An individual participant data (IPD) meta-analysis on the attachment network to multiple caregivers

Protocol*

*This protocol consists of all Preregistration of Secondary Data Analysis items recommended by OSF (<https://osf.io/jqxfz/>)

Conducted by the Collaboration on Attachment to Multiple Parents and Outcomes Synthesis (CAMPOS)

January 2020

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Introduction

According to attachment theory, infants form selective attachment relationships through repeated interactions with their parents or other primary caregivers (Bowlby, 1969). Infants develop secure attachment relationships when parents are available and responsive in times of distress; in turn, infants with secure attachment relationships derive a sense of safety from physical or perceived proximity to caregivers when facing distress. However, when parents respond insensitively to children's distress, by being hostile or punitive, intrusive, inconsistent, or unresponsive, children are likely to develop insecure attachment patterns (Ainsworth, Blehar, Waters, & Wall, 1978)- that is, either an insecure-avoidant attachment, characterized by turning away from one's caregiver in times of need, or an insecure-resistant attachment, characterized by expressing anger or resistance towards one's caregiver simultaneously with proximity-seeking (Ainsworth et al., 1978; Main, 2000). These 'organized' attachment patterns of secure and insecure attachment behavior have been thought of as consistent strategies to maximize proximity to the caregiver at times of distress (Main, 2000). This is in contrast to disorganized attachment behaviour, which has been linked to alarming behaviours by caregivers (Cyr, Euser, Bakermans-Kranenburg, & Van IJzendoorn, 2010; Schuengel, Bakermans-Kranenburg, & Van IJzendoorn, 1999). As such, disorganized attachment behaviors reflect a disruption of attachment behavior strategies (Main & Solomon, 1990), presumably stemming from the paradox between the parent's role as a haven of safety and simultaneously as a source of alarm (Hesse & Main, 2006). Over time, attachment patterns influence an array of long-term developmental outcomes, including psychological functioning (as elaborated below) and physiological regulation (Cassidy, Jones, & Shaver, 2013).

Although early studies have acknowledged the role of both parents in child rearing, their predominant focus on mother-infant relationships was influenced by cultural values about caregiving roles, and also by the theoretical concept of "monotropy" (Bowlby, 1951, 1988). Bowlby actually intended the term "monotropy" to denote infants' inborn tendency to seek proximity to familiar caregivers, providing a building block for the formation of attachment relationships (Duschinsky, 2020). However, understandably the prefix 'mono' was generally taken, erroneously, to imply that *only one* person, usually the mother, is an important attachment figure, whereas other caretakers are at most subsidiary attachment figures with a marginal influence on the child's development. Moreover, the evolutionary psychological idea that children may prefer to turn to a single primary caregiver at times of need to promote efficiency in soliciting prompt and successful support, thus conferring advantages in human phylogeny (Cassidy, 2016), makes it plausible that one caregiver may be singled out as most important. Nevertheless, research has shown that infants form attachment relationships with at least *two* caregivers (most often, mothers and fathers) simultaneously and independently (Easterbrooks & Goldberg, 1984; Grossmann, Grossmann, Huber, & Wartner, 1981; Grossmann et al., 2002; Lamb, Hwang, Frodi, & Frodi, 1982; Main, Kaplan, & Cassidy, 1985; Sagi-Schwartz & Aviezer, 2005). Accordingly, Van IJzendoorn, Sagi, and Lambermon (1992) raised the following question: Given that infants simultaneously form independent attachment relationships with mothers and fathers, how can infant attachment *to only one caregiver*, usually the mother, predict developmental outcomes?

Studies evaluating integrative effects of infant's attachment to mother and father on later life functioning are still scarce. Moreover, in spite of the fact that infant disorganized attachment to one parent was shown to be a significant predictor of multiple key developmental outcomes (e.g., Cooke, Kochendorfer, Stuart-Parrigon, Koehn, & Kerns, 2018; Groh et al., 2014; Pallini et al., 2018; Van IJzendoorn, Dijkstra, & Bus, 1995), no study has yet addressed outcomes associated with different disorganization status configurations with mothers and fathers. This, perhaps, also has to do with a tacit reification of attachment classifications among researchers, so that - even if this was contrary to theory -

in practice they have been functionally treated as quasi-personality variables (Morris 2013); as such, assessment of attachment disorganization with another caregiver may have been implicitly deemed redundant (to researchers or funders of research) given that assessment with one caregiver would already have brought to light the personality (rather than the relationship specific aspect) of the developing child. Another contributing factor may have been the relatively late emergence of the disorganization classification, which became routinely used after all but one of the infant attachment network studies were published (Grossmann et al., 2002; Main & Weston, 1981; Suess, Grossmann, & Sroufe, 1992; Van IJzendoorn, Sagi, & Lambermon, 1992).

Beyond any empirical considerations, assessing infants' multiple attachment relationships is an important endeavor to pursue due to the fact that it constitutes a more ecologically valid approach to evaluating the social context of development than only assessing a single relationship (Belsky, 1981). A move from the traditional view of dyadic, infant-mother attachment approach to the triadic, infant-mother *and* infant-father framework was recommended decades ago (e.g., Belsky, 1981; Cowan, 1997; Kozłowska & Hanney, 2002). However, attachment theory has yet to offer a robust reply to the call for this family-based approach to child development. This may be mainly due to the resource-intensive nature of examining and coding twice the amount of infant attachment patterns in studies of this nature (i.e., attachment to both mother and father), the limited number of studies that did assess infant attachment networks have been limited in sample size (around 30–100 infants). As a result, studies have thus far produced mixed findings. This has contributed to theoretical inconsistencies regarding whether the configuration of infants' attachment patterns to their mothers and fathers predicts future developmental outcomes better than the unique effect of attachment patterns with either parent alone (Dagan & Sagi-Schwartz, 2018; Dagan & Sagi-Schwartz, in press).

Research on the joint influence of attachment patterns to both parents has been a challenge because it requires an assessment of a very large number of triads (infant, mother, and father) in order to obtain a large enough sample size of 4 different configuration groups: (a) insecure with both parents (I-I); (b) secure with mother, insecure with father (S_M-I_F); (c) insecure with mother, secure with father (I_M-S_F); and (d) secure with both parents (S-S). For example, Dagan and Sagi-Schwartz (2018) noted that ensuring an adequately powered four-group sample that meets the minimum quota for the smallest probable attachment configuration group (infants who are insecurely attached to both parents; approximately 15% of the children) requires assessing at least 440 infants for attachment patterns with both parents. Administering behavioral attachment assessments for 440 infants with both parents, as well as developmental outcome assessments across time, would be both an extremely complex and laborious endeavor. The most feasible step towards answering the question of whether the configuration of infants' attachment patterns to their mothers and fathers predicts future developmental outcomes better than previously studied in the field would be the aggregation of data currently already available.

Although a traditional meta-analysis is most often used to quantify the results accumulated via multiple studies, such a meta-analytic procedure cannot reliably answer the research question at hand due to two main reasons. First, for assessing the predictive power of infant attachment network on later developmental outcomes, a traditional meta-analysis would be bound by the selections made in primary studies for reporting outcomes. This would limit comparison and aggregation of outcome constructs (e.g., cognitive, socioemotional, and psychopathological symptoms/behaviors outcomes). Second, because papers contain only sample aggregates of moderating factors (e.g., parental age, socioeconomic status), studying moderator effects in a traditional meta-analysis would disregard any within-sample variation, leading to biased moderator effects (Lau, Ioannidis, & Schmid, 1998; Stewart & Tierney, 2002). Relatedly, cross-level interactions between participant characteristics and study characteristics could not be studied.

The most powerful and feasible way to meaningfully aggregate findings regarding infant attachment network to mother and father is via an individual participant data (IPD) meta-analysis (Verhage et al., in press). IPD meta-analysis involves accumulating and aggregating raw participant data from relevant studies (Riley, Lambert, & Abo-Zaid, 2010). In the case of attachment network assessment, IPD meta-analytic procedures would overcome some of the limitations of traditional meta-analysis in two main ways. First, gathering raw data will enable us to standardize and harmonize outcome data from multiple outcome measures used in the original studies (some of which may have not been reported) to arrive at a more comprehensive set of outcomes constructs of interest. Second, IPD meta-analysis will allow for examination of moderator effects to test the boundaries of the investigated models, and arrive at more credible findings (Ioannidis, 2017); these will be available due to the use of (a) individual-level data which takes into account within-sample variability, and (b) the use of more data than is reported in manuscripts, which increases power for the main and moderator tests.

Bringing together individual participant data from multiple studies that assessed infant/child attachment patterns to both parents and developmental outcomes will also enable the consortium to reconfigure previously collected data according to *a priori* models (e.g., create groups such as S-S and I-I) that may or may not have been considered in the original studies. The number of participants aggregated via IPD - potentially 10 times the amount of data reported in published attachment network models thus far (see Appendix B for a provisional list of eligible studies)- will significantly increase the analytic power to detect effects of attachment network on developmental outcomes.

Research Questions

Hypothesis-testing

As described above, in the largely US and European nuclear families that have been considered in the attachment literature to date, infants and children may form two attachment relationships: one with mother and one with father. This results in one of four attachment configurations: (a) insecure with both parents (I-I); (b) secure with mother, insecure with father (S_M-I_F); (c) insecure with mother, secure with father (I_M-S_F); and (d) secure with both parents (S-S). Accordingly, we raise two research questions that may be answered by testing competing hypotheses (Figure 1; see Appendix E).

Research Question 1: Does the number of secure attachments matter in predicting developmental outcomes, or is one secure attachment sufficient for optimal development? The Additive versus Buffering Hypotheses

Some findings support the *Additive Hypothesis* (Dagan & Sagi-Schwartz, 2018), which predicts a linear “dose-response” association between the number of secure attachment patterns and developmental outcomes. That is, children who are securely attached to both parents will show the best outcomes, followed by children who are securely attached to only one parent, whereas children who are insecurely attached to both parents will have the poorest outcomes. In contrast, other studies showed that infants who were secure with only one parent showed comparable outcomes to infants who were securely attached to both parents, but had better outcomes than those who were insecurely attached to both parents. Such findings are consistent with the *Buffering Hypothesis* (Dagan & Sagi-Schwartz, 2018), according to which an early secure attachment to one parent is sufficient to offset the risk effects of an insecure attachment to the other, and there is no advantage to having a secure attachment to both parents.

In line with attachment theory and meta-analytic results regarding the intended outcome testing (see under *Harmonization of developmental outcome measures below*), ***we hypothesize that the predictive effect of multiple attachment relationships on developmental outcomes of interest***

is consistent with the Additive Model. That is, children with secure attachment to both parents will show better developmental outcomes than children with secure attachment to only one parent, and the latter will show better developmental outcomes than children who are insecurely attached to both parents. If the null hypothesis will fail to be rejected, the Buffering Hypothesis will be tested as an alternative hypothesis, based on preformulated auxiliary hypotheses put forward by Dagan & Sagi-Schwartz (2018).

Research Question 2: Does one parent contribute more than the other to developmental outcomes, or do they matter equally? The Hierarchical versus Horizontal Hypotheses

According to the *Hierarchical Hypothesis* (Bowlby, 1969; Bretherton, 1985; Van IJzendoorn et al., 1992), one parent influences the developmental outcomes of the child more than the other parent. This would result in one of two possible developmental trajectories: infants securely attached to the mother and insecurely attached the father will show better developmental outcomes than those securely attached to the father but insecurely attached to the mother, or *vice versa*. In contrast, the *Horizontal Hypothesis* (Dagan & Sagi-Schwartz, 2018) predicts that infants with a secure attachment to only the mother exhibit similar developmental outcomes to those who form a secure attachment only to the father.

Assuming that mothers are on average more involved in time and across domains with child rearing than fathers (e.g., Parker & Wang, 2013), it is plausible that the quality of attachment with mother would affect outcome more strongly than the quality of child-father attachment. In line with attachment theory and meta-analytic results regarding the intended outcome testing, *we hypothesize that developmental outcomes of interest will be predicted in accordance with the Hierarchical Model*, with child-mother attachment influencing more strongly on the developmental outcome of interest than child-father attachment. That is, children with secure attachment only to mother will show better developmental outcomes than children with secure attachment only to only father. If the null hypothesis will fail to be rejected, the Horizontal Hypothesis will be tested as an alternative hypothesis, based on preformulated auxiliary hypotheses put forward by Dagan & Sagi-Schwartz (2018).

Research Question 3: Which integrative model best predicts developmental outcomes?

Overall, these research questions and sets of competing hypotheses (Additive vs. Buffering and Hierarchical vs. Horizontal) combine into four mutually exclusive explanatory models: (a) Additive-Hierarchical, (b) Additive-Horizontal, (c) Buffering-Hierarchical, and (d) Buffering-Horizontal. Table 1 (see Appendix F) depicts the model-based predictions, including the relations between the different attachment configurations within each model.

Stemming from Research Questions 1 and 2 above, *we hypothesize that developmental outcomes of interest will be predicted in accordance with the Additive-Hierarchical Model*. That is, children who are securely attached to both parents will show the best outcomes compared to all other groups, followed by children who are securely attached only to the mother, and then those who are securely attached only to the father. Children with insecure attachment to both parents will exhibit the worst outcomes of all four groups.

Exploratory research questions

- (a) ***Does attachment insecurity with one parent lead to better developmental outcomes in high risk populations?*** Based on findings from existing published research on infant attachment networks, as well as meta-analyses finding that secure attachment predicts better socioemotional outcomes than insecure attachment (e.g., Groh et. al., 2014; Fearon, 2014), all four of the models (Additive-Hierarchical, Additive-Horizontal, Buffering-Hierarchical, and Buffering-Horizontal; see Table 1 below) predict that infants who are securely attached to one

parent (S-I) will fare no better than infants who are securely attached to both parents (S-S). While this pattern is most plausible based on theory and evidence to date, other theorizing leads to the possibility that in some rearing environments, having one insecure attachment within the family may actually allow infants to better adapt to high-risk ecological contexts than infants who are securely attached to both parents. This may be the case, for example, in contexts that are characterized by high competition for resources and low trust (Ellis, Bianchi, Griskevicius, & Frankenhuis, 2017). For example, insecurely attached children tend to better recall negative events than secure children (Belsky, Spritz, & Crnic, 1996); as such, they may benefit from either detection or avoidance of negative events in their high risk environment in the future. This adaptive attentional capacity may, in turn, attenuate otherwise excessive psychopathological symptoms that tend to arise as a result of such harsh environments. Accordingly, we will explore whether infants who are securely attached to only one parent- the S-I group- exhibit better (according to the prevailing hypothesis in the field) developmental outcomes in high-stress, low resource contexts than their counterparts who are securely attached to both parents (i.e., the S-S group). For example, it might be the case that in high risk samples, a possible model would show the following: $S_M-I_F = I_M-S_F > S-S > I-I$; that is, infants who are securely attached to either parent will show non significantly different developmental outcomes but both groups will fare better than the S-S group.

- (b) **Moderators for Research Question 1.** Given that risk conditions have been found to moderate the link between infant attachment patterns and multiple developmental outcomes (e.g., Groh et al., 2014), we will examine whether **parental risk status** moderates the link between the number of secure attachments and each of the developmental outcomes. For example, we would expect that having two secure attachment relationships may buffer the deleterious effect of high risk environmental conditions (e.g., low SES, parental psychopathology) on the developing child more effectively than having only one secure attachment relationship; the buffering effect of secure attachment with one parent on the potential deleterious effects of insecure attachment with the other parent, in contrast, may show insignificant low-risk environmental conditions, where little stress is experienced. Moreover, some studies found that longer time intervals between assessment of attachment patterns and developmental outcomes led to a smaller effect size of the link between them the two (e.g., Colonnese et al., 2011; Madigan et al., 2013; but see Groh et al., 2014, for contrary meta-analytic evidence). Accordingly, we will test whether the **time gap** between the most recent of the two attachment network assessments and development outcomes moderates the link between early attachment network and each of the developmental outcomes of interest. We expect that the larger the time gap, the smaller the effect size between the attachment network and developmental outcomes.
- (c) **Moderators for Research Question 2.** Parents may differ with respect to the level of involvement in child rearing (Bakermans-Kranenburg, Lotz, & Dijk, 2019; Brown, McBride, Bost, & Shin, 2011; Renk et al., 2003). Accordingly, we will test for moderation effects of relative **parental involvement**. For example, we would expect that in triads where mothers are more involved in child rearing than fathers, the Hierarchical hypothesis, but not the Horizontal hypothesis, will be corroborated. In such cases, it is reasonable to predict that interacting more with the developing child will make mothers more influential than fathers.

General methods

Objectives

The main aim of the project is to add to our understanding of how the joint effect of early attachment to both mothers and fathers may influence later developmental outcomes. The question at hand is as follows: **What role do two infant/child–parent attachment relationships jointly play in children’s developmental outcomes?** The few studies conducted to date on the integration of infant-mother and infant-father attachment patterns focused exclusively on dichotomous secure/insecure classifications (e.g., (Sagi-Schwartz & Aviezer, 2005; Suess, Grossmann, & Sroufe, 1992; van IJzendoorn, Sagi, & Lambermon, 1992; Verschueren & Marcoen, 1999). However, in this IPD meta-analysis we will further examine the infant attachment network with respect to attachment disorganization, given the significance of attachment disorganization in predicting key developmental outcomes (e.g., Fearon et al., 2010; Lyons-Ruth, Pechtel, Yoon, Anderson, & Teicher, 2016; Van IJzendoorn, Schuengel, & Bakermans-Kranenburg, 1999). **The aforementioned research question will thus be articulated, and accordingly empirically assessed in terms of two attachment variables: (1) the status of infant *security of attachment to each parent (secure versus insecure)*; and (2) the status of infant *disorganization to each parent (organized versus disorganized)*.**

We choose to assess attachment networks based on the categorical classification of infant attachment security since it has been the most widely used approach, and thus we anticipate maximum available sample size collecting categorical data. However, the argument has been made that there may be a potential advantage of assessing attachment security via a dimensional approach (e.g., Fraley & Spieker, 2003; Groh et al., 2019; Richters, Waters, & Vaughn, 1988). Although we anticipate a significant reduction in sample size, we will attempt to collect dimensional data for the purpose of sensitivity analyses (see Sensitivity analyses sub-section below).

Harmonization of developmental outcome measures

One of attachment theory’s main assumptions is that early infant-parent relationship experiences play a crucial role in promoting positive social and emotional adaptation across the life course (Bowlby, 1969; Carlson & Sroufe, 1995). The mechanism underlying this assumption states that early infant experiences with caregivers at times of need feed into expectations about social relationships (Bowlby, 1973; Bretherton & Munholland, 2008). Specifically, these expectations have been thought to shape the individuals interpersonal behaviors (Bretherton, 1985, 1991, 1992; Sroufe, Egeland, Carlson, & Collins, 2005; Sroufe & Waters, 1977) and mental health (Groh et al., 2014). In line with this theoretical assumption, meta-analyses confirmed that outcome constructs known to be predicted by early infant attachment patterns as assessed via observation methods are **(a) social competence** (Groh et al., 2014; Schneider, Atkinson, & Tardif, 2001) and two dimensions of developmental psychopathology, namely **(b) internalizing behaviors** and **(c) externalizing behaviors** (Colonesi et al., 2011; Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley, & Roisman, 2010; Groh, Roisman, van IJzendoorn, Bakermans-Kranenburg, & Fearon, 2012; Madigan, Atkinson, Laurin, & Benoit, 2013).

Meta-analyses that assessed associations between infant attachment and other developmental outcome domains have been published as well. These meta-analyses will be used to assess the feasibility for testing additional theory driven hypotheses, for which we will collect the following outcome constructs as well. Sufficient data needs to be available to achieve a priori set power of 0.80 regarding the following outcome domains: **(d) language competence** (Van IJzendoorn, Dijkstra, & Bus, 1995); **(e) emotional understanding** (Cooke et al., 2016); **(f) emotional regulation**, including positive and negative affectivity (Cook et al., 2018); **(g) effortful control** (Pallini et al., 2018), and **(h) self-regulation**

(Pallini et al., 2018). The outcome data will be harmonized based on either *independent informant* (i.e., non-mother and son-father informant, such as teachers), or when independent informants are not available, on the average scores of mother and father reports.

Outcome constructs may have been operationalized with a range of measures. A protocol for harmonizing outcome measures will be developed jointly for IPD meta-analyses within the Collaboration for Attachment Research Synthesis (CARS). This harmonization protocol will be developed in particular jointly with the ongoing CAPIS project (Collaboration for Attachment and Parenting Intervention Synthesis; Van IJzendoorn, Reisz, Reijman, Duschinsky, Schuengel, et al.).

Eligibility criteria

Studies must have:

- Assessed infant or child attachment patterns with both mothers and fathers using an observational tool. In cases where the time gap between attachment observational measures is unknown, analyses without these samples will be run as part of sensitivity testing.
- Assessed either concurrent or later developmental outcomes.
- Used an attachment behavioral coding measure for caregiver-child attachment, coded by observers (i.e., excluding parent-report, parent-observation, self-report, self-observation, and projective measures)

Identification of studies

Studies for the current project (see Appendix B) were drawn based on the eligibility criteria from the *Child Attachment Studies Catalogue and Data Exchange (CASCADE)*, the Determinants of Child Development Lab in the Department of Psychology, University of Calgary, with the permission and supervision of the lab director, Dr. Sheri Madigan. CASCADE is a catalogue of all research studies until 2017) that have assessed infant and child attachment. Search for CASCADE using the search terms (see Appendix A) was conducted the following databases: **Medline, EMBASE, PsychINFO, and Web of Science**.

Data collection

Data on the main study variables, participant characteristics, and study characteristics will be sought for all participants.

Caregiver-child attachment:

- Type of measure
- In case of multiple infant attachment assessments with the same parent, preference will be given to SSP classifications, because this measure has been most widely used and reported in the field and previous IPD meta-analysis that examined infant attachment (Verhage et al., 2018). For the purpose of constructing the different configurations of infant attachment networks to mothers and fathers, attachment classifications will be grouped into (a) *secure and insecure* (comprising of avoidant, resistant, and cannot-classify attachment classifications, with or without primary disorganized classification); and (b) *organized* (secure and insecure attachment classifications which were not assigned with a primary disorganized classification) and *disorganized*.
- Consistent with previous research (Lehman, Denham, Moser, & Reeves, 1992) and IPD meta-analysis that examined infant attachment (Verhage et al., 2018), Attachment Q-Sort (AQS; Waters & Deane, 1985) scores will be categorized as secure or insecure based on a cutoff score

of .40; scores above the cutoff will be categorized as secure, and scores equal to or below the cutoff will be classified as insecure.

If Strange Situation Procedure (including SSP-modified version, and the Preschool Assessment of Attachment [PAA]):

- SSP forced main classification
- SSP forced sub-classification
- SSP four-way main classification (not applicable to the PAA)
- SSP four-way sub-classification (not applicable to the PAA)
- SSP D-score (not applicable to the PAA)
- SSP Behavior rating scales (Proximity seeking, Contact maintenance, Resistance, Avoidance)

If Attachment Q-Sort:

- AQS continuous score

If Preschool Attachment Assessment:

- PAA main classification
- PAA sub-classification

If Main-Cassidy classification system:

- Main-Cassidy system forced main classification
- Main-Cassidy system forced sub-classification
- Main-Cassidy system four-way main classification
- Main-Cassidy system four-way sub-classification
- Main-Cassidy system D-score
- Main-Cassidy system scales

Characteristics of child and caregivers:

- Age
- Social support for each caregiver
- Relationship status with respect to the other caregiver (e.g., married, divorced)
- Current relationship status
- Education level
- Income
- Occupation
- Ethnicity
- Clinical status
- Risk status (this may vary depending on the sample; e.g., adolescence parents, low SES, poverty)
- Type of caregiver (biological parent, foster parent, adoptive parent)
- Gender parent
- Gender child
- Child identifier (anonymized)
- Parental involvement

A suggested coding format for these data is provided (see attached SPSS sheet to this project). It would be helpful if individual researchers provided their data in the suggested format, but it is not essential to do so. Data will be accepted in any format that is most convenient for the researchers. Any data supplied electronically should be encrypted or sent through a secure ftp server. A final copy of the data from each study will be sent back to the researchers for verification.

Main analyses

In the following analyses, all studies will be analyzed in a single step by using a multilevel structure to account for the variance within studies, with developmental outcomes being the dependent variables and attachment networks being the predictors.

Analysis 1: Testing the Additive versus Buffering Hypotheses (Research Question 1)

We will conduct a series of one-way analysis of variance (ANOVAs), where each developmental outcome will be the dependent variable, and attachment network (secure with both parents [S-S], secure with only one parent [S-I], and insecure with both parents [I-I]) will be the independent between-subjects factors. Planned contrasts (polynomial, quadratic) will be used to test the buffering hypothesis first (to establish whether having any secure attachment relationship is associated with more adaptive outcomes (contrasts “no secure attachments” [-2], “one secure attachment” [+1], “two secure attachments” [+1]), followed by the additive hypothesis that tests whether having two secure attachment relationships is associated with more adaptive outcomes than having one (contrasts “no secure attachments” [0], “one secure attachment” [-1], “two secure attachments [+1]) Similar contrasts will be tested for disorganized attachment.

For example, if I-I infants will show significantly more internalizing symptoms than both S-S and S-I infants, but the latter two groups will not show significantly different outcome means, it will indicate that being secure with at least one parent is beneficial compared with being insecure with both; accordingly, the Buffering hypothesis will be corroborated. Alternatively, if I-I infants will show significantly more internalizing symptoms than both S-S and S-I infants, and S-I infants will show significantly more internalizing symptoms than the S-S infant group, it will indicate that the more secure attachment an infant has, the better the outcome; accordingly, the Additive hypothesis will be corroborated.

Analysis 2: Testing the Hierarchical versus Horizontal Hypotheses (Research Question 2)

We will conduct a series of one-way analysis of variance (ANOVAs), where each developmental outcome will be the dependent variable, and attachment network (secure only with mother [S_m-I_f], secure with only with father [I_m-S_f]) will be the independent between-subjects factors. Given that only two groups will be compared, no planned contrasts will be conducted.

Analysis 3: Comparing the four attachment network models (Research Question 3)

We will conduct a series of one-way analysis of variance (ANOVAs), where each developmental outcome will be the dependent variable, and attachment network (secure with both parents [S-S], secure with only mother [S_m-I_f], secure with only father [I_m-S_f], and insecure with both parents [I-I]) will be the independent variable. Planned contrasts (polynomial, quadratic) will be used to test whether infants with two insecure attachments fare worse than infants with at least one secure attachment (contrasts “no secure attachments” [-3], “one secure attachment with mother” [+1], “one secure attachment with father” [+1], “two secure attachments” [+1]). Then, we will contrast the S-S group (+2) with both of the single secure attachment groups (S_m-I_f [-1], I_m-S_f [-1]) to test whether these groups are organized according to the buffering hypothesis (insignificant planned comparison analysis) or additive hypothesis (significant planned comparison analysis, with S-S group showing outcome average representing better outcome than the other two infant groups). Then, we will directly contrast S_m-I_f (-1) and I_m-S_f (+1) groups to test whether these groups are organized according to the horizontal hypothesis (insignificant planned contrasts analysis), or hierarchical hypothesis (significant planned contrast analysis, with parent

dominance decided based on the group outcome average). In cases where the model predicts an absence of meaningful effect between two groups (e.g., as in the case of the Buffering-Horizontal hypothesis, where $S-S = S_M-I_F = I_M-S_F$), equivalence tests will be performed to assess statistical equivalence (on top of the statistical difference from zero; Lakens, 2017). Based on the pattern of planned contrast results, we will be able to either corroborate or falsify all four models proposed in Appendix C.

For example, if I-I infants will show significantly more internalizing symptoms than all other 3 infant groups (i.e., S-S, S_M-I_F , I_M-S_F), and all 3 other infant groups will show statistical equivalence, we may conclude that being secure with at least one parent is beneficial compared with being insecure with both, and that there is no primary caregiver with which secure attachment is more important than the other with regards to this specific outcome; accordingly, the Buffering-Horizontal hypothesis will be corroborated.

Sensitivity analysis

To assess the robustness of findings, we will conduct several sensitivity analyses.

- (1) Given that no research has robustly established a minimum interval time below which a spillover effect from one SSP assessment to another may occur when administered to the same infant, all available SSP data will be requested and analyzed according to the research questions posed above. We will conduct a Regions of Significance testing (RoS; e.g., Roisman, Newman, Fraley, Haltigan, Groh, & Haydon, 2012) to assess at what level of the moderator (i.e., continuous measure of the number of days between SSP assessment)- if any- does the link between attachment network and the developmental outcome at hand becomes significant.
- (2) We will test our findings against competing analyses that are based on other assessment methodologies: (a) Comparing outcomes based on individual differences in attachment networks derived at via traditional categorical attachment classifications (i.e., secure/insecure) versus classifications which are arrived at by computing continuous scores (for SSP dimensions, see Fraley, & Spieker, 2003; Richters, Waters, & Vaughn, 1988. For AQS cut-off scores, see Verhage et al., 2018); (b) Comparing the harmonized outcome data we chose to test in our primary analyses (see “Harmonization of developmental outcome measures” above) versus harmonized outcome data based on other informants (e.g., mother report alone, father report alone, and self-report).
- (3) We will perform a sensitivity analysis for differential effects between complete and imputed data.
- (4) We will conduct post-hoc sensitivity power analysis based on the number of participants collected from the different studies (see Appendix B), and assuming a power = .80 and a $p = .05$. This will allow us to assess the smallest effect that we could detect with high probability given the number of collected participants (i.e., minimal detectable effect; MDE).

Project coordination

The day-to-day conduct of these meta-analyses will be carried out by the project coordination team at both Stony Brook University and Vrije Universiteit Amsterdam.

Timetable

November 2019: Write to study authors to ask for collaboration

Spring 2020– Spring 2021: Check and verify incoming data, build database

Spring/Summer 2021: Data analyses

Privacy policy

Data should be sent without any identifying information on participants. Data sent through our FTP server will be encrypted as soon as it is uploaded. Data sent through regular mail or fax will be stored in a closed cabinet. The checking and combining of the data will be done at Vrije Universiteit and data files will be password-protected. Data analysis will take place at Vrije Universiteit or remotely over a secure connection on the protected server of Vrije Universiteit by a core member of the project from his or her research institute, based on a data sharing agreement between both institutes. Data will not be used, circulated, or distributed in any way that allows access to individual study data, without first seeking permission of the PI of the data set. Only core members of the research team may have access to the ensemble data. Individual datasets/studies will not be retracable to the original researchers in the final combined dataset.

Publication policy

After identification of eligible studies, study authors will be contacted and asked to participate in the Collaboration for Attachment to Multiple Parents and Outcomes Synthesis (CAMPOS). By agreeing to participate, authors commit to providing data on their participants for use in the project. Participating authors will become members of the collaborative group and all results from the meta-analyses will be presented in the group's name, and will be invited to contribute as named or group author to the writing of manuscripts based on the project. Participating authors will also be invited to a collaborators meeting in which the results will be presented.

All results of these meta-analyses will be presented in the CAMPOS group name, comprising of all authors who contributed data for the meta-analyses, the International Advisory Group, and the Project Coordination Group. Initial results will be presented in a closed meeting of CAMPOS. All contributors have the opportunity to comment on the results and provide feedback during this meeting, after which abstracts will be written to be presented at international conferences. Several manuscripts containing the research questions will be drafted, which will be circulated to each CAMPOS members for comments. Manuscripts will be submitted for publication to peer-reviewed journals.

Appendix A – Search term

strange situation*; (secure* or resist* or avoid* or disorganiz*);
("attachment q sort" or "attachment q-sort" or "Cassidy and Marvin" or "preschool assessment of attachment" or "Main-Cassidy" or "preschool attachment assessment" or "school age attachment")."

Appendix B – Provisional list of eligible studies

First author name (Year)	Triad <i>N</i>	Infant/child Attachment measure
Abrams, Kelley Yost (2006)	25	SSP
Abrams, Kelley Yost (2000)	25	SSP
Arnott, Bronia (2007)	15	SSP
Aviezer, Ora (2002)	66	SSP
Bar-Haim, Yair (2002)	64	SSP
Belsky, Jay (1984)	61	SSP
Belsky, Jay (1988)	130	SSP
Belsky, Jay (1987)	184	SSP
Belsky, Jay (1996)	125	SSP
Boldt, Lea (2017)	102	SSP
Boldt, Lea (2016)	99	SSP
Boldt, Lea (2014)	100	SSP
Braungart-Rieker, Julia M. (2001)	86	SSP
Braungart-Rieker, Julia M. (1999)	77	SSP
Braungart-Rieker, Julia M. (2014)	114	SSP
Brock, Rebecca L. (2014)	62	AQS
Brown, Geoffrey L. (2010)	62	SSP
Bureau, Jean-François (2014)	107	SSP-M
Bus, Adriana G. (1997)	100	SSP
Caldera, Yvonne M. (2006)	60	AQS
Chase-Lansdale, P. Lindsay (1987)	97	SSP
Colonnesi, Cristina (2013)	20	AQS
Cox, Martha J. (1992)	33	SSP
Coyl, Diane D. (2010)	235	AQS
Edwards, Ellen P. (2004)	208	SSP
Fonagy, Peter (1991)	100	SSP
Freitag, Milam K. (1996)	40	SSP
Frodi, Ann (1983)	51	SSP
Frosch, Cynthia A. (2001)	131	SSP
Fuertes, Marina (2016)	82	SSP-M
Garwood, Molly Murphy (1998)	105	SSP
George, Melissa Renee Ward (2010)	235	SSP-M
Goldberg, Susan (1984)	75	SSP
Goossens, Frits A. (1990)	75	SSP
Grossman, Karin (2002)	49	SSP
Grossman, Klaus (1981)	46	SSP
Heidt-Kozisek, Elizabeth (1997)	30	SSP
Hinshaw-Fuselier, Sarah Seymour (2004)	125	SSP
Kazura, Kerry (2000)	27	SSP
Kennedy, Mark (2015)	30	AQS

Kim, Sanghag (2014)	102	SSP
Kochanska, Grazyna (2012)	102	SSP
Kochanska, Grazyna (2005)	101	SSP
Kochanska (2013)	101	SSP
Kochanska, Grazyna (2010)	101	SSP
Lamb, Michael E. (1978)	32	SSP
Lamb, Michael E. (1982)	51	SSP
Laurent, Heidemarie K. (2008)	80	PAA
Lickenbrock, Diane M. (2015)	117	SSP
Lickenbrock, Diane M. (2013)	106	SSP
Lickenbrock, Diane M. (2010)	135	SSP
Lindsey, Eric W. (2009)	80	SSP
Lindsey, Eric W. (2015)	86	SSP
Lionetti, Francesca (2014)	30	SSP
Lundy, Brenda L. (2002)	15	AQS
Madigan, Sheri (2011)	31	SSP
Main, Mary (1988)	40	SSP
Main, Mary (1985)	40	SSP
Main, Mary (1981)	61	SSP
McElwain, Nancy L. (2004)	62	SSP
McElwain, Nancy L. (1999)	53	SSP
Moilanen, Irma (2000)	60	SSP
Moilanen, Irma (2000)	30	SSP
Monteiro, Ligia (2008)	56	AQS
Monteiro, Ligia (2010)	44	AQS
Moore, Ginger A. (1996)	136	SSP
Notaro, Paul C. (1999)	62	SSP
Oppenheim, David (1988)	59	SSP
Owen, Margaret Tresch (1981)	132	SSP
Owen, Margaret Tresch (1984)	59	SSP
Owen, Margaret Tresch (1997)	33	SSP
Pipp, Sandra (1993)	30	SSP
Planalp, Elizabeth M. (2013)	115	SSP
Sagi, Abraham (1986)	86	SSP
Sagi, Abraham (1985)	86	SSP
Schneider Rosen, Karen (1993)	62	SSP
Schneider Rosen, Karen (1999)	41	SSP, AQS
Schoppe-Sullivan, Sarah (2006)	87	SSP
Solomon, Judith (1999)	?	SSP
Steele, Howard (1996)	100	SSP
Steele, Howard (1999)	63	SSP
Steele, Howard (2008)	63	SSP
Suess, G. J. (1992)	39	SSP
Tirkkonen, Tiina (2016)	54	PAA
Tluczek, Audrey (2015)	118	AQS
Umemura, Tomo (2013)	102	SSP

van Ee, E. (2016)	68	SSP
van IJzendoorn, Marinus H. (1992)	80	SSP
van IJzendoorn, Marinus H. (1992)	86	SSP
Verissimo, Manuela (2011)	35	AQS
Volling, Brenda L. (1992)	30	SSP
Volling, Brenda L. (2001)	45	SSP
Volling, Brenda L. (2014)	224	AQS
Wille, Diane E. (1998)	70	AQS
Wong, Maria (2009)	62	SSP
Youngblade, Lise M. (1995)	67	SSP
Youngblade, Lise M. (1993)	73	SSP, AQS
Youngblade, Lise M. (1992)	73	SSP, AQS
Zentall, Shannon R.(2012)	46	SSP

Appendix C: Figure 1

Figure 1 (from on Dagan & Sagi-Schwartz, 2018). Four competing hypotheses, ordered according to the issue they address.

Note. S-S = secure with mother and father; I-I = insecure with mother and father; SM = secure with mother; SF = secure with father; IM = insecure with mother; IF = insecure with father.

Appendix D: Table 1

Table 1 (from on Dagan & Sagi-Schwartz, 2018). Model-Based Outcome Predictions.

Integrative Model	Prediction*	Brief Description
(a) Additive-Hierarchical	$S-S > S_M-I_F > I_M-S_F > I-I$ OR $S-S > I_M-S_F > S_M-I_F > I-I$	Secure attachment to only one parent (but not the other) leads to better outcomes than insecure attachment to both parents, but poorer outcomes than secure attachment to both parents.
(b) Additive-Horizontal	$S-S > S_M-I_F = I_M-S_F > I-I$	Secure attachment to either parent (but not the other) leads to better outcomes than insecure attachment to both parents, but poorer outcomes than secure attachment to both parents.
(c) Buffering-Hierarchical	$S-S = S_M-I_F > I_M-S_F > I-I$ OR $S-S = I_M-S_F > S_M-I_F > I-I$	Secure attachment to only one parent (but not the other) leads to as good outcomes as secure attachment to both parents.
(d) Buffering-Horizontal	$S-S = S_M-I_F = I_M-S_F > I-I$	Secure attachment to either parent (but not the other) leads to as good outcomes as secure attachment to both parents, all better than insecure attachment to both parents.

Note. Greater than symbols represent better developmental outcomes. S-S = Secure with mother and father; I-I = Insecure with mother and father; SM = Secure with mother; SF = Secure with father; IM = Insecure with mother; IF = Insecure with father. *All models assume that the I-I group has worse outcomes than the other three configuration groups.

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