additional observational attachment measures have been developed since the inception of the SSP, including modified versions of the SSP (SSP-M) for preschoolers and school-aged children (Cassidy et al., 1992; Main & Cassidy, 1988). Another commonly used observational measure of infant and child attachment is the Attachment Q-Set (AQS; Waters & Deane, 1985). The AQS includes 90 item descriptors and following several hours of home visiting these descriptors are sorted into nine piles of 10 (from highly uncharacteristic to highly characteristic of the child); then, a single global rating score from highly insecure to highly secure is derived by comparing the child/caregiver Q-sorts to expert criterion sort.

The Need for Re-Examining the Link between Caregiver Sensitivity and Child Attachment

The concept of sensitivity refers to a caregiver's ability to respond contingently, promptly, and appropriately to children's bids and signals (Ainsworth et al., 1978). It is theorized that infants' repeated experiences of having their needs met and their displays of distress/communicative signals responded to are likely to build the expectation that their

caregiver will be available when they become distressed or alarmed. Following 25 years of research on maternal sensitivity and child attachment, De Wolff and Van IJzendoorn (1997) conducted a meta-analysis of 30 studies (N = 1,666) examining the association between maternal sensitivity and infant-mother attachment security as assessed in the SSP in infants under the age of 2 years. Results revealed significant correlations between all measures of sensitivity and infant-mother attachment security (r = .22; 95% CI [.18-.27]). In 2011, Lucassen and colleagues conducted a focused meta-analysis of 16 studies that examined paternal sensitivity and infant-father attachment in the SSP, and also found a statistically significant association (r = .12; 95% CI [.06-.17]), though lower than the association between maternal sensitivity and infant-mother attachment in the SSP as reported by De Wolff and Van IJzendoorn. In 2017, Zeegers and colleagues presented a meta-analysis of 51 studies (N = 6,664, which only considered studies published between 1997 and 2016. This study combined maternal and paternal sensitivity into one analysis. The Zeegers et al. meta-analysis limited its inclusion criteria to children under three years of age, only to the SSP and AQS assessments (i.e., SSP-M were excluded), and to biological caregivers, non-clinical, and non-medical risk samples only. In this targeted set of studies, Zeegers et al. found a pooled effect size of r = .25 (95% CI [.20-.31]), which is comparable to what De Wolff and Van IJzendoorn (1997) found.

Although these meta-analyses offered insight into the magnitude of the association between caregiver sensitivity and child attachment, their generalizability is likely limited by their inclusion criteria; these were restricted to a subset of the population (e.g., non-clinical samples) or to specific attachment measures (e.g., the Strange Situation Procedure only). Moreover, some of these meta-analyses have identified variation in effect sizes, signaling that there are systematic differences across studies that need to be captured; yet, relatively little is known about sources of

between-study heterogeneity (Fearon & Belsky, 2018). Thus, there are several reasons, discussed in detail below, to re-examine the association between caregiver sensitivity and child attachment.

First, over time and coinciding with societal shifts of increased participation and involvement of fathers in childcare since the 1980s, greater attention has been placed by researchers on understanding child-father attachment (Bakermans-Kranenburg et al., 2019). It has been theorized that mothers and fathers may interact with children in somewhat different ways, yet they both present similar caregiving behaviors and engage in sensitive caregiving behaviors (Cabrera et al., 2018; Fagan et al., 2014). Mothers do, nonetheless, display higher levels of sensitivity than fathers in observational studies, although this difference is small and the gap in sensitivity levels has been shrinking over time (Deneault, Cabrera, et al., 2023). Nonetheless, for both mothers and fathers, positive parent-child relationships have been shown to equate to more positive developmental outcomes for children (e.g., Cooke et al., 2022; Deneault et al., 2021; Deneault, Hammond, et al., 2023; Rodrigues et al., 2021).

Previous meta-analytic efforts have compared effect sizes for mothers and fathers based on effect sizes derived in separate meta-analyses conducted at different times, or by combining mothers and fathers into a pooled analysis. The limitation of the former approach is that 15 years of research have elapsed between the sets of meta-analytic comparisons. During that time, the nature of child-father relations and family structures has evolved considerably. The limitation of the pooled approach is that it assumes effect sizes are homogeneous, which has not yet been adequately supported (e.g., Schoppe-Sullivan et al., 2006; Volling et al., 2002). Moreover, unique mechanisms (Lickenbrock & Braungart-Rieker, 2015) have been identified for mothers and fathers and when mothers and fathers are combined into one pooled analysis, the potential for identifying distinctive moderators for child-mother and child-father dyads cannot be

explored. Identifying sources of heterogeneity that may be unique for mothers and child-father dyads could valuably inform intervention research. Taken together, we believe that the time is ripe for a comprehensive re-examination of moderators of associations between maternal and paternal sensitivity and child attachment security.

A second reason to re-examine the association between caregiver sensitivity and child attachment is that important questions remain about factors that may moderate associations. The number of studies in previous meta-analyses (De Wolff & Van IJzendoorn, 1997; Lucassen et al., 2011; Zeegers et al., 2017) have been small (ranging from k = 16-51), resulting in low statistical power for detecting moderators. There are some initial clues as to what factors may explain variation across study findings. In their initial meta-analysis of 30 studies, De Wolff and Van IJzendoorn observed variation in effect sizes; yet, when they examined effect sizes across an isolated set of 16 studies that used Ainsworth's original sensitivity rating scales, no heterogeneity was observed. Larger effect sizes between caregiver sensitivity and child attachment have also been found amongst studies using the AQS (Van IJzendoorn et al., 2004), and a weakening of effect sizes has been observed as the distance between the assessment of caregiver sensitivity and child attachment increases (Atkinson et al., 2000). Contextual factors may also be important. For example, in the full set of 30 studies in the De Wolff and Van IJzendoorn meta-analysis, effect sizes were larger when samples with moderate SES (r = .27; k = 18 studies) were directly compared to samples with low SES (r = .15; k = 8 studies). Effect sizes were also larger when the sensitivity measure was conducted after the infant's first birthday (r = .27; k = 11 studies), compared to prior to the infant's first birthday (r = .20; k = 19 studies).

Although the above-mentioned results offer initial insights into potential moderators that may explain when effect sizes for the association between caregiver sensitivity and child

attachment may be smaller or larger, Fearon and Belsky (2018) have noted that it is crucial to comprehensively fill the existing "moderator gap" to maximize the potential of future research and practice initiatives. The Zeegers et al. (2017) meta-analysis has had the largest sample size to date (k = 51) and did test several moderators to explain between-study variability, but none of the moderators tested proved significant. As mentioned above, their restrictive inclusion criteria may have reduced their ability to detect any moderation. In the current meta-analysis, with an inclusive set of 181 studies (238 effect sizes), we set out to meta-analytically re-examine the role of caregiver sensitivity on child attachment security and to identify important sources of variation across the wealth of studies amassed to date, so that we may better understand when sensitivity is strongly predictive of attachment security and when it is not.

A third reason to re-examine associations between sensitivity and attachment is that no meta-analysis to date has examined the differential association of caregiver sensitivity in relation to avoidant, resistant, and disorganized attachment. Although distinct sequelae have been established for each attachment classification (e.g., Groh, Fearon, et al., 2017; Sroufe et al., 1999), in research on caregiver sensitivity the insecure groups have most often been combined. Initially, the rationale for this decision was a statistical one, prompted by the small numbers of children classified as resistant and avoidant (Cassidy & Berlin, 1994). Nonetheless, this dichotomous contrast has remained over time, leading to a lack of insight into the specificity of the caregiving behavioral determinants of avoidant and resistant attachment specifically.

In 1999, Van IJzendoorn et al. examined associations between insensitive caregiving and disorganized attachment in 2,000 dyads and found a significant but small correlation of r = .10. They concluded that "insensitive caregiving does not appear sufficient to evoke disorganized attachment behaviors in the child" (p. 243). Main and Hesse (1990) proposed that the origins of

disorganized attachment were not insensitive caregiving per se, but rather, frightened, frightening, or dissociative caregiving behaviors. Subsequently, Lyons-Ruth et al. (1999) proposed that the caregivers' failure to comfort and/or regulate the child may manifest in a variety of disrupted behaviors and communications, such as withdrawing from interaction with the child, directing intrusive and/or hostile behavior toward the child, role-reversing behavior and/or contradictory responses to the infant's cues. A meta-analysis by Madigan et al. (2006) showed a large pooled correlation of .34 across 9 studies ($N = 644$) supporting the proposition that anomalous forms of parenting behaviors (see Lyons-Ruth et al., 1999; Main & Hesse, 1990) predict disorganized attachment.

Others have argued that some aspects of insensitivity, in some contexts, may be linked to disorganized attachment. For example, in a sample of adolescent child-mother dyads with low income and education, maternal sensitivity strongly and independently predicted attachment disorganized attachment (Moran et al., 2008). Moreover, a recent meta-analysis of three studies, exclusive to preschool-aged children, by O'Neill et al. (2021) found that the association between caregiver sensitivity and disorganized attachment was $r = -.19$. Thus, increasing the specificity of our knowledge about the differential association between caregiver sensitivity and each insecure child attachment classification could prove valuable for future research in the field, as well as intervention efforts seeking to target the caregiving behaviors most strongly associated with insecure and/or disorganized attachment.

Potential Moderators of the Association Between Caregiver Sensitivity and Child Attachment

In the current meta-analysis, we focus on several substantive moderators in addition to parent gender: (a) measurement characteristics, (b) parent and child age, (c) child sex at birth; (d)

socio-demographic factors, (e) clinical and medical risk, (f) foster or adoptive caregiving, (g) geographic region, and (h) study characteristics.

1. Measurement Characteristics. There are several measurement characteristics that may explain the between-study heterogeneity observed to date. First, it has been argued that observational coding practices could influence effect size estimates: studies where sensitivity and attachment are examined in the same context (e.g., home observations of the Maternal Behavior Q-Sort [MBQS] and AQS) could inflate effect sizes compared to studies that relied on cross-context assessments (e.g., MBQS and SSP; Van IJzendoorn et al., 2004). The second is the type of sensitivity and attachment measure, which was discussed above. Third, other measurement characteristics including location (i.e., home vs. laboratory) of the sensitivity measure, as well as the number of observations and the duration of the observation, could contribute to effect size heterogeneity (Lindhiem et al., 2010). Fourth, coding precision is critical for estimating effect size based on two observational measures, and studies with poor reliability across either measure (i.e., ICC < .70) could increase between-study variation. Lastly, Mesman and Emmen (2013) conducted a systematic review of sensitivity measures and provided a list of eight validated measures that clearly demonstrated key elements of Mary Ainsworth's definition of sensitivity. These included the Ainsworth sensitivity scale (Ainsworth et al., 1974), the CARE-Index (Crittenden, 2021), Coding Interactive Behavior (Feldman, 1998), Emotional Availability Scales (Biringen, 2008), Erickson scales (Erickson et al., 1985), Global Ratings of Mother-Infant Interaction (Murray & Cooper, 1996), MBQS (Pederson et al., 1999), NICHD-SECCYD sensitivity scales (Owen, 1992), and Parent-Child Early Relationship Assessment (Clark, 1985). In this meta-analysis, we will examine if effect sizes differ based on "validated" versus other measures of sensitivity.

2. Parent and Child Age. In his model on the determinants of parenting Belsky (1984) proposed that one's developmental history, which includes age, is reflected in parenting. For example, older parents are often more responsive to children, engage in more conversational turns with infants and have more realistic expectations of their child's development (Belsky, 1984). Parent age may be an especially important moderator to examine with child-father dyads, as a meta-analysis by Rodrigues et al. (2021) suggests that the association between paternal sensitivity and child developmental outcomes may strengthen as fathers/children age.

In terms of child age, infants spend more of their time with their caregivers than older children, so it could be argued that the potency of caregiver sensitivity would be highest in early versus later in childhood. Yet, associations between caregiver sensitivity and child attachment may strengthen as the child ages and expectations about the caregiver's behavioral responses to distress consolidate over time. Indeed, as noted above, child age was a significant moderator in the meta-analysis by De Wolff and Van IJzendoorn (1997) in which effect sizes were higher in older versus younger children. Thus, this moderator merits re-examination in the current meta-analysis to inform research and practice initiatives.

3. Child Biological Sex. Child sex is a commonly examined characteristic in child development research. In terms of caregiver sensitivity, it has been proposed that there may be sex-based relations (e.g., Aber & Baker, 1990), but the literature supporting this notion is currently mixed and nuanced (e.g., Schoppe-Sullivan et al., 2006). In terms of child attachment, reliable sex differences have rarely been observed (Bakermans-Kranenburg & Van IJzendoorn, 2009; Van IJzendoorn et al., 1999), and a recent synthesis demonstrated that the proportion of infant boys and girls with secure or insecure attachment is comparable (Madigan, Fearon et al., 2023). Moreover, Zeegers et al. (2017) tested whether the percentage of boys moderated the

association between sensitivity and child attachment and did not find child sex to be a significant moderator. That said, it has been proposed that sex differences in child attachment may not emerge until the middle-childhood years (Del Giudice & Belsky, 2010). As a result, we will examine child sex at birth as a moderator in the current synthesis as our database includes children from infancy to middle childhood.

4. Socio-Demographic Factors. Individuals with higher socio-economic status (SES) may be more privileged in allocating time and finances to child stimulation (Becker, 2009), which could influence effect size estimates. Although De Wolff and Van IJzendoorn (1997) found that SES moderated the association between caregiver sensitivity and attachment, Zeegers et al. (2017) did not find this moderator to be significant in their restricted sample. It has also been suggested that caregivers from a marginalized ethnic group may face difficulties with poverty, as well as discrimination, which can contribute to daily forms of stress that impact caregiving behavior (Bakermans-Kranenburg et al., 2004). In the current meta-analysis, we examine percent of the sample identifying as racially and ethnically marginalized, as well as low versus middle/upper SES, as moderators.

5. Clinical and Medical Samples. It has been proposed that provision of sensitive care may be more challenging when caregivers face mental health challenges such as depression, bipolar disorder, anxiety, and/or substance abuse (e.g., Bernard et al., 2018; Gelfand & Teti, 1990). For example, a caregiver suffering from depression may experience symptoms such as low motivation, flat affect, anhedonia, as well as difficulties regulating their emotions, all of which could impact their ability to engage in sensitive caregiving. Moreover, depression is also associated with concentration difficulties, which would limit a caregiver's ability to recognize and respond to children's cues and signals. Meta-analyses have found associations between

maternal depressive symptoms and levels of caregiver sensitivity (Bernard et al., 2018), as well as maternal depression and insecure attachment (Atkinson et al., 2000; Badovinac et al., 2018).

For children, clinical status can refer to samples in which children had either internalizing (e.g., anxiety, depression) or externalizing (e.g., aggression, oppositional) behavioral problems. Meta-analyses have shown that caregiver sensitivity (Cooke et al., 2022) and attachment security (Fearon et al., 2010; Groh et al., 2012; Madigan et al., 2013) are lower in children with internalizing and externalizing behavioral problems.

Child medical risks include premature birth or chronic medical illnesses (e.g., cystic fibrosis, congenital heart disease). Caregivers' behaviors may be impacted by the child's medical condition, with either withdrawal due to medical fragility or intrusiveness or overcompensation due to fear of child mortality (Marvin & Pianta, 1996; Van IJzendoorn et al., 1992). Taken together, it is possible that between-study variation could be explained by caregiver and child clinical status for mental health difficulties, as well as child medical illness status, and these variables therefore represent important moderators to test in this meta-analysis.

6. Samples with Adoptive and Foster Parent-Child Dyads. It has been suggested that a sensitive period for forming secure attachment relationships may exist early in infancy (Bowlby, 1969) when infants are frequently and intensively interacting with a select number of caregivers (Humphreys & Zeanah, 2015). Children raised in institutional or foster care may not experience or develop a secure attachment relationship with an attachment figure or may develop an atypical attachment. These children may mistrust adult caregivers or may lack expected contingent input from caregivers (Bakermans-Kranenburg et al., 2011). When adopted out of institutional or foster care, their mistrust in caregivers or lack of expectations for contingent interactions with caregivers may create difficulties in forming secure attachment, regardless of the caregivers'

levels of sensitivity. Thus, in the current study we will examine whether associations between caregiver sensitivity and child attachment security differ in biological caregivers versus foster and adoptive caregivers.

7. Geographical Region. The concept of maternal sensitivity is thought to be universal across cultures (Mesman et al., 2015), but the specific behaviors measured to assess it (e.g. what constitutes an "appropriate" caregiver response to child signals) may be influenced by researchers' cultural values (LeVine, 2004). Thus, we will examine geographic region as a moderator in our analyses, defined in terms of regions of the world.

8. Study Characteristics. We will examine commonly run moderator analyses pertaining to study characteristics, including publication year and publication status, as well as study design (i.e., cross-sectional vs longitudinal). We also examine the time between the assessment of sensitivity and attachment as a moderator, as an attenuation effect has been observed in the magnitude of this association (Atkinson et al., 2000).

The Current Study

The number of studies reporting on the relation between caregiver sensitivity and child attachment has grown considerably in the last few decades. Commensurate with this growth has been greater heterogeneity in measurement and diversity in caregivers and sample populations being studied. Thus, it is timely to conduct a comprehensive meta-analysis of studies amassed to date. In these analyses, one objective is to examine the role of parental gender. Pooled effect sizes for mothers and fathers will be separately derived and directly compared to determine if they statistically differ from one another, and to test whether unique moderators emerge for mothers and fathers. It is hypothesized that sensitivity will be associated with child attachment

security, but consistent with previous literature, associations will be larger for mothers versus fathers.

A second objective is to explain potential moderators that may explain between-study heterogeneity in studies amassed to date. This endeavor is particularly important as few moderators have been identified in previous meta-analyses on caregiver sensitivity and child attachment. Important moderators to examine include (1) measurement characteristics (i.e., type of measure, location of observation, number of observations, coder independence, reliability status, validated sensitivity measure, and duration of sensitivity observation), (2) parent and child age, (3) child sex; (4) socio-demographic factors (i.e., income, ethnicity), (5) child and parent clinical risk and child medical risk, (6) foster/adoptive samples, (7) geographical region, and (8) study characteristics (i.e., publication status, study design, publication year, time between assessments of sensitivity and attachment). We examine each of these moderators in a univariate fashion and also conduct multivariate moderator analyses to determine which moderators remain significant once we account for multiple moderators. As previous meta-analyses have not identified consistent moderators of the association between caregiver sensitivity and child attachment, we do not make any a priori predictions of which moderators are likely to be significant in the current meta-analysis.

There has been a proliferation of studies examining how caregiver sensitivity differs across the specific subtypes of insecure attachment (i.e., avoidant, resistant, and disorganized). Thus, a third and exploratory objective of this synthesis is to examine if the magnitude of associations between sensitivity and child attachment differs for children classified as avoidant, resistant, and disorganized versus secure. It is expected that effect sizes for the association between caregiver sensitivity and avoidant and resistant attachment will be comparable and

statistically larger than associations between sensitivity and disorganized attachment, as disorganized attachment is hypothesized to be more strongly related to frightening and alarming rather than to insensitive caregiving behavior. Together, our three study objectives seek to advance knowledge on a central determinant of child attachment, to further inform future research endeavors, and to assist in intervention planning.

Method

Definitional Criteria

Caregiver sensitivity is defined as a caregiver's ability to contingently, appropriately, and promptly respond to the child's bids and signals in both distress and non-distress situations (Ainsworth et al., 1978). In this meta-analysis we only include observational measures of sensitivity, as observational and questionnaire measures of parenting are often poorly correlated (e.g., Boonen et al., 2015; Zaslow et al., 2006). We included measures of "responsiveness," "emotional availability," and "contingency," which can be described broadly as a component of "sensitivity," even if these measures are less focused on the caregiver's noticing and interpreting of signals, but more focused on the caregiver's promptness and engagement of response (Ainsworth, 1977; Kochanska & Aksan, 2004). In moderator analyses examining the type of sensitivity construct, the construct label (e.g., sensitivity, responsiveness, emotional availability) used in each individual study, as defined by study authors, was the construct coded. Consistent with other meta-analyses (e.g., Cooke et al., 2022), both single rating measures of sensitivity and derived composites (e.g., sensitivity + warmth) were included. *Child attachment* was defined as an observational measure of the quality of the child's attachment relationship with a biological or non-biological caregiver. Both observational measures conducted in the laboratory (i.e., the SSP or SSP-M) and the home (i.e., the AQS; Waters & Deane, 1985) were included.

Search Strategy

As part of a larger project, the Child Attachment Studies Catalogue and Data Exchange (CASCADE [Madigan, 2020]), we created an inventory of all studies using observational measures of parent-child attachment (i.e., SSP, AQS, and SSP-M). All related variables in each study with an observational measure of parent-child attachment were catalogued in terms of other variables and correlates available in the study, including parenting behavior. For the purposes of CASCADE, a science librarian conducted electronic searches in several databases, including PsycINFO, MEDLINE, Embase, and Dissertation Abstracts International for published and unpublished studies from prior to the publication of the SSP (i.e., Jan 1, 1967) up to August 5, 2020. Both database-specific subject headings and text word fields were searched with variations of the terms "strange situation" and "attachment". Synonymous terms were first combined with the Boolean "OR." These concepts were then combined with the Boolean "AND." In all databases, truncation symbols were used in text word searches when appropriate to capture variations in spelling and phrasing. Language restrictions were not applied.

The search strategy for CASCADE identified 29,980 non-duplicate titles and abstracts, which were then reviewed for study inclusion in CASCADE (see PRISMA flow diagram in Figure 1). For the purpose of this specific meta-analysis on caregiver sensitivity and child attachment, we also reviewed other relevant meta-analyses in the field of attachment (e.g., Cyr et al., 2010; De Wolff & Van IJzendoorn, 1997; Lucassen et al., 2011; O'Neill et al., 2021; Van IJzendoorn et al., 1999; Zeegers et al., 2017), as well as studies meeting our inclusion criteria, for additional relevant studies, which resulted in the addition of 16 potential studies to be included.

Study Inclusion and Exclusion Criteria

Study inclusion for CASCADE. A team of four students, each of whom had achieved greater than > 90% agreement on a set of 60 training abstracts, reviewed all titles and abstracts for inclusion into CASCADE. Studies were included in CASCADE if they had an observational measure of infant or child attachment and the full text article was available in English, French, or Spanish (languages spoken by our study team). A total of 2,405 studies in the titles/abstracts review stage moved onto full text review and 2,378 met full inclusion to be catalogued into CASCADE.

Study inclusion for this meta-analysis. Studies available in CASCADE were included in the current meta-analysis if they had: (a) an observational measure of caregiver sensitivity; (b) an observational measure of child attachment (security, avoidance, resistance, and/or disorganization); and (c) sufficient statistics were reported to extract or calculate an effect size. Studies were excluded if caregiving behavior was measured after the assessment of attachment and/or the association between sensitivity and child attachment was assessed following a parenting intervention. If associations were assessed at baseline in an intervention, these were included. Amongst the 2,378 studies available in CASCADE, 1696 were excluded as they did not report a sensitivity measure, and the remaining full-text exclusions were due to overlapping samples (n = 396), intervention studies (without baseline data, n = 27), review articles (n = 27), and/or where statistics were not available in studies (n = 138) (Figure 1). In total, 181 studies met full inclusion criteria and underwent data extraction for this meta-analysis.

Data Extraction

A data extraction coding protocol was developed and used to extract all moderator variables and effect size for each study meeting full inclusion criteria. One coder extracted all data and 20% of studies were double coded by a trained research assistant. Reliability across the

continuous measures (ICC ≥ 0.98) and categorical (91% agreement) measures on average was high. Any discrepancies were resolved to consensus via discussion and, if needed, consultation with the senior author.

Moderators. We extracted the following moderators from each study:

1. Measurement factors:
    - Child attachment measure: (a) SSP, (b), SSP-M; (c) AQS.
    - Caregiver sensitivity measure: Recorded as (a) Ainsworth, (b) CARE-Index, (c) Coding Interactive Behavior, (d) Emotional Availability Scales, (e) Erickson scales, (f) Global Ratings of Mother-Infant Interaction, (g) MBQS, (h) NICHD-SECCYD sensitivity scales, or (i) Parent-Child Early Relationship Assessment.
    - Location of sensitivity assessment: Recorded as (a) home or (b) laboratory.
    - Number of sensitivity observations: Recorded as (a) single assessment or (b) multiple assessments.
    - Coder independence (i.e., coders who coded sensitivity were independent from those who coded attachment). Recorded as (a) dependent/unreported or (b) independent.
    - Reliability of attachment and sensitivity: Recorded as (a) poor (<.70), (b) adequate (≥.70 to <.80), or (c) excellent (≥.80).
    - Duration of sensitivity assessment (in minutes).
2. Parent and Child Age
    - Parent age: Recorded in years. Parent age at the assessment of caregiver sensitivity was strongly associated with parent age at the assessment of child attachment (r = .95, p < .001), therefore, only parent age at the assessment of attachment (in years) was used in analyses.

- Child age: Recorded in months. Child age at the assessment of caregiver sensitivity was highly correlated with child age at the assessment of child attachment ($r = .98$, $p < .001$), therefore only child age at the assessment of attachment (in months) was used in analyses.

3. Child Sex and Parent Gender
    - Child Sex. Recorded as percent of boys in the sample. Note, for the moderator analysis, only samples with percentages different from 0% or 100% were included.
    - Caregiver gender: Recorded as (a) continuous measure of percent of sample that are mothers, as some studies have mixed samples of mothers and fathers; or (b) categorical measure of father-only or mother-only samples.
4. Socio-demographic factors:
    - Socio-economic risk: Sample socio-economic status was coded as low versus middle-to-high income backgrounds.
    - Race/ethnicity: Data were extracted for proportion of sample from a historically oppressed ethnic groups (% marginalized). We identified groups to be ethnically minoritized if they did not identify as White and lived in a country in which the majority ethnicity was White (e.g., Canada, Europe, UK, USA).
5. Child and parent clinical risk and child medical risk:
    - Child clinical risk. Recorded as (a) no risk or (b) clinical sample (sample with high [>80%] proportion of children who were from clinical populations.
    - Parent clinical risk. Recorded as (a) no risk or (b) clinical sample (sample with high [>80%] proportion of parents had some form of psychopathology.

- Child medical risk. Recorded as (a) no medical risk or (b) medical risk (sample with high [>80%] proportion of children with some form of medical risk, e.g., preterm).

6. Foster/adoptive samples. Recorded as (a) foster/adoptive parents or (b) other parents.
7. Geographical region. Recorded as country and continent where the study was conducted.
8. Study characteristics:

- Publication status: Recorded as (a) published or (b) unpublished.
- Publication year: Year of publication recorded.
- Study design: Recorded as (a) cross-sectional or (b) longitudinal.
- Duration of time between sensitivity and attachment measures: Recorded as months between assessments.

Transparency and Openness

Analysis code, data, and research materials relevant to this study can be found at this link: https://osf.io/372g6/. This meta-analysis was not pre-registered.

Data Synthesis and Analysis

We developed a cross-referencing protocol to ensure that each sample was only represented by one publication. First, in the event that the same sample was represented across multiple study publications, we selected the publication with the largest sample size and most comprehensive data extraction information. Second, in the event a sample was represented in both published and unpublished studies, we retained data from the published study, which has undergone peer-reviewed and may be less prone to methodological errors.

Extracted effect sizes (e.g., *r*, *d*, t-tests, etc) represented associations between caregiver sensitivity and secure attachment. Effect sizes were also extracted, if provided, for the association between caregiver sensitivity and different types of attachment: secure, avoidant,

resistant, and disorganized. Positive pooled effect sizes, represented as a correlation (r), indicated that higher levels of caregiver sensitivity were associated with children's secure attachment (e.g., classification of secure attachment; higher scale scores on the AQS). Negative pooled effect sizes indicated that lower levels of caregiver sensitivity were associated with a specific attachment type.

Given that this study relied on a multilevel meta-analysis procedure, we extracted all effect sizes provided in each study. For example, if a study reported on multiple associations over time (e.g., the association between sensitivity at 12 months and attachment at 12 and 24 months), all effect sizes were included. Similarly, separate effect sizes for subscales of sensitivity (e.g., responsiveness), were extracted. Of the 181 studies included in this meta-analysis, 23% included multiple effect sizes, resulting in a total of 238 effect sizes that reported on an association between caregiver sensitivity and child attachment.

Studies presented statistics in different formats, including group differences, odd ratios, Pearson's correlations, and regression coefficients (Borenstein et al., 2021). We transformed all effect sizes into Pearson's correlations (*r*) with 95% confidence intervals using standard transformation formulas in the R package *esc* (Lüdecke et al., 2019) . In $k = 22$, we could not extract effect sizes from the study because insufficient information was reported. In such cases, we emailed study authors and requested relevant statistics for inclusion into the meta-analysis. Fourteen authors replied (63.6%) and of those, eight authors (36.4%) were able to provide the requested information. Authors who replied but did not provide data no longer had access to the data. In the event that a study reported that associations were non-significant without the provision of an effect size metric ($k = 15$), we computed an effect size by entering a two-sided *p* value of .50, which is standard practice in meta-analyses (Rosenthal, 1995).

Correlations were converted to Fisher's *z* to reduce variability due to the variance depending on the magnitude of correlations (Borenstein et al., 2021), then transformed back to correlations with 95% confidence intervals to ease interpretation. Consistent with field-specific recommendations by Schuengel et al. (2021) for interpretation of effect sizes in attachment meta-analyses, correlations of .10, .20, and .30 were interpreted as small, medium, and large in magnitude, respectively.

We conducted random effects meta-analyses to account for differences in study population parameters and to more correctly capture the heterogeneity commonly identified in observational studies (Russo, 2007). For the meta-analysis on attachment security, the analysis was conducted (a) for all samples (reported in Supplementary Material), (b) for mother-only samples, and (c) for father-only samples. Analyses, including moderator analyses, were conducted separately for mothers and fathers. This decision stemmed from evidence showing that, even if effect sizes are similar across parents, child-mother and child-father relationships may be impacted differently by external factors (Fagan et al., 2014). For example, the association between paternal sensitivity and child-father attachment security may be more affected by child characteristics (e.g., child age) than in the case of mothers as caregivers (Schoppe-Sullivan et al., 2006).

The analyses were conducted in R using the *robumeta* package (Fisher & Tipton, 2015), which allows for a multilevel approach that accounts for dependency between the multiple effect sizes reported in some studies. An assumed Rho value of .80 was used for the correlated effects model weights, in line with recommendations by Tanner-Smith et al. (2016). Sensitivity analyses at Rho of .00, .20, .40, .60, .80, and 1.00 revealed that the choice of Rho value did not alter the

results (i.e., there were no changes at the level of the fourth decimal across Rho levels). Consequently, we only report results for Rho = .80.

We evaluated the presence of publication bias and *p*-hacking and funnel plot examination in the *metafor* package (Viechtbauer, 2010) and a *p*-curve analysis in the *dmetar* package. We also conducted a multilevel meta-analysis version (MLMA) of the Egger's test (Rodgers & Pustejovsky, 2021). We assessed the between-study heterogeneity via the score dispersion in the prediction interval (Borenstein, 2022), and report the overall level of heterogeneity (τ^2) and the ratio of between-study heterogeneity to total variance using the I^2 index. We tested for moderators that may account for between-study heterogeneity through meta-regressions using the *robumeta* package. First, moderators were considered at a univariate level by testing each moderator individually. Categorical moderators were only performed if df > 4, in order to ensure that provided estimates were reliable (see Tanner-Smith et al., 2016). The omnibus test of categorical moderation was evaluated with the Wald test of the *clubSandwich* package (Pustejovsky, 2020). Given the multiple contrasts tested, the alpha level for the univariate analyses was set at $p < .01$. Second, for the attachment security meta-analyses, univariate moderators identified as significant were tested at the multivariate level by grouping similar moderators to account for their relative contributions. The alpha level for the multivariate analyses was set at $p < .05$.

The meta-analyses on attachment avoidance, resistance, and disorganization were conducted for mother-only samples because only 3 samples (6 effect sizes) provided the category breakdown for child-father attachment. These meta-analyses focused on the main result and did not explore moderators.

Results

Study Characteristics

Characteristics for each included study are presented in Supplemental Table 1. In total, 181 studies were included. Of these studies, 174 reported on the association between sensitivity and security, 35 on sensitivity and avoidant attachment, 36 on sensitivity and resistant attachment, and 23 on sensitivity and disorganized attachment. The studies included a total of 23,597 unique participants with a range of 8 to 6,850 participants (mean = 130, median = 68). The vast majority of studies assessed sensitivity in mothers only (k = 156, 86%), with the rest assessing sensitivity in fathers only (k = 12, 7%), in both mothers and fathers (k = 9, 5%), or in parents without separating based on gender (k = 4, 2%, range of mothers in those samples was 89-98%). With respect to SES, studies included families that were at a low SES (k = 29, 16%), mid-high SES (k = 58, 32%), or mixed SES (k = 62, 34%). The rest of the studies (k = 32, 18%) did not specify this information. Participants were primarily White across studies (mean = 78% White, median = 93% White), with a range of 0% to 100% White participants.

Studies were mostly conducted in North America (k = 113, 62%) or Europe (k = 45, 25%), with the rest being conducted in Asia (k = 9, 5%), the Middle East (i.e., Israel; k = 7, 4%), South America (k = 2, 1%), Africa (k = 2, 1%), and Australia/NZ (k = 2, 1%). One study (k = 1, 1%) reported on data from North America and South America. Most studies were peer-reviewed articles (k = 158, 87%) and the rest were part of dissertations or books (k = 23, 13%). Studies were published between 1978 and 2020 (median = 2005).

Effect Size Characteristics

Many of the studies included in the meta-analysis reported on multiple effect sizes (e.g., multiple measures, multiple time points; range: 1-4). To represent each effect size, the following

characteristics are reported at the level of effect sizes (k = 238). The construct of sensitivity assessed was 'sensitivity' in most studies (k = 181, 76%), responsiveness (k = 39, 16%), emotional availability (k = 4, 2%), contingency (k = 2, 1%), or another term (k = 12, 5%). Sensitivity was assessed in the home (k = 116, 49%), in the lab (k = 99, 42%), in another institution (k = 7, 3%), or a mix of locations (k = 4, 2%). The average duration of observation was 43 minutes, with a range of 2 to 960 minutes. Ainsworth's original study was an outlier at 960 minutes; the second longest duration was 270 minutes (median = 15 minutes). The coding system used was variously the Ainsworth system (k = 87, 37%), the Emotional Availability Scales (k = 27, 11%), the MBQS (k = 28, 12%), the CARE-Index (k = 14, 6%), the NICHD scales (k = 8, 3%), or another system (k = 53, 22%)—the rest did not report on the coding system used (k = 21, 10%). The inter-rater reliability was poor (k = 11, 5%), adequate (k = 45, 19%), excellent (k = 152, 64%), or unreported (k = 30, 13%).

The attachment assessment was conducted with the SSP (k = 166, 70%), the SSP-M (k = 16, 7%), or the AQS (k = 56, 23%). Among studies that reported on the expertise of the coders (k = 131), 89% were coded by expert coders. The inter-rater reliability was poor (k = 18, 8%), adequate (k = 42, 16%), excellent (k = 136, 58%), or unreported (k = 42, 18%). Most studies reported that sensitivity and attachment were coded by independent coders (k = 172, 72%). The rest were coded by the same coder (k = 10, 4%) or did not report this information (k = 56, 24%).

Parents were on average 30.0 years old at the assessment of sensitivity (range: 17 to 46 years old), and children were 15.6 months old on average (range: 1 to 75 months, median = 12 months). Parents were on average 30.4 years old at the assessment of attachment (range: 18 to 46 years old), and children were 19.3 months old on average (range: 8 to 75 months, median = 15 months). A minority of the effect sizes reflected parents (k = 11, 5%) or children (k = 31, 13%)

with clinical risk, or medical risk (k = 30, 13%). The majority of samples included non-foster or non-adoptive parents (k = 223, 94%).

Meta-Analysis on Parental Sensitivity and Attachment Security

Main Analysis

All Child-Caregiver Dyads. Results that include all samples that measured the association between parental sensitivity and attachment security (including those that presented a mix of mothers and fathers). Caregiver sensitivity and child-caregiver attachment were significantly associated: r = .25, 95% CI [.22, .28], k = 174, 230 effect sizes, N = 22,914. This association was of moderate to large magnitude (Schuengel et al., 2021). The prediction interval indicated that the true effect size, in which 95% of comparable populations would fall, ranged from r = -.06 to r = .48, indicating the presence of heterogeneity with effects ranging from non-significant to large in magnitude (τ^2 = .03, I^2 = 74.30%). The funnel plot did not suggest bias in favor of small studies with large effect sizes (see Supplemental Figure 1), but the MLMA Egger test suggested small-studies bias (B = 1.07, p < .001). From the 230 provided effect sizes, the p-curve analysis (Simonsohn et al., 2014) included 218 significant at the p < .05 level, 217 of which were significant at the level of p < .025. The test of right skewness was significant (*zHalf* = -98.72, p < .001) and the test of flatness was not significant (*zHalf* = 100.74, p = .999). This analysis suggested evidential value, which signifies that the effect is not spurious and that there was sufficient evidence to rule out p-hacking and selective reporting.

Child-Mother Dyads. A total of 159 studies (202 effect sizes) with a total of 21,483 participants focused on maternal sensitivity and child-mother attachment. A significant association of medium to large magnitude was observed: r = .26, 95% CI [.22, 29], p < .001. The prediction interval ranged from r = -.05 to r = .49, indicating the presence of heterogeneity with

effect sizes ranging from non-significant to large in magnitude (τ^2 = .03, I^2 = 74.72). The funnel plot did not suggest bias in favor of small studies with large effect sizes (see Supplemental Figure 2), but the MLMA Egger test suggested small-studies bias (B = 1.09, p = .002). Of the 202 provided effect sizes, the *p*-curve analysis (Simonsohn et al., 2014) included 192 significant effects at $p < .05$. Of these, 91 were significant at the level of $p < .025$. The test of right skewness was significant (*zHalf* = -92.65, $p < .001$) and the test of flatness was not significant (*zHalf* = 94.63, p = .999). This analysis suggested evidential value, which signifies that the effect is not spurious and that there was sufficient evidence to rule out *p*-hacking and selective reporting.

Child-Father Dyads. A total of 22 studies (23 effect sizes) with a total of 1,626 participants focused on paternal sensitivity and child-father attachment. A significant medium effect size was identified: r = .21, 95% CI [.14, 27], $p < .001$. The prediction interval ranged from r = -.02 to r = .40, indicating the presence of heterogeneity with effects ranging from null to large in magnitude (τ^2 = .01, I^2 = 45.43). The funnel plot suggested some bias in favor of small studies with large effect sizes (see Supplemental Figure 3), as did the MLMA Egger test (B = 1.43, p = .05). From the 23 provided effect sizes, the *p*-curve analysis (Simonsohn et al., 2014) included 21 significant at the $p < .05$ level, all of which were significant at the level of $p < .025$. The test of right skewness was significant (*zHalf* = -32.27, $p < .001$) and the test of flatness was not significant (*zHalf* = 32.67, p = .999). This analysis suggested evidential value, which signifies that the effect is not spurious and that there was sufficient evidence to rule out *p*-hacking and selective reporting.

Comparison of Parental Gender. We tested whether effect sizes were comparable for child-mother and child-father dyads. Comparisons were done using the uncorrected estimates given that corrections may introduce bias in analyses (Carter et al., 2019). In an attempt to get a

reliable test of the potential difference in the magnitude of effect sizes, we used multiple methods. First, among samples with either 100% mothers or 100% fathers, we tested parental gender as a categorical moderator, and the Wald test did not identify a significant difference between effect sizes for child-mother and child-father dyads ($F = 1.30$, $p = .27$; see Figure 2 for a graphical depiction of the effect sizes). Second, given that moderator tests may fall prey to low statistical power, we conducted an equivalence test to confirm that effect sizes are comparable irrespective of parent gender. Equivalence bounds were set at $r = .10, .20, .30$ based on guidelines of effect sizes (Schuengel et al., 2021), converted into Cohen's *d.* The 90% equivalence confidence interval of this effect (-.003, .076) fell between the strictest equivalence bound (-.201, .201). This was supported by a two one-sided test (TOST) of equivalence testing conducted with *TOSTmeta,* which rejected the null hypothesis of non-equivalence ($z = -6.80$, $p < .001$).

As a sensitivity analysis, we also tested the moderating effect of parental gender in the subsample of studies that included child-mother and child-father dyads from the same families ($k = 11$, $n = 788$). Similar results were identified (i.e., non-significant categorical moderating effect: $F = 0.62$, $p = .45$).

Univariate Moderators

All Child-Caregiver Dyads. The analysis of moderators identified a number of significant moderating variables (Table 1). First, the effect size varied as a function of the attachment measure used, such that the effect was larger for AQS studies ($r = .34$, 95% CI [.28, .39]) than SSP ($r = .23$, 95% CI [.19, .27]) and SSP-M studies ($r = .20$, 95% CI [.11, .29]). The effect size was larger when the reliability of the attachment measure was excellent ($r = .27$, 95% CI [.23, .31]) or adequate ($r = .24$, 95% CI [.17, .32]) than poor ($r = .13$, 95% CI [.04, .21]). The

effect size was larger when the sensitivity measure used was the MBQS (r = .46, 95% CI [.38, .53]) than Ainsworth's scale (r = .24, 95% CI [.19, .29]) or the EAS (r = .24, 95% CI [.15, .33]); these three measures were the focus of the moderator analysis given that other measures (e.g., NICHD) were less frequently used.

Given that results indicated larger effect sizes for the AQS and MBQS, we conducted a sub-analysis to determine if this effect size was due to the measure or to a spillover effect of coding the MBQS and AQS from the same interaction. The association between sensitivity and attachment was larger when both the AQS and MBQS were used during the same observation (r = .45, 95% CI [.40, .54]) compared to studies that used one of the two measures (r = .31, 95% CI [.23, .38]) or other measures (r = .21, 95% CI [.18, .25]). This suggests inflation of the effect size when studies base the AQS and MBQS measures on the same observed interactions.

Among continuous moderators, significant moderators included the duration of the sensitivity task, by which the association was larger with longer observations (Supplemental Figure 4). The effect size also became smaller when the time between assessments was longer (Figure 5). Of note, this effect remained significant after taking out the studies that used the same observation to code the AQS and MBQS (b = -.010, 95% CI [-.02, -.003]).

Mother-Child Dyads. There were enough studies (and degrees of freedom) to test all moderators except for the independence of coders (Table 2). Significant moderators included the attachment measure, the reliability of the attachment measure, the sensitivity measure, the duration of the sensitivity task, and the time between assessments. For the attachment measure used, the effect size was larger for the AQS (r = .33, 95% CI [.28, .39]) than the SSP (r = .24, 95% CI [.19, .28]) and the SSP-modified (r = .21, 95% CI [.11, .30]). In terms of the reliability of the measure, the effect size was larger when reliability was excellent (r = .27, 95% CI [.23,

.31]) or adequate (r = .22, 95% CI [.17, .27]) compared to poor (r = .17, 95% CI [.07, .27]). We compared across the most common sensitivity measures used (i.e., Ainsworth, EAS, MBQS), and the effect was larger when sensitivity was measured using the MBQS (r = .46, 95% CI [.38, .54]) than Ainsworth's scale (r = .24, 95% CI [.19, .29]) or the EAS (r = .25, 95% CI [.16, .33]). Given that results indicated larger effect sizes for the AQS and MBQS, we conducted a sub-analysis to determine if this effect size was due to the measure or to a spillover effect of coding the MBQS and AQS from the same interaction. The association between sensitivity and attachment was larger when both the AQS and MBQS were used during the same observation (r = .46, 95% CI [.40, .52]) compared to studies that used one of the two measures (r = .31, 95% CI [.23, .38]) or other measures (r = .22, 95% CI [.18, .25]). Thus, there may be some inflation of the effect size when studies base the AQS and MBQS measures on the same observed interactions.

Other significant moderators included the time between assessments, whereby the effect size became smaller as the time between assessments increased (b = -.009, 95% CI [-.016, -.003], p = .01, see Supplemental Figure 6). Of note, this effect remained significant after taking out the studies that used the same observation to code the AQS and MBQS (b = -.009, 95% CI [-.02, -.003]). The effect also was larger as the duration of the sensitivity observation increased (b = .001, 95% CI [.000, .002], p = .002; see Supplemental Figure 7).

Child-Father Dyads. Only a small number of moderators had enough studies to be tested: location of sensitivity assessment, study design, child age, child gender, duration of sensitivity task, percentage of minorities, parent age, publication year, and time between assessments (Table 2). Two moderators emerged as significant. The effect size was larger when

children were older (b = .005, 95% CI [.002, .009], p = .01; see Supplemental Figure 8) and when fathers were older (b = .025, 95% CI [.001, .043], p = .01; see Supplemental Figure 9).

Multivariate Moderator Analyses

In order to examine which moderators would remain significant once we account for multiple moderators, we tested multilevel meta-regression models for significant moderators (Table 3). These models were tested for all caregivers and child-mother dyads only, given that they included a sufficient number of studies for this test. The models included the attachment measure used, the reliability of the attachment measure, the sensitivity measure used, the duration of the sensitivity observation, and the time between assessments.

In the model for all caregivers, two moderators remained significant after accounting for other moderators. The effect size was larger when the MBQS was used (b = .200, 95% CI [.006, .388], p = .04), and smaller when the time between assessments increased (b = -.013, 95% CI [-.024, -.002], p = .03). In the model for child-mother dyads, the effect size was larger when the MBQS was used (b = .214, 95% CI [.019, .409], p = .03).

Maternal Sensitivity and Insecure Child-Mother Attachment

The association between maternal sensitivity and each of the insecure child-mother attachment types (avoidant, resistant, and disorganized) was examined. The attachment types were compared with security (e.g., avoidant compared to secure).

Avoidant Attachment

Thirty-five studies (43 effect sizes) reported on the association between maternal sensitivity and avoidance (n = 4,798 children). No outliers were identified. The results indicated a significant association, medium to large in magnitude: r = -.24, 95% CI [-.34, -.13], p < .001. The prediction interval indicated the presence of considerable heterogeneity, with the true effect

size ranging from r = -.66 to r = .28 (τ^2 = .07, I^2 = 89.59). The funnel plot and Egger's MLMA test did not suggest the presence of small-study effect bias (B = -0.68, p = .70; see Supplemental Figure 10). Of the 43 effect sizes provided, the p-curve analysis included 39 studies, all of which were significant at the level of p < .025. The test of right skewness was significant (*zHalf* = -42.88, p < .001) and the test of flatness was not significant (*zHalf* = 43.22, p = .999). This analysis suggested evidential value, which signifies that the effect is not spurious and that there was sufficient evidence to rule out p-hacking and selective reporting.

Resistant Attachment

Thirty-six studies (43 effect sizes) reported on the association between maternal sensitivity and resistance (n = 4,838 children). One study was identified as an outlier and winsorized to the limit of ±3 SD for inclusion in the analysis. The results indicated a significant association, small to medium in magnitude: r = -.14, 95% CI [-.22, -.07], p < .001. The prediction interval ranged from r = -.54 to r = .30, indicating considerable heterogeneity with the true effect size ranging from a large negative to a large positive association (τ^2 = .04, I^2 = 81.70). The funnel plot and Egger's test did not suggest the presence of small-study effect bias (B = -1.63, p = .94; see Supplemental Figure 11). Of the 43 effect sizes provided, the p-curve analysis included 38 that were significant at p < .05. Of these, 37 were significant at the level of p < .025. The test of right skewness was significant (*zHalf* = -41.51, p < .001) and the test of flatness was not significant (*zHalf* = 42.80, p = .999). This analysis suggested evidential value, which signifies that the effect is not spurious and that there was sufficient evidence to rule out p-hacking and selective reporting.

Disorganized Attachment

Twenty-three studies (24 effect sizes) reported on the association between maternal sensitivity and disorganization (n = 3,799 children). One study was identified as an outlier and winsorized to ±3 SD for inclusion in the analysis. The results indicated a significant association medium in magnitude: r = -.22, 95% CI [-.31, -.13], p < .001. The prediction interval ranged from r = -.54 to r = .14, showing the presence of heterogeneity with effects ranging from a large negative association to a small positive association (τ^2 = .03, I^2 = 81.69). The funnel plot and Egger's test did not suggest the presence of small-study effect bias (B = -2.19, p = .93; see Supplemental Figure 12). Of the 24 provided studies, the p-curve analysis included 22 studies that were significant at the level of p < .025. The test of right skewness was significant ($zHalf$ = -34.96, p < .001) and the test of flatness was not significant ($zHalf$ = 36.29, p = .999). This analysis suggested evidential value, which signifies that the effect is not spurious and that there was sufficient evidence to rule out p-hacking and selective reporting.

Comparison of Insecure Attachment Types

A multilevel meta-analysis comparing the three types of insecure attachments revealed no significant difference in the magnitude of the association between sensitivity and insecure attachment types (compared to A as a referent level; C: b = .060, 95% CI [-.020, .140], p = .14; D: b = -.013, 95% CI [-.132, 105], p = .82; see Figure 3 for a graphical depiction of the effect sizes).

Discussion

Over a half-century ago, the founders of attachment theory offered the theoretical proposition that a caregiver's behavior in response to their child's signals would influence the type of attachment their child forms with them (Ainsworth et al., 1978). This now common-sense notion was considered somewhat radical at the time, but studies have demonstrated a robust

association between parenting sensitivity and child attachment security, and attachment theory has become a mainstay of developmental and clinical science. For example, bolstering caregiver sensitivity is now a core focus of parent-child interventions used across the globe (Bakermans-Kranenburg et al., 2003; Facompré et al., 2018; Van IJzendoorn et al., 2023). Research on parenting behavior and child attachment has grown exponentially in the last few decades, with replications in larger, well-controlled studies, as well as new studies on populations with different family structures (e.g., fathers, adoptive and foster caregivers), backgrounds (e.g., across the socio-economic stratum), and child characteristics (e.g., medical and/or clinical considerations). The multi-level meta-analyses in the current study draw on studies conducted to date to explore when and for whom the association between caregiver sensitivity and child attachment, anticipated by attachment theory, are smaller or larger.

In the current meta-analysis, we found that across 174 studies (230 effect sizes) and 22,914 parent child dyads, the association between caregiver sensitivity and child attachment security was statistically significant and moderate in magnitude (r = .25). This is the most comprehensive meta-analysis conducted to date on the topic, with over three times as many studies as the latest meta-analysis (i.e., Zeegers et al., 2017) and six times as many as the original meta-analysis by De Wolff and Van IJzendoorn (1997). Compared to previous meta-analyses, we also have far fewer exclusions regarding methodological, demographic, and child-specific characteristics. Interestingly, although our sample size was larger and our approach more inclusive, the derived pooled associations between caregiver sensitivity and child attachment security are remarkably similar to previous meta-analyses. Thus, decades of research suggest a robustly consistent finding: the quality of caregiving one receives in early childhood plays an important role in the development of parent-child attachment. It should be noted that studies

showed considerable heterogeneity, which reduces the risk for publication bias, but at the same time limits the generalizability of the combined effect size, especially given the identified small-study effects.

In addition to a comprehensive synthesis of the literature amassed to date on the topic of caregiver sensitivity and child attachment security, there were three novel objectives of this meta-analysis: (a) to provide pooled estimates and compare the associations between maternal and paternal sensitivity and child attachment; (b) to elucidate which sample, study, and methodological variables strengthen or weaken associations; and (c) to describe the effect of caregiver sensitivity on each type of insecure attachment classification. We discuss the results pertaining to each study objective in turn below, followed by a consideration of theoretical and practical implications, future directions, and study limitations.

Did the Association Differ Between Maternal and Paternal Sensitivity and Child Attachment?

There is now widespread acceptance and evidence that fathers play a significant role in children's development (Cabrera et al., 2018), and developmental research has been enriched by explicit theorizing and research on fathering (e.g., Bakermans-Kranenburg et al., 2019; Cabrera et al., 2014; Palkovitz, 2019). A particular point of interest has been whether paternal sensitivity predicts the formation of a secure attachment for child-father dyads, as it does for child-mother dyads. In previous meta-analyses, the effect sizes for the association between maternal and paternal sensitivity and child attachment were r = .22 (95% CI [.18-.27]; k = 30; N = 1,666; De Wolff & Van IJzendoorn, 1997) and r = .12 (95% CI [.06-.17]; k = 16; N = 1,355; Lucassen et al., 2011), respectively. Although these meta-analyses were conducted 15 years apart, a comparison of their confidence intervals suggested that the estimates in the respective studies

across child-mother and fathers-child dyads were statistically different, with the association between maternal sensitivity and child attachment being larger than the association between paternal sensitivity and child attachment. In contrast, in the current set of studies in this meta-analysis, the effect sizes for child-mother and child-father dyads were not statistically different. Specifically, across 159 studies (202 effect sizes, 21,483 dyads) we found that the association between maternal sensitivity and child attachment was $r = .26$ (95% CI [.22, .29]) and that the association between paternal sensitivity and child attachment ($k = 22$ studies and 23 effect sizes; $k = 1{,}626$) was in an overlapping range, $r = .21$ (95% CI [.14, .27]). Thus, the literature no longer reflects a gap between effect sizes for maternal sensitivity and child attachment and paternal sensitivity and child attachment.

Our important finding that associations between maternal and paternal sensitivity and child attachment security are similar also parallels research on the contribution of caregiver sensitivity to child language, cognition, and behavioral outcomes (Cooke et al., 2022; Madigan et al., 2019; Madigan, Fearon et al., 2023; Rodrigues et al., 2021; Van der Storm et al., 2022), where effect size magnitudes were similar for mothers and fathers, as well as the literature on similar contributions of caregiver sensitivity for mothers and fathers on child brain development (e.g., larger brain volume and greater cortical thickness; Kok et al., 2015). There are several reasons why the current meta-analysis may have identified similar magnitudes of associations for maternal and paternal sensitivity although past meta-analyses have not. From a practical standpoint, the current meta-analysis included a greater number of studies, and larger sample sizes, which can increase the precision of the meta-analytic estimates. In addition, whereas Lucassen et al. (2011) only included studies of children who participated in the SSP, with an average age of 15 months (range: 12-20.5 months), this meta-analysis includes all observational

measures of attachment, from infancy to middle childhood (e.g., SSP, AQS, modified-SSP), which inherently widens the age range of children included (i.e., *M* = 19.3 months; range 8-75 months). This point is important because father involvement has been shown to increase as children age. For example, a study by Belsky et al. (1984) showed that overall engagement with children at ages 1, 3, and 9 months was lower for fathers compared to mothers; however, the gap in the degree of engagement narrowed over the course of children's developmental trajectory. Thus, the greater heterogeneity in child age in the current meta-analysis may boost the effect size for fathers in particular, as the quality of their attachment relationship tends to consolidate over the child's second and third year of life. This hypothesis is supported by the finding in the current study that the association between paternal sensitivity (but not maternal sensitivity) and child attachment security was stronger for older children.

Another related possibility draws from the vast socio-cultural changes that have shaped the family unit. The role of fathers in child rearing has changed substantially in the past few decades (Bakermans-Kranenburg et al., 2019). For example, in 1970, fathers in many industrialized countries spent on average 11.8 minutes/weekday engaging in childrearing (e.g., playing, supervising, feeding, etc.), whereas in 2010, this average jumped six-fold to 62 minutes (Craig & Mullan, 2010; Roby, 1975). Commensurate with this change was an increase in women's labor force participation, which also shifted family structures and roles and responsibilities for childrearing (Cabrera et al., 2000). At the sociocultural level, norms, values, and expectations around father involvement in child rearing have rapidly changed. Policies such as parental leave have been implemented in many parts of the world to increase opportunities for fathers to be involved in caregiving (Heymann et al., 2013). With greater opportunities for caregiving and childcare come increased opportunities for engaging in sensitive and reciprocal

interactions that shape the child-parent attachment relationship. Taken together, both methodological and sociocultural factors are plausible explanations for our observation that the effect sizes for maternal and paternal sensitivity did not differ, which again, is a departure from the results of previous meta-analyses.

One debate in the attachment literature has been whether fathers display lower levels of sensitivity than mothers. A recent meta-analysis identified that mothers show higher levels of sensitivity than fathers, but only to a small extent (Deneault, Cabrera, et al., 2022). This gap in sensitivity has decreased across recent years and was not observed in some geographical regions of the world (e.g., Europe). The current study contributes to the ongoing discussion about sensitivity and parental gender. Specifically, even when levels of sensitivity vary between mothers and fathers, their association with secure attachment do not statistically differ. Moreover, the prevalence of secure infant-mother (51.2%) and secure infant-father (61.2%) attachment as assessed in the SSP in particular, is statistically similar (Madigan, Fearon et al., 2023). Likewise, as mentioned, associations between maternal and paternal sensitivity and secure attachment with various child outcomes are also similar (Cooke et al., 2022; Dagan et al., 2021; Deneault et al., 2021; Deneault, Hammond, et al., 2023; Madigan et al., 2019; Rodrigues et al., 2021). Taken together, available evidence suggests that there are more similarities than differences in the ways that sensitive caregiving and attachment security with mothers and fathers benefit children's development.

What Factors Moderated the Association between Parental Sensitivity and Child Attachment?

Moderators for Maternal Sensitivity. Although we did not find significant differences in the magnitude of associations for mothers and fathers, we did find unique sources of between-

study variability for each caregiver. Specifically, for child-mother dyads, methodological characteristics accounted for between study heterogeneity in effect sizes, whereas for fathers, only paternal and child age emerged as significant moderators. These moderators will be discussed in turn below.

Moderators for Maternal Sensitivity. Several methodological variables were important for the association between maternal sensitivity and child attachment, in both univariate and multivariate analyses (i.e., accounting for other methodological moderators within the analysis). First, we found that the magnitude of the effect sizes varied based on both the sensitivity and attachment measures being used. Specifically, effect sizes were larger in studies using the AQS measures (r = .33) compared to the SSP or SSP-M (r = .23), and also larger when sensitivity was measured using the MBQS (r = .46) versus the Ainsworth's scale (r = .24) or the EAS (r = .25). The MBQS and AQS rely on observational assessments of attachment in the home and the home environment is where infants in most societies form their expectations about caregivers, which may contribute to differences in effect sizes. It is important to point out that if the AQS and MBQS were both measured over the course of the same naturalistic home assessment (by different observers), effect sizes were considerably larger. Thus, it may be difficult for both raters to score one member of the dyads, without being influenced by the other (Van Bakel & Riksen-Walraven, 2004), which in turn could inflate associations. Notably, in the univariate moderation analyses, the association between sensitivity and attachment was larger when attachment was assessed using the continuous AQS compared to the categorical SSP or SSP-M. Yet, in the multivariate analysis in which, among others, the (significant predictor) MBQS was included, the moderating effect of the AQS versus SSP/ SSP-M became small and non-

significant. It would therefore be premature to conclude that the AQS, with its continuous ratings, would show better predictive validity than the categorical SSP/ SSP-M assessments.

It is also possible that the duration of *coding* Q-sort measures in combination with the extensive length of the home observation, may account for some of the statistical variation observed across attachment and sensitivity measures. For example, the Ainsworth and EAS scores are based on Likert rating scales which take less time to assign. In contrast, the method of ascertaining a sensitivity score using the MBQS involves an extensive sort of 90 caregiving descriptors, which takes considerable time (~1 hour). The coding process of the MBQS therefore, may lend itself to greater reflection and possibly greater precision and variance, on the true quality of maternal sensitivity. In addition, the context in which sensitivity is measured, particularly whether it is measured in a distress or non-distress context, may be particularly influential (e.g., Leerkes, 2011). More studies are needed comparing associations across these contexts to draw conclusions about the role of the observational context.

Second, in both the univariate and multivariate analyses, as the duration of time between the assessment of maternal sensitivity and child attachment was longer, effect sizes were smaller. Thus, the greater the temporal distance between the measure of caregiver sensitivity and child attachment, the smaller the effect size, paralleling a previous meta-analysis of 41 studies (2,243 dyads) conducted by Atkinson et al. (2000). The importance of temporality for understanding patterns of associations has previously been found in attachment-based research. For example, in a meta-analysis by Madigan et al. (2013), the association between insecure attachment and children's internalizing problems was weaker as the temporal distance between these two measures was greater (although, in contrast, the association between insecure attachment and externalizing problems has been shown to increase over time; Groh et al., 2017). When greater

time between the assessment of two variables are associated with poorer predictions (e.g., Borowski et al., 2021; Holden & Miller, 1999), this may occur because the nature of the caregiving behavior and/or child attachment security changes, for better or worse. That is, the stability of caregiver sensitivity (r = .40; Madigan et al., 2019) and attachment security (r = .28; Opie et al., 2021) are, on average, modest. Thus, some caregivers and children may show increases or decreases in sensitivity and attachment security over time. Caregiver sensitivity and attachment security may decrease due to caregiver's experiencing acute circumstances (e.g., hospitalization), life events (e.g., onset of mental distress, child maltreatment), and/or changes in family circumstances (e.g., new sibling; parental divorce) (Barnes & Theule, 2019; Cyr et al., 2010; Moss et al., 2005; Vaughn et al., 1979; Volling et al., 2021). Nonetheless, the weakening of effect size over time could also be due to positive change, where caregiver sensitivity improves over time, possibly due to the caregiver's mental health improving and/or family stress decreasing.

Third, in both the univariate and multivariate analyses, we found that effect sizes were larger when interrater reliability for attachment was excellent (r = .27) or adequate (r = .22) compared to poor (r = .17). Attachment-based trainings are notoriously time-intensive, including multi-week-long workshops, followed by additional practice and reliability tests to determine observer agreement with expert coders. Even with such training, there is no guarantee that high intercoder reliability will be achieved in individual studies. Given the variation in coder reliability, it is important to take reliability into account when interpreting effect sizes as well as when conducting power analyses for planned hypothesis-testing studies (Parsons et al., 2019).

In sum, this meta-analysis revealed that individual studies' approaches to measuring caregiver sensitivity and/or child attachment require careful consideration, as effect sizes vary

depending on the approaches taken. Numerous valid and reliable measurements of sensitivity exist, but there are several methodological standards that should be met, including adequate interrater reliability with certified trainers, ensuring trained coders within studies are reliable, having independent coders for caregiver sensitivity and child attachment, and coding caregiver sensitivity and child attachment across different observations. The latter two are important as effect sizes may be inflated when caregiver sensitivity and child attachment are coded by the same coders and/or within the same observational context. Another methodological standard in the field should be adequate or excellent interrater reliability. It is incumbent on researchers to train with certified trainers adequately and become reliable in attachment-based measures, and to maintain high fidelity to the measure over time. In turn, the availability and accessibility of attachment-based measurement training are crucial for the sustainability of the field. Importantly, there is currently no standard set of videos and coding used for training assessors to use measures of sensitivity, which opens the door to possible heterogeneity and coder drift over time. The field is in need of more standardized training to ensure true reliability across coders and replicability.

Moderators for Paternal Sensitivity. Before delving into significant moderators of the association between paternal sensitivity and child attachment security, it is worth noting that many moderators could not be tested for paternal sensitivity due to the lack of variation across samples. That is, samples with data on paternal sensitivity were largely drawn from low-risk populations, such that no samples included child clinical, medical, or socio-demographic risks. Similarly, none of the studies were conducted outside of North America or Europe. The lack of opportunity to test moderators in child-father samples is a recurring problem (see also Deneault et al., 2021), which highlights the urgent need for more diverse samples of fathers beyond the current predominantly white, low-risk, biparental fathers in heterosexual relationships.

Among the moderators that could be tested, we found that effect sizes were larger as both children and fathers' ages were older, which are interrelated variables. During infancy, there is often more dependence on mothers to meet children's feeding needs, and accordingly, potentially fewer opportunities for interactions with fathers. As infants become toddlers and later preschoolers, their feeding and playing practices change, and their interactions with fathers become more frequent and diversified (Lamb, 2004). As a result, fathers may have greater opportunity to learn their children's cues, and children gain greater confidence regarding the extent to which their signals will be met (Cabrera & Tamis-LeMonda, 2013). This factor, in turn, helps to shape the quality of the child-father attachment relationship. Additional support for these hypotheses can be found in recent meta-analyses on paternal sensitivity and child cognitive, executive functioning, and socio-emotional outcomes that showed that effect sizes were larger when variables were assessed in the toddlerhood and preschool periods compared to infancy, which was also attributed to greater paternal involvement in caregiving as children age (Rodrigues et al., 2021). Thus, although paternal sensitivity appears to be a key building block for the development of secure attachment, as well as a variety of domains of child outcomes, effect size magnitudes for these associations may be less evident early in development.

From a practical perspective therefore, child age should be an important consideration in future study designs with child-father dyads, not only for corroborating the current set of findings, but also to monitor change in this pattern of associations. That is, it is possible that as parental leave becomes more accepted and available in the postpartum period, and therefore, greater opportunities are allotted for father-infant interactions, the finding that effect sizes increase as children age may dilute. Parental leave for fathers has, for example, been found to predict higher involvement and parenting responsibilities in a sample of socio-economically

disadvantaged US fathers (Knoester et al., 2019). Given the benefits of positive fathering behaviors (Rodrigues et al., 2021) and secure child-father relationships (Deneault, Bureau, et al., 2022), promoting father involvement in early childhood may be an important way to support positive child development more broadly. That may even start before the birth of the baby. For example, in an RCT testing video-feedback to promote sensitive child-father interaction using ultrasound imaging during pregnancy, intervention fathers showed increased sensitivity with their 2-month-old infants (Buisman et al., 2022).

Does the Type of Insecure Attachment Matter?

It has been theorized that avoidant and resistant attachments have unique caregiving behavioral antecedents (Ainsworth et al., 1978; Cassidy & Berlin, 1994; Lyons-Ruth et al., 1999; Main & Hesse, 1990); yet, these insecure classifications are often combined into one category to test the contrasts between secure versus insecure and insensitivity versus sensitive caregiving, typically due to small sample sizes of children in each insecure group (see Raby et al., 2021). A growing number of studies have begun to examine the specificity of caregiver sensitivity for the specific types of insecure attachment, albeit this empirical work has almost entirely been focused on child-mother dyads. We synthesized this subset of the literature meta-analytically and found that maternal sensitivity was significantly associated with all insecure types (avoidant: $k = 43$, $r = -.24$; resistant: $k = 43$, $r = -.14$; and disorganized: $k = 24$, $r = -.22$). We compared whether these effect sizes significantly differed using a multilevel meta-analysis and failed to find statistical difference between avoidant, resistant, and disorganized attachment.

There are a few possible explanations for the lack of specificity among avoidant, resistant, and disorganized attachment. First, the lack of difference may be due to statistical reasons. Although we had moderate sample sizes for these analyses, confidence intervals were

wide for all estimates and large between-study heterogeneity was identified. More studies may be needed to derive narrower confidence intervals, and thereby, potential differences across insecure classifications. Thus, as more studies are published in the coming years, we recommend this analysis be replicated so that firmer conclusions on differences between avoidant, resistant, and disorganized attachment can be drawn. Second, the hypothesis in attachment theory is that avoidant and resistant attachment have distinct caregiving antecedents, yet empirical support for this is sorely lacking. Specifically, caregiver affective disengagement and emotional unavailability have been proposed to predict avoidant attachment and inconsistently sensitive caregiving behaviors have been proposed to predict resistant attachment (Cassidy & Berlin, 1994; Isabella & Belsky, 1991; Main, 1995). Yet there is little available evidence for this often-repeated claim. Although Ainsworth et al. (1978) found that mothers of infants with resistant attachment displayed somewhat fewer rejecting behaviors towards their infants, the difference compared to mothers of infants with avoidant attachment was not marked (p. 230, Table 27), and overall, the levels of maternal sensitivity were similar in infants with avoidant and resistant attachment. Thus, based on Ainsworth's original findings, it may not be surprising to find that effect sizes for avoidant and resistant attachment are similar.

Interestingly, insensitive caregiving behaviors predict both avoidant and resistant attachment, but other antecedents and sequelae for these insecure subtypes are distinct. A meta-analysis of over 20,000 infant Strange Situation Procedures by Madigan, Fearon et al. (2023) revealed that higher rates of avoidant (and disorganized) but not resistant attachment are found in low-income families. In fact, none of the socio-demographic, medical, clinical, or family characteristics examined by Madigan, Fearon et al. (2023) uniquely predicted resistant attachment. In another meta-analysis on child temperament, Groh, Narayan, et al. (2017) found

that although temperament was weakly associated with insecure attachment as a broad construct, it was moderately associated with resistant attachment specifically. Thus, to our knowledge, the only variable that has been identified as distinctively predictive of resistant attachment, is child temperament. In terms of its sequelae, avoidant (and disorganized attachment), but not resistant attachment, are associated with child internalizing and externalizing behavior problems (Fearon et al., 2010; Groh et al., 2012; Madigan et al., 2013), which supports the continued use and exploration of distinctions between forms of organized insecure attachment. As has been frequently noted, future studies exploring these distinctions should endeavor to overcome the consistent limitation in the field of attachment of small samples (Cassidy & Berlin, 1994; Deneault, Bureau, et al., 2022; Deneault, Hammond, & Madigan, 2023; Groh et al., 2014; Madigan, Fearon et al., 2023; Verhage et al., 2016). It is critical, therefore, that future research leverage multisite data collection approaches and/or individual participant data (IPD) analyses when examining distinct antecedents and sequelae of avoidant, resistant, and disorganized attachment (e.g., Dagan et al., 2024; Verhage et al., 2018).

Based on current theoretical models of the roots of disorganized attachment, we expected to find a smaller effect size for the association between caregiver sensitivity and disorganized attachment than for avoidant and resistant attachment. Indeed, distinct caregiving behavioral correlates, independent from sensitivity, have been conceptualized and empirically linked with disorganized attachment, including frightened, frightening, or dissociative caregiving behaviors (FR behaviors; Main & Hesse, 1990), as well as disrupted caregiving behaviors (Lyons-Ruth et al., 1999). The current meta-analysis did, nonetheless, identify an effect size for disorganization that was similar to that of avoidant and resistant attachments.

It is notable that the magnitude of the association between sensitivity and disorganized attachment found in this meta-analysis (r = -.22) is considerably smaller than that of a meta-analysis on FR/disrupted caregiver behaviors and disorganized attachment (Madigan et al., 2006; r = .34). Thus, although caregiver insensitivity may increase the likelihood for disorganized attachment, FR/disrupted caregiver behaviors are likely more powerful in predicting disorganized attachment. In a direct test of this hypothesis, Moran et al. (2008) examined the contribution of both disrupted behaviors (assessed in play contexts in the lab) and maternal sensitivity (assessed in the home) on disorganized attachment in a sample of adolescent mothers. They found that disrupted caregiver behaviors robustly predicted disorganized attachment, but caregiver sensitivity also had a small but unique contribution.

It has also been suggested that, at its extremes, maternal insensitivity overlaps with some aspects of behaviors captured in the FR and disrupted caregiving measures (Bailey et al., 2007). Indeed, these behaviors are intercorrelated, especially in high-risk samples (e.g., r = -.49 in a sample of adolescent mothers; Moran et al., 2008). Insensitivity can include overt hostility/punitive behavior and disengagement, both of which overlap with behaviors encompassed within disrupted caregiver behavior, namely intrusiveness/negativity and withdrawal, respectively (but see Out et al., 2009). It may be when insensitive caregiver behavior proves alarming to a child that it predicts disorganized attachment, alongside FR behaviors (Duschinsky, 2018).

It is theorized that children with disorganized attachment exhibit a disruption or breakdown of their organized attachment strategy in the SSP. Thus, although they are assigned a classification of disorganized, they also receive a best fitting secondary classification of avoidant, secure, or resistant and it may be that this secondary classification dominates outside of

stressful situations. As a result, it is possible that caregiver insensitivity is related to disorganized attachment through secondary classifications (Lyons-Ruth et al., 1999). For example, caregivers high in both sensitivity and disrupted caregiving may be more likely to have infants with disorganized/secure attachment, whereas caregivers with low sensitivity and high disrupted caregiving may be more likely to have infants with disorganized/insecure attachment. Caregiver insensitivity and FR/disrupted behavior were initially expected to be orthogonal constructs, but in fact, they may have larger associations and overlap under specific conditions (e.g., Moran et al., 2008), and it is possible that they interact in unique ways to predict child attachment disorganization and insecurity. Exploring this idea further using statistical techniques such as latent profile analysis may be particularly fruitful for advancing understanding of the distinctive caregiving precursors of child-parent attachment.

What are Future Directions Based on our Study Findings?

Throughout the last 50 years, scholars have examined the original idea proposed by Ainsworth et al. (1978) that early caregiving experiences, in particular caregiver sensitivity, is a critical ingredient for the development of secure attachment, as well as adaptive functioning and well-being throughout the lifespan. This idea, and its initial empirical support (Ainsworth et al., 1978), has inspired generations of scholars in developmental science, clinical science, and neuroscience to further understanding of how caregiver sensitivity can help to shape offspring development. We believe that the current synthesis, together with many other meta-analyses on caregiver sensitivity in the field (e.g., Cooke et al., 2022; Madigan et al., 2019; Rodrigues et al., 2021; Van der Storm et al., 2022), cements the role of caregiver sensitivity in children's developmental trajectories. In the sections that follow, we outline several future directions that

we believe could galvanize the next generation of research on caregiver sensitivity, both within the parenting and attachment fields, and beyond.

Research with Diverse Groups. Although the concept of maternal sensitivity was initially conceptualized and explored by Mary Ainsworth in Uganda (Ainsworth, 1967) and attachment research has proliferated across the globe (Deneault, Bureau, et al., 2023; Madigan, Fearon et al., 2023), it remains the case that the majority of studies in this meta-analysis have been based in North America and Europe (87%). It should be noted that this meta-analysis may have been limited in its inclusion of studies from some geographical regions given that only studies in English, French, and Spanish were included in CASCADE. Measures of sensitivity have been found to have expectable correlates in cross-cultural contexts; nonetheless, the nature and scope of applicability of sensitivity measures remains a topic of discussion in the field (see Mesman et al., 2012). In addition to needing more cross-cultural research, there is also a need for additional research with diverse populations. Specifically, samples in this meta-analysis were largely composed of white participants (mean = 78%, median = 93%) and biological parents (94%), mostly from middle to upper middle-class groups (84%). Thus, a need remains to extend attachment research to more diverse family structures and compositions (e.g., same-sex parents, stepfamilies), levels of urbanization (e.g., urban versus rural residences), and socio-economic representation. Moreover, as it has been argued that race and ethnicity intersect with socio-economic status to predict lower levels of parental sensitivity (Bakermans-Kranenburg et al., 2005; Mesman et al., 2012), studying the patterning of associations from an intersectionality lens could be particularly informative for the field of attachment and child development.

Research on Other Caregiver Behaviors. As noted initially by De Wolff and Van IJzendoorn (1997), sensitivity is a contributor to child attachment, but it is not an "exclusive

condition of attachment security." Our effect size of r = .26 (or d = .54) suggests that in the presence of a sensitive caregiver, a child has a 65% chance of developing a secure attachment. Thus, the association is not deterministic, and is valid only at the group level. That is, not all children who experience caregiver sensitivity will go on to develop secure attachment with that caregiver, and not all children who experience insensitive care will develop an insecure attachment (see Bakermans-Kranenburg, & Van IJzendoorn, 2007). Other positive domains of caregiver behaviors have been proposed as critical ingredients to child outcomes, including warmth, mutuality, synchrony, stimulation, positive affect, and autonomy support (see Beebe et al., 2010; Levy & Feldman, 2019; Whipple et al., 2011). Many of these domains of parenting are intercorrelated (De Wolff & Van IJzendoorn 1997). Practically, when a caregiver has the propensity for responding to a child's signal of need, there are greater opportunities for synchronous exchanges of affect, language, or physical contact. For fathers in particular, conceptual models of paternal caregiver behavior have also included interaction quantity, accessibility, and responsibility (Lamb et al., 1985), and involvement (e.g., Cox et al., 1992). Nonetheless, these domains of maternal and paternal parenting are often examined independently of one another.

Little attention to date has been devoted to the potential unique, shared, and/or additive effects of these dimensions of parenting on child attachment, and developmental outcomes more broadly (Moran et al., 2008; Whipple et al., 2011). It would be interesting, for example, to determine the amount of unique and shared variability in child attachment that is predicted by sensitivity, positive affect, and warmth. Is there additional explanatory power when mutuality and synchrony are added to this equation? If not, then it would indicate that the domains are methodologically redundant. If so, this points to different targets of intervention that if used in

combination, could support the child's attachment security. Examining multiple dimensions of parenting may be particularly important for ascertaining a high level of granularity of what is common and specific to avoidant and resistant attachment, as the caregiving predictors for these subtypes have thus far been largely indistinguishable.

Consistent with ideas put forth by Sameroff (2000) and Rutter (1979), cumulative exposure to various positive (and/or negative) aspects of parenting could operate in an additive (i.e., *in addition to*) or interactive (i.e., *in combination with*) manner. Thus, it is also of interest to explore which combinations of parenting dimensions additively or interactively contribute to child attachment. For example, is the association between sensitivity and secure attachment larger when caregivers show more warmth? In one of the few studies to date, Brown et al. (2012) demonstrated that at high levels of sensitivity, secure attachment was likely to occur regardless of the levels of paternal involvement; yet, at low levels of sensitivity, high paternal involvement was associated with child attachment security. These results suggest that the "quantity" of time parents spend with children should be examined alongside the "quality" of the caregiving behavior (i.e., sensitivity), and should spur additional research focusing on multi-deterministic ways in which domains of caregiver behavior operate to predict child attachment.

Research on the Role of Multiple Caregivers. Children develop within a social system that includes multiple potential attachment relationships (Bakermans-Kranenburg, 2021). Findings here and elsewhere suggest that regardless of which caregiver is providing the sensitivity, children benefit. Yet, research on maternal sensitivity is often examined independently of paternal sensitivity, and vice versa. When caregivers within a family are examined together, it is possible to disentangle the interplay between multiple sources of influences (Lickenbrock & Braungart-Rieker, 2015; Schoppe-Sullivan et al., 2006). For example,

cross lagged studies have shown that levels of maternal sensitivity can influence levels of paternal sensitivity over time, and vice versa, and, together, have a greater impact on children's behavioral development than dyadic relations alone (Scott et al., 2018). Thus, one important avenue for future research is to examine how maternal and paternal sensitivity could uniquely and jointly contribute to children's socio-emotional development. Important questions include, for example, does the sensitivity of one caregiver spill over onto the other? Can one sensitive caregiver offset the insensitive caregiving of another? Does the presence of two insensitive caregivers have a multiplicative effect (i.e., double jeopardy) on child attachment and maladjustment? These more nuanced questions reflect the complex environmental influences in children's early lives. Such questions require the inclusion of multiple caregivers in research designs and are needed to more accurately capture how children develop within their network of caregivers.

In a recent IPD synthesis on 1,097 dyads from 9 studies that had both child-mother and child-father attachment, Dagan et al. (2021) demonstrated that the presence of at least one insecure attachment relationship (with either fathers or mothers) versus secure attachment with both parents increased the child's risk of developing elevated internalizing problems. Studies that include a multiple-caregiver framework that more accurately characterize the social context in which children develop, such as the one by Dagan et al. (2024) and one by Van IJzendoorn et al. (1992) that included day care providers, have the potential to advance scientific understanding and spur new and novel research directions in developmental science.

Research on Mediating Mechanisms. With the literature on the role of caregiver sensitivity to attachment security and child cognitive and behavioral outcomes now being more established (Cooke et al., 2022; Madigan et al., 2019; Rodrigues et al., 2021; Van der Storm et

al., 2022), research can move beyond examination of direct associations to advancing understanding of mechanisms. How could (in)sensitivity serve as the mechanism through which indicators of risk predict child insecure attachment? This line of research is consistent with transactional and ecological models presented by Sameroff (2009) and Bronfenbrenner (1980), respectively, who postulated that distal variables (i.e., socio-economic status, neighborhood violence) influence proximal factors that the child experiences directly (i.e., caregiver behaviors), to determine individual child outcomes. For example, a recent study by Gerlach et al. (2022) demonstrated that the association of low socio-economic status on child attachment was largely mediated by caregiver sensitivity. They concluded that restrictions on income (and the stresses that come with low SES, e.g., food insecurity) may diminish a parent's ability to focus on their child's cues and signals, which in turn compromises the developing attachment relationship. Together with other studies demonstrating sensitivity as a mechanism in the link between socio-economic status on child attachment (e.g., Bakermans-Kranenburg et al., 2004; Borairi et al., 2021; Fish, 2001), results such as these can elucidate additional factors that need to be addressed by interventions seeking to support caregiver sensitivity.

There are now a plethora of experimental studies testing the causal assumption that improving maternal sensitivity will in turn improve child outcomes (see Bakermans-Kranenburg et al., 2003; Facompré et al., 2018). Indeed, interventions that are effective in enhancing maternal sensitivity tend to also show effects on increased child security of attachment (Bakermans-Kranenburg et al., 2003) and child externalizing behavior (O'Farrelly et al., 2021). Despite the growing interest in fathering and paternal sensitivity, there is very little experimental research testing whether attuning fathers to their children's cues and signals promotes change in the attachment relationship (and child outcomes more broadly). Thus, an important area of future

research is to determine whether attachment-based interventions that focus on sensitivity, developed initially for child-mother dyads, can also be effective and efficacious when being applied to child-father dyads.

Research on Bidirectional Influences. Consistent with transactional models of child development (Sameroff, 2010), it is possible that children evoke the type of parenting behavior that they receive. For example, a precocious child may evoke higher levels of caregiver sensitivity, which in turn can promote more positive and reciprocal shared exchanges. Investigations examining the temporal direction of child attachment to caregiver sensitivity are scarce, perhaps due to the arduous nature of repeated collections and coding of child attachment. Still, in one cross lagged panel model, Brown et al. (2012) found that over and above paternal sensitivity at 13 months, child-father attachment at age 13 months predicted paternal sensitivity at age 36 months. Thus, a secure child-father attachment may have reinforcing properties that promote further active child-father engagement and evoke increased sensitivity from fathers. It will be important in future research endeavors to examine the longitudinal and reciprocal associations between attachment and caregiver sensitivity and elucidate the temporal sequencing of associations, and paired alongside experimental studies, closer approximations of directionality and causality can be ascertained.

Research on the Feasibility of Sensitivity Measures for Clinical Use. Although this meta-analysis drew upon considerable breadth of research conducted on the role of caregiver sensitivity for child attachment, there remains a discernable lack of tools for assessing caregiver sensitivity in community agencies and clinical practice. In fact, the lack of validated tools for use in community practice has been highlighted as one of the major challenges facing the research-to-practice gap in the field of attachment (Cicchetti & Toth, 2006; Forslund et al., 2021). The

translation of research measures of sensitivity to clinical practice is certainly a challenging task, as these measures are time consuming to learn and administer and would require adaptation for practice contexts and demonstrated value compared to assessment-as-usual (Forslund et al., 2021). Nonetheless, it has been recommended that "assessments of the caregiver's capacity to provide a safe haven for the children when alarmed is more valuable…than information about the child's attachment classification per se, especially when provision of more effective caregiving is the key concern" (Forslund, 2021, p. 34).

Thus, it is timely for attachment researchers to respond to the call for more versatile and manageable measures of caregiver sensitivity for use in clinical practice. Given the interest and eagerness among practitioners for such measures, a fruitful approach to this endeavor may be to co-construct and co-develop research initiatives with practitioners to shrink the research-to-practice gap more effectively (Racine et al., 2022). Indeed, it has been suggested that to find innovative solutions for real-world problems, it is often necessary to step outside the academic silo by partnering with community organizations to promote bidirectional and sustainable flows of knowledge, with both practitioners and researchers contributing their specific skills and knowledge base (Forslund et al., 2021; Racine et al., 2022; Skipper & Pepler, 2020; Van IJzendoorn & Bakermans-Kranenburg, 2021). Such flows of knowledge also have great potential to shape the agenda for future methodological and theoretical innovations (Schuengel et al., 2021).

Study Limitations

The results derived in this meta-analysis should be considered within the context of several limitations. First and foremost, effect sizes in meta-analyses are correlational, not causal. Evidence of causal associations cannot be ascertained in this meta-analysis of observational

studies, but experimental studies have demonstrated that changes in caregiving behavior can lead to shifts in the nature of the child-caregiver attachment relationship (Bakermans-Kranenburg et al., 2003; Tereno et al., 2017; Van IJzendoorn et al., 2023; Yarger et al., 2020). Directionality of associations was also assumed: Only studies in which caregiver sensitivity preceded, or was concurrent to, the assessment of attachment security were included. This decision was consistent with the notion that caregiver sensitivity is a primary determinant of the formation of child-parent attachment security (Ainsworth et al., 1978).

Second, our meta-analysis examined variation in study findings at the study-level, not at the participant-level. Thus, a single study contributes only one (weighted) value for the average percent of boys in a sample. In practice, the variance in moderators within a sample is usually much greater than that across studies. For these reasons, our moderator analyses may be underpowered, despite our large sample sizes.

Third, although the literature on fathering and child-father interactions is growing, it still only represents a very small portion of the literature to date. Specifically, of the 23,109 dyads included in this meta-analysis, only 7% (n = 1,626) were child-father dyads whereas 93% were child-mother dyads (n = 21,483). The resulting consequence of the smaller body of research on fathers for this particular meta-analysis is that we could derive pooled effect size estimates for the association between paternal sensitivity and child-father attachment, but we were limited in our testing of moderators of this association and for sub-analyses for avoidant, resistant, and disorganized attachment. Our inability to test moderators for insecure types may be due, at least in part, to small sample sizes of child-father dyads that force the grouping of insecure categories of attachment into one group to derive the secure versus insecure contrast. Yet, more recently, there is interest in not only studying child-father dyads, but also in differentiating the antecedents

and sequelae of the different types of insecure attachment (e.g., Dagan et al. 2021; Deneault, Hammond, et al., 2023; Deneault, Bureau, et al., 2022; Madigan, Fearon et al., 2023). Future data could powerfully inform, and help to tailor, attachment-based interventions seeking not only to bolster secure attachment, but minimize the risks of children developing avoidant, resistant, and disorganized attachment.

Fourth, we examined publication year as a proxy for determining if effect sizes have increased or decreased over time. Even if publication year has been identified as an important moderator of the intergenerational association of attachment, that is, parent representation of attachment to child-parent attachment (Verhage et al., 2016), it was not identified as a significant moderator in this meta-analysis. This non-significant moderator is somewhat surprising given the substantial socio-cultural changes around fathering in the past several decades. However, publication year is an imperfect variable for this purpose, as it only estimates when data may have been collected. For example, recruitment for the NICHD data occurred in 1991, but manuscripts from this rich dataset continue to be published today. Date of data collection is rarely reported in Method sections. For future research endeavors, it would be beneficial for study authors to include the dates of data collection in their method sections so that this variable could be more precisely assessed as a potential moderator in future meta-analyses.

Fifth, the database search for the CASCADE catalogue was conducted in English in databases that contain mostly English reports. Although studies were included if they were written in either of three languages (i.e., English, French, or Spanish), studies written in other languages and not indexed in English may not have been included, which may contribute to a lack of geographical and cultural representation. This issue is not exclusive to the current meta-analysis but applies more broadly to scientific domains with publications in numerous languages.

A recent editorial explicitly calls for broadening searches to non-English sources to help steer evidence syntheses towards a larger and more diverse set of research publications, which in turn promotes clearer conclusions about psychological phenomena and their implications (Johnson, 2021)

Concluding Remarks

This meta-analytic study represents the most comprehensive to date of the association between sensitive caregiving behavior and secure child-caregiver attachment. Our multi-level meta-analytic approach allowed us to extensively test caregiver differences (i.e., mothers, fathers), a large set of potential moderators, as well as differential association of caregiver sensitivity in relation to secure, avoidant, resistant, and disorganized attachment. Key findings were as follows:

- Significant and equivalent associations between sensitivity and attachment security were observed for both child-mother dyads and child-father dyads.
- For maternal sensitivity, key moderators were methodological in nature: the attachment and sensitivity measures used, interrater agreement on observational measures, and the intervening period between assessments of maternal sensitivity and child attachment.
- Maternal sensitivity was similarly negatively associated with avoidant, resistant, and disorganized attachment.
- For paternal sensitivity, effect sizes increased with paternal age and child age.

Given the breadth and scope of this meta-analysis, the findings from this synthesis confirm the importance of both maternal and paternal sensitivity for the development of child attachment security. Furthermore, it contributes to a more nuanced understanding of the key factors that moderate the association between sensitive caregiving behavior and secure child-caregiver

attachment. We hope that future directions in this area of research include more cross-cultural research with diverse populations (e.g., new family structures, levels of urbanization), attention to other domains of caregiver behaviors (e.g., warmth, mutuality, synchrony, stimulation, positive affect, emotional support, limit-setting), exploration of mediating and moderating mechanisms, the influence of children's wider caregiving network, increased experimental research on paternal sensitivity, and the development of assessment tools for clinical practice.

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Table 1

Main Meta-Analytical Results and Moderator Analysis for Parental Sensitivity and Child-Parent Attachment Security (All Studies Included)

Main meta-analytical results	*N*	*k* [effect sizes]	*r*	95% CI	I^2	*p*
	22,914	174 [230]	.25	[.22, .28]	74.30	.001
Categorical Moderators	Effect sizes	*df*	*r*	95% CI	*Wald test (F)*	*p*
Attachment measure					6.26	.005
AQS	56	36.1	.34***	[.28, .39]		
SSP	160	114.3	.23***	[.19, .27]		
SSP-M	14	11.2	.20***	[.11, .29]		
Sensitivity measure [a]					11.30	.001
Ainsworth	85	55.6	.24***	[.19, .29]		
EAS	27	18.4	.24***	[.15, .33]		
MBQS	26	16.9	.46***	[.38, .53]		
Sensitivity and attachment measure					25.4	.001
AQS & MBQS	18	11.1	.45***	[.40, .50]		
AQS or MBQS	48	29.3	.31***	[.24, .38]		
Other measures	172	119.2	.21***	[.18, .25]		
Location sensitivity assessment					1.85	.18
Home	112	76.3	.26***	[.22, .30]		
Laboratory	96	70.8	.22***	[.17, .26]		
Number of observations					0.73	.40
Single assessment	178	142.5	.25***	[.22, .29]		
Multiple assessments	52	18.3	.22***	[.15, .29]		
Coder independence					2.05	.16
Dependent/unreported	62	38.2	.21***	[.14, .28]		
Independent	168	122.9	.26***	[.23, .30]		
Reliability attachment					5.36	.01
Excellent	143	96.3	.27***	[.23, .31]		
Adequate	40	26.0	.24***	[.17, .32]		
Poor	17	9.55	.13*	[.04, .21]		
Reliability sensitivity					2.33	.13
Excellent	151	110.9	.26***	[.22, .30]		
Adequate	41	24.6	.22***	[.17, .26]		
Poor	11	6.3	.17**	[.09, .26]		
Sensitivity measure validated					3.05	.09

Non-validated	42	29.3	.22***	[.17, .27]		
Validated	159	112.6	.27***	[.23, .31]		
Socio-demographic status					0.14	.72
Mid-high	140	92.5	.22***	[.19, .26]		
Low	53	9.0	.24***	[.18, .29]		
Parent clinical status					4.23	.07
No	219	152.8	.26***	[.22, .29]		
Yes	11	8.0	.14*	[.02, .26]		
Child clinical status					2.04	.10
No	200	143.1	.24***	[.21, .27]		
Yes	30	18.6	.34***	[.22, .46]		
Child medical status					2.31	.14
No	200	141.8	.24***	[.21, .27]		
Yes	30	20.4	.33***	[.21, .44]		
Foster/adoptive sample					.09	.77
No	216	151.1	.25***	[.22, .28]		
Yes	14	9.6	.23***	[.11, .35]		
Geographical region					0.99	.42
Africa	3	1.0	.24*	[.06, .41]		
Asia	12	6.5	.42**	[.16, .63]		
Europe	58	38.8	.23***	[.15, .29]		
Middle East	8	5.5	.27**	[.12, .42]		
North America	142	101.3	.25***	[.21, .28]		
Oceania	2	1.0	.06	[-.97, .98]		
South America	5	1.9	.30	[-.19, .66]		
Publication status					0.10	.76
Published	205	141.5	.25***	[.22, .28]		
Unpublished	25	19.4	.24***	[.14, .33]		
Study design					3.43	.07
Cross-sectional	117	86.0	.28***	[.24, .32]		
Longitudinal	113	80.4	.22***	[.17, .27]		

Continuous Moderators	Effect sizes	*df*	*b*	95% CI	*t-value*	*p*
Duration sensitivity task[c]	196	145	.001	[.0001, .002]	2.10	.002
Child age	230	172	.002	[-.001, .004]	1.23	.22
Parent age	181	129	-.004	[-.012, .004]	-1.05	.30
Child sex[b]	219	165	.004	[-.001, .009]	1.60	.11
Parent gender (% mothers)	230	172	.001	[-.000, .001]	1.52	.13
Ethnic Minority	142	142	.000	[-.001, .001]	0.14	.89
Publication year	230	172	.001	[-.003, .005]	0.54	.59

Time between assessments	230	172	-.010	[-.016, -.003]	-2.87	.005

Note. [a] These measures were the most common ones and thus the ones used for this analysis; other measures were not included in this comparison. [b] This analysis excluded $k = 11$ samples that were composed of only boys or only girls. [c] The duration of the Ainsworth et al. (1978) study was winsorized from 960 minutes to the next highest value (270 minutes). Levels of categorical moderators with $df < 4$ were not included in the Wald test; their correlation and 95% CIs are presented for descriptive purposes only and should be interpreted with caution given that $df < 4$ may cause unreliable results. Positive pooled effect sizes, represented as *r*, indicate that higher levels of sensitive caregiving are associated with more attachment security (e.g., classification as secure, higher scale scores).
* $p < .05$, ** $p < .01$, *** $p < .001$

Table 2

Meta-Analytical Results and Univariate Moderators of the Associations Between Maternal Sensitivity and Infant-Mother Attachment and Between Paternal Sensitivity and Infant-Father Attachment Security

	Maternal Sensitivity						Paternal Sensitivity					
Main meta-analytical results	*n*	*k* [effect sizes]	*r*	95% CI	I^2	*p*	*n*	*k* [effect sizes]	*r*	95% CI	I^2	*p*
	21,483	159 [202]	.26	[.22, .29]	74.72	.001	1,626	22 [23]	.21	[.14, .27]	45.43	.001
Categorical Moderators	Effect sizes	*df*	*r*	95% CI	*Wald test (F)*	*p*	Effect sizes	*df*	*r*	95% CI	*Wald test (F)*	*p*
Attachment measure					5.00	.01					-	-
AQS	51	34.5	.33***	[.28, .39]			5	2.7	.35***	[.23, .46]		
SSP	139	103.1	.24***	[.19, .28]			18	13.3	.17***	[.09, .25]		
SSP-M	12	10.2	.21***	[.11, .30]			1	-	-	-		
Sensitivity measure[a]					11.00	.001					-	-
Ainsworth	75	51.1	.24***	[.19, .29]			10	7.8	.22*	[.06, .36]		
EAS	23	15.6	.25***	[.16, .33]			-		-	-		
MBQS	24	15.9	.46***	[.38, .54]			2	1.0	.36*	[.27, .45]		
Sensitivity and attachment measure					23.5	.001					-	-
AQS & MBQS	16	10.1	.46***	[.40, .52]			2	1.0	.36*	[.28, .45]		
AQS or MBQS	43	28.7	.31***	[.23, .38]			3	1.5	.34	[-.12, .68]		
Other measures	143	107.0	.22***	[.18, .25]			18	14.4	.18***	[.10, .25]		
Location sensitivity assessment					1.37	.25					0.04	.85
Home	105	72.7	.27***	[.22, .31]			7	5.4	.21*	[.06, .36,]		
Laboratory	79	63.6	.23***	[.18, .28]			14	10.7	.20**	[.10, .29]		
Number of observations					1.08	.31					-	-
Single	152	128.7	.26***	[.23, .30]			21	17.1	.20***	[.13, .27]		

association													
Multiple associations	50	18.3	.22***	[.14, .29]			2	-					
Coder independence					1.49	.23					0.83	.39	
Dependent/ unreported	43	33.7	.22***	[.14, .30]			7	4.5	.15	[-.05, .35]			
Independent	148	113.6	.27***	[.23, .30]			16	12.5	.23***	[.15, .30]			
Reliability attachment					5.74	.01					-	-	
Excellent	116	87.0	.28***	[.23, .32]			15	11.6	.22***	[.14, .30]			
Adequate	33	22.7	.25***	[.17, .32]			5	3.2	.22	[-.12, .51]			
Poor	16	2.7	.12*	[.02, .21]			1	-	-	-			
Reliability sensitivity					2.54	.11					-	-	
Excellent	131	98.9	.27***	[.23, .31]			17	13.3	.26***	[.11, .39]			
Adequate	34	23.1	.22***	[.17, .27]			5	3.1	.20*	[.10, .29]			
Poor	10	5.3	.17**	[.07, .27]			1	-	-	-			
Sensitivity measure validated					2.81	.10					-		
Non-validated	37	27.4	.22***	[.17, .27]			5	3.5	.21**	[.12, .30]			
Validated	138	102.6	.28***	[.23, .32]			16	12.0	.22***	[.11, 32]			
Socio-demographic status					0.05	.82					-		
Mid-high	116	92.5	.23***	[.19, .27]			0	-	-	-			
Low	53	9.0	.24***	[.18, .29]			22	-	-	-			
Parent Clinical Status					4.05	.08					-	-	
No	192	139.9	.26***	[.23, .30]			22	-	-	-			
Yes	10	7.1	.14	[-.01, .28]			1	-	-	-			
Child clinical status					3.15	.09					-	-	
No	173	129.6	.24***	[.21, .28]			23	-	-	-			
Yes	29	18.1	.35***	[.23, .46]			0	-	-	-			
Child medical status					2.36	.14					-	-	
No	173	128.4	.24***	[.21, .28]			23	-	-	-			
Yes	29	19.8	.33***	[.22, .44]			0	-	-	-			
Foster/adoptive					0.07	.79					-	-	
No	191	139.3	.26***	[.22, .29]			21	16.4	.20***	[.12, .27]			

Yes	11	7.6	.24***	[.09, .38]			2	1.0	.36*	[.28, .45]		
Geographical region					1.03	.41					-	-
Africa	3	1.0	.24*	[.06, .41]			0	-	-	-		
Asia	12	6.5	.42**	[.16, .63]			0	-	-	-		
Europe	48	32.2	.22***	[.14, .30]			6	3.0	.28***	[.13, .41]		
Middle East	8	5.5	.28**	[.12, .42]			0	-	-	-		
North America	124	92.1	.26***	[.22, .29]			17	14.1	.19***	[.11, .27]		
Oceania	2	1.0	.09	[-.98, .98]			0	-	-	-		
South America	5	1.9	.30	[-.19, .67]			0	-	-	-		
Publication status					0.20	.66					-	-
Published	178	128.5	.26***	[.22, .29]			22	17.5	.21***	[.12, .27]		
Unpublished	24	18.6	.24***	[.14, .33]			1	-	-	-		
Study design					2.9	.09					0.01	.93
Cross-sectional	101	77.9	.28***	[.24, .33]			12	9.0	.21**	[.10, .31]		
Longitudinal	101	74.9	.23***	[.18, .28]			11	8.2	.21**	[.10, .32]		
Continuous Moderators	Effect sizes	*df*	*b*	95% CI	*t-value*	*p*	Effect sizes	*df*	*b*	95% CI	*t-value*	*p*
Duration sensitivity task[c]	170	133	.001	[.000, .002]	2.08	.002	21	18	.000	[-.004, .005]	0.07	.95
Child age	202	157	.002	[-.001, .004]	1.26	.21	23	20	.005	[.002, .009]	3.10	.01
Child sex[b]	191	152	.003	[-.002, .009]	1.19	.24	23	20	.006	[-.001, .013]	1.78	.09
Ethnic Minority	169	132	.000	[-.001, .001]	0.06	.95	20	17	.003	[-.005, .010]	0.68	.51
Parent age	158	117	-.003	[-.012, .006]	-0.68	.50	20	17	.025	[.001, .043]	2.88	.01
Publication year	202	157	.002	[-.002, .005]	0.75	.45	23	20	.002	[-.004, .009]	.82	.42
Time between assessments	202	157	-.009	[-.016, -.003]	-2.69	.01	23	20	.003	[-.014, .019]	0.31	.76

Note. [a] These measures were the most common ones and thus the ones used for this analysis; other measures were not included in this comparison. [b] For mothers, this analysis excluded $k = 8$ samples that were composed of only boys or only girls. [c] The duration of the Ainsworth et al. (1978) study was winsorized from 960 minutes to the next highest value (270 minutes). Levels of categorical moderators with $df < 4$ were not included in the Wald test; their correlation and 95% CIs are presented for descriptive purposes only and should be interpreted with caution given that $df < 4$ may cause unreliable results. In the case that only one level had more than one study, only the *n* is presented (e.g., the clinical moderator in fathers). Positive effect sizes indicate that higher levels of sensitive caregiving are associated with more attachment security (e.g., classification as secure, higher scale scores).

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 3

Multivariate Regression with Significant Moderators for Attachment Security in All Samples and in Mother-Child Dyads

All caregivers (101 effect sizes, *df* = 63)	*b*	95% CI	*t-value*	*p*
Intercept	.337	[.113, .559]	3.02	.004
Attachment: SSP	-.068	[-.216, .079]	-0.93	.36
Attachment: SSP-M	-.090	[-.251, .071]	-2.23	.27
Reliability attachment: excellent	.008	[-.124, .140]	0.12	.90
Reliability attachment: poor	-.185	[-.383, .013]	-1.87	.07
Sensitivity: EAS	.013	[-.113, .139]	0.21	.83
Sensitivity: MBQS	.200	[.006, .388]	2.06	.04
Duration of sensitivity observation	.000	[-.001, .002]	0.29	.78
Time between assessments	-.013	[-.024, -.002]	-2.29	.03
Mother-child dyads (87 effect sizes, *df* = 55)	*b*	95% CI	*t-value*	*p*
Intercept	0.332	[.108, .556]	2.97	.004
Attachment: SSP	-0.066	[-.213, .081]	-0.90	.37
Attachment: SSP-M	-0.087	[-.254, .080]	-1.04	.30
Reliability attachment: excellent	0.01	[-.136, .156]	0.13	.90
Reliability attachment: poor	-0.184	[-.394, .025]	-1.77	.08
Sensitivity: EAS	0.014	[-.127, .155]	0.20	.84
Sensitivity: MBQS	0.214	[.019, .409]	2.20	.03
Duration of sensitivity observation	0.00	[-.001, .002]	0.20	.84
Time between assessments	-0.011	[-.023, .001]	-1.88	.07

Note. Positive values for *b* and *t* indicate that the association between sensitivity and attachment security becomes stronger for this level of the moderator (categorical moderators) or as moderator values increase (continuous moderators). Negative values for *b* and *t* indicate that the association becomes weaker for this level of the moderator (categorical moderators) or as moderator values increase (continuous moderators).

Figure 1 *PRISMA Flow Diagram*

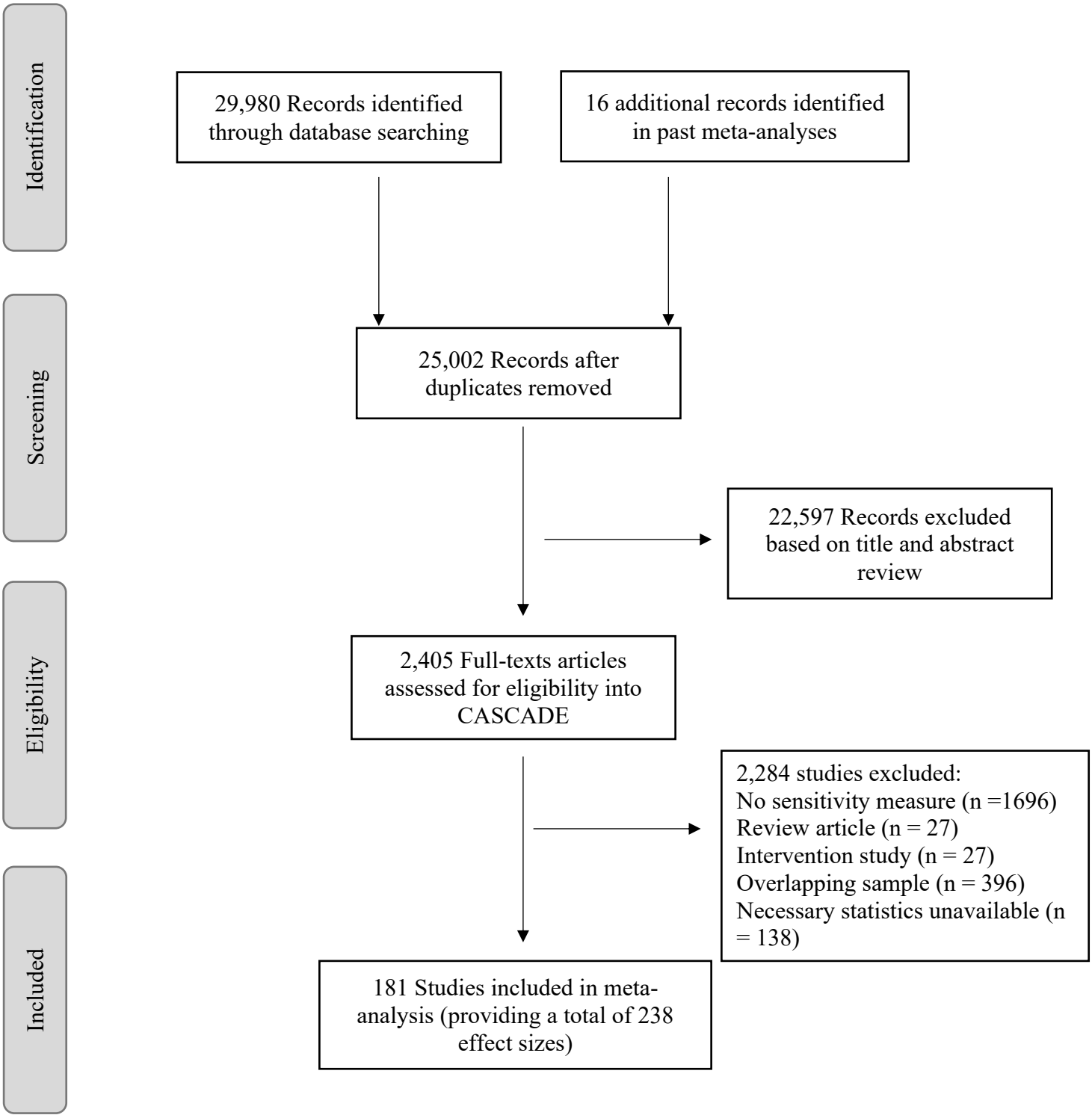
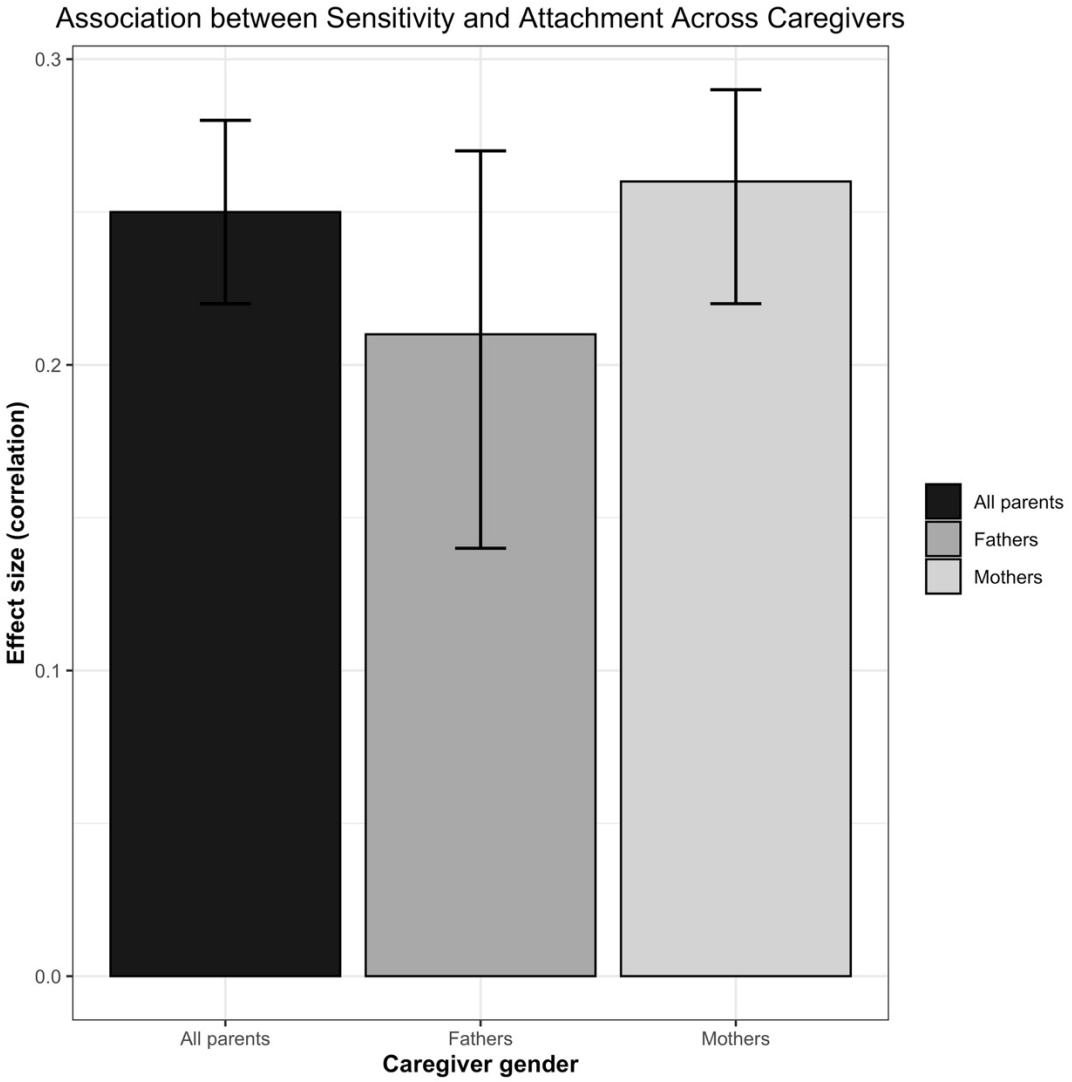
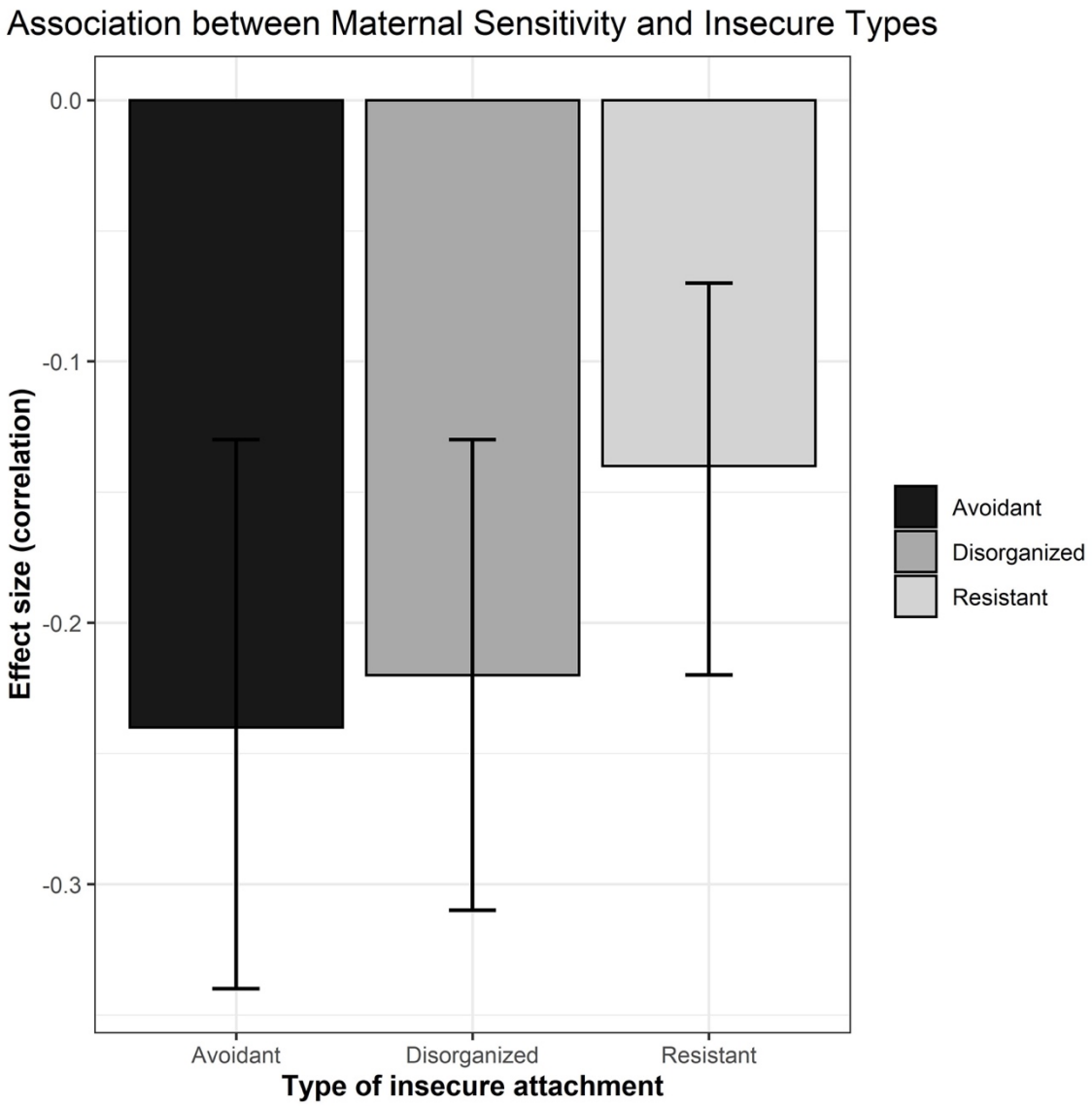


Figure 2



Note. This figure shows the effect sizes for the association between sensitivity and attachment security for all parents, then for fathers and mothers. Positive pooled effect sizes indicate that higher levels of sensitive caregiving are associated with more attachment security (e.g., classification as secure, higher scale scores). As depicted in the figure, the effect sizes for mothers and fathers were not significantly different.

Figure 3



Note. This figure shows the effect sizes for the association between sensitivity and types of insecurity, namely avoidant, resistant, and disorganized. Negative pooled effect sizes indicate that higher levels of sensitive caregiving are associated with less attachment insecurity (e.g., not classified as avoidant, resistant or disorganized, lower scale scores). As depicted in the figure, the effect sizes for the various insecure attachment types were not significantly different.