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Attachment Relationship Quality With Mothers and Fathers and Child Temperament: An Individual Participant Data Meta-Analysis

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A growing body of research suggests that, compared with single parent–child attachment relationships, child developmental outcomes may be better understood by examining the configurations of child–mother and child–father attachment relationships (i.e., attachment networks). Moreover, some studies have demonstrated an above-chance level chance of concordance between the quality of child–mother and child–father attachment relationships, and child temperament has been offered as a plausible explanation for such concordance. To assess whether temperament plays a role in the development of different attachment network configurations, in this preregistered individual participant data meta-analysis we tested the degree to which the temperament dimension of negative emotionality predicts the number of secure, insecure-avoidant, insecure-resistant, and disorganized attachment relationships a child has with mother and father. Data included in the linear mixed effects analyses were collected from seven studies sampling 872 children (49% female; 83% White). Negative emotionality significantly predicted the number of secure ($d = -0.12$) and insecure-resistant ($d = 0.11$), but not insecure-avoidant ($d = 0.04$) or disorganized ($d = 0.08$) attachment relationships. Nonpreregistered exploratory analyses indicated higher negative emotionality in children with insecure-resistant attachment relationships with both parents compared to those with one or none ($d = 0.19$), suggesting that temperament plays a small yet significant role in child–mother/child–father insecure-resistant attachment relationships concordance. Taken together, results from this study prompt a more in-depth examination of the mechanism underlying the small yet significantly higher chance that children with increased negative emotionality have for developing multiple insecure-resistant attachment relationships.

Public Significance Statement

Little is known about whether temperament, which is thought of as a behavioral manifestation of one's genetic predisposition, plays a role in the development of simultaneous attachment relationships with multiple caregivers. Results from this study suggest that parents-reported temperamental attributes of negative emotionality play a small yet significant role in the number and concordance of insecure (especially resistant type) attachment relationships children develop with their mothers and fathers, prompting an in-depth examination of the mechanism underlying such associations.

Keywords: attachment, network, negative emotionality, temperament

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Attachment theorists have long asserted that individual differences in early child attachment behaviors, which are thought to be affected by the caregiving environment, develop by and large independently from children's constitutionally-based affective, motivational, and cognitive capacities (Sroufe, 1985), commonly referred to as temperament. Others, however, have contested such a view. Specifically, Kagan (1995) argued that temperament-based reactions to the caregiving environment shape the nature of interactions between children and their caregivers, and therefore, need to be considered as an alternative explanation for individual differences in attachment behaviors. Especially relevant to this debate have been the temperamental dimensions that reflect a general tendency to experience negative emotions, including fear (or behavioral inhibition) and irritable distress (e.g., Goldsmith et al., 1986; Kagan, 1982).

The current preregistered individual participant data (IPD) meta-analysis is the first to combine two approaches that have been commonly applied to study the associations between temperament and the quality of attachment relationships. The first approach has been to examine the association between single child–parent (primarily child–mother) attachment relationships and temperament (for a meta-analysis, see Groh et al., 2017). The second approach has been to assess the concordance between the quality of child–mother and child–father attachment relationships (for meta-analyses, see Fox et al., 1991; Pinquart, 2022; Van IJzendoorn & De Wolff, 1997), an above-chance level concordance that could be partly driven by children's constitutional characteristics. Combining these two approaches in this study allows us to uniquely assess the extent to which temperament may explain

available at https://osf.io/ytwvr. The analytic code necessary to reproduce the analyses presented in this article is available from Or Dagan. The materials necessary to attempt to replicate the findings presented here are not publicly accessible. The study protocol preregistration is available at https://osf.io/a3qs9. The updated study protocol preregistration is available at https://osf.io/ytwvr. The power analysis preregistration is available at https://osf.io/tcj45. The data harmonization preregistration is available at https://osf.io/q35cd.

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similarities in the quality of attachment relationships that children develop with their mothers and fathers (i.e., the attachment network), which in turn have been shown to predict behavioral problems (Dagan et al., 2022) and language competence (Dagan, Schuengel, et al., 2021).

Associations Between Temperament and Attachment Relationships

According to attachment theory, children's repeated interactions with their primary caregivers lead to the formation of attachment relationships with them (Bowlby, 1973). Consistent and responsive caregiving promotes children's expectations that their caregiver is available in alarming circumstances, such as when they are in pain or under emotional distress. This set of expectations is manifested in proximity-seeking behaviors in times of need, which constitute one of the hallmarks of secure attachment relationships. In contrast, uncertainty about the availability of caregivers in times of need is thought to explain insecure patterns of attachment relationships observed in the strange situation procedure (SSP; Ainsworth et al., 1978). Designed to activate the infant's attachment system, the SSP includes brief separations from and reunions with the parent, during which the infant's behavior is evaluated. Such behavior is thought to reflect the child's expectations regarding the parent's availability.

Children classified as insecure-avoidant in the SSP tend to exhibit limited proximity-seeking and direct attention away from their caregivers upon reunion during the SSP. Alternately, children classified as insecure-resistant in the SSP show strong proximity-seeking behavior toward their caregivers prior to separation from them, and exhibit simultaneous proximity-seeking with passivity or angry outbursts upon reunion. Children with a disorganized attachment relationship exhibit conflicted, apprehensive, or disoriented behavior toward their caregivers when under presumed distress during the SSP (Main & Solomon, 1986), potentially reflecting exposure to frightening, frightened, or disruptive caregiving behaviors (Madigan et al., 2006; Main & Hesse, 1990; Schuengel et al., 1999). A meta-analysis of over 20,000 SSPs by Madigan et al. (2023) revealed that the distribution of infant attachment is 51.6% secure, 14.7% avoidant, 10.2% resistant, and 23.5% disorganized. Moreover, the distribution was similar for mothers and fathers.

Groh et al. (2017) meta-analytically assessed the associations between negative temperament in children between ages 1 and 5, tested via different negative affect dimensions (e.g., fear, irritability, and distress), and child–parent (mostly child–mother) attachment relationship quality. Negative temperament was weakly associated with insecure parent–child attachment relationships ($d = 0.14$; $N = 11{,}440$, $k = 109$). Furthermore, the association between negative temperament and insecure child–parent attachment quality was mainly driven by the association between negative temperament and insecure-resistant attachment ($d = 0.30$; $N = 6{,}286$, $k = 55$). In contrast, nonsignificant associations were observed between negative temperament and insecure-avoidant ($d = 0.10$; $N = 5{,}950$, $k = 51$) and disorganized ($d = 0.11$; $N = 3{,}784$, $k = 23$) attachment relationships. When assessing the links between child–father attachment and negative temperament, Groh et al. (2017) reported comparable magnitude of associations to those found for child–mother attachment relationships, with none being statistically significant ($d = 0.15$, $N = 647$, $k = 7$ for secure; $d = 0.08$, $N = 346$, $k = 4$ for insecure-avoidant; $d = 0.27$, $N = 346$, $k = 4$ for insecure-resistant; no studies were available for the association with disorganized infant–father attachment).

The potential role of temperament in the development of attachment relationships has also been assessed via the concordance between the quality of mother–child and father–child attachment relationships. Meta-analyses have documented an above-chance level of concordance between mother–child and father–child attachment quality (Van IJzendoorn & De Wolff, 1997; Fox et al., 1991; Pinquart, 2022). Children's constitutional characteristics might explain this concordance, though alternative mechanisms might explain such concordance as well (e.g., similar parenting behavior developed via modeling, or assortative mating; Van IJzendoorn & De Wolff, 1997).

The Present Study

In the current study, we combined two approaches to assess the potential associations between temperament and attachment relationships—that is, assessment of children's temperament and the network of child–mother and child–father attachment relationships. Doing so allowed us to evaluate the degree to which children's temperamental dimension of negative emotionality is associated with the number of secure, insecure-avoidant, insecure-resistant, and disorganized attachment relationships children have with their mothers and fathers. Given that negative temperament was meta-analytically shown to be only weakly associated with individual secure child–parent attachment relationships ($d = 0.14$; Groh et al., 2017), and that twin studies demonstrated the negligible role of genetic factors in individual differences in early attachment relationships with both mothers and fathers (Bakermans-Kranenburg et al., 2004; Bokhorst et al., 2003; Roisman & Fraley, 2008), we hypothesized that negative emotionality would not be associated with the number of children's secure attachment relationships. Similarly, the nonsignificant associations with individual child–parent insecure-avoidant and disorganized attachment relationships (Groh et al., 2017) led us to hypothesize that negative emotionality would not be associated with the number of children's insecure-avoidant and disorganized attachment relationships. Lastly, given that negative temperament was meta-analytically shown to be modestly associated with insecure-resistant parent–child attachment relationships (Groh et al., 2017), and that insecure-resistant attachment relationships with both mother and father were shown to have an above-chance level chance of concordance (Fox et al., 1991), we hypothesized that negative emotionality would be associated specifically with the number of children's insecure-resistant attachment relationships. Relatedly, through a set of nonpreregistered analyses we also explored the role of negative emotionality in the concordance of child–mother and child–father attachment relationships in general, and in child–mother/child–father insecure-resistant attachment relationships specifically (see Analytic Approach for details).

Method

Transparency and Openness

The protocol we followed to produce this IPD meta-analysis, including the analytic plan and hypotheses, was preregistered with the Center for Open Science and is accessible via the following link: https://osf.io/a3qs9 (Dagan, Schuengel, Verhage, et al., 2023). We updated the preregistered protocol to adjust for design

differences across the previously collected data used in the meta-analysis to assess the research question of this paper; the updated preregistered protocol can be found at the following link: https://osf.io/ytwvr (Dagan et al., 2023b). The data necessary to reproduce the analyses presented here are not publicly accessible because data were collected over decades in which participants were not yet routinely asked to consent to public posting of their data. The analytic code used in the analyses presented in this paper is available from Or Dagan.

Protocol, Registration, and Reporting

This study is part of the Collaboration on Attachment to Multiple Parents and Outcomes Synthesis (CAMPOS). CAMPOS is a research project that uses IPD meta-analyses to assess the predictive significance of early joint attachment relationships with mothers and fathers for children's socioemotional outcomes. In this report, we adhered to the preferred reporting items for systematic reviews and meta-analysis of individual participant data (PRISMA-IPD) statement (Stewart et al., 2015).

Eligibility Criteria

We sought all available studies that measured both (a) child attachment relationships with mothers and fathers via observational attachment behavior assessments (i.e., excluding parent-report, parent-observation, self-report, self-observation, and projective measures), and (b) a child negative emotionality assessment (observed and questionnaire-based). Principal investigators of the included studies were approached for data sharing after we established the preregistered minimum detectable effect size (MDES) sensitivity power analysis was justified.

In short, we followed recommendations by Arend and Schäfer (2019) regarding power analysis in two-level models using SIMR (Green & MacLeod, 2016; Green et al., 2016), a power estimation method based on Monte Carlo simulation in the statistical software R (R Core Team, 2022). We estimated the mean number of child–mother/child–father triads (Level 1) and total number of clusters (Level 2), assuming a significance level of .05 and a standardized intraclass correlation coefficient (ICC) of .01, and estimated power based on 1,000 simulations. In a reiterative process, we estimated Levels 1 and 2 direct effects sizes (keeping outcome specific Levels sample sizes, significance level, and ICC constant), until we reached an estimated power of ∼80%. Based on the parameter estimations, we obtained the Levels 1 and 2 MDES per negative emotionality (see the following link: https://osf.io/tcj45; Dagan et al., 2022).

Study Identification and Selection

Studies for the current IPD meta-analysis were identified through the Child Attachment Studies Catalog and Data Exchange (CASCADE; Madigan, 2020). CASCADE is a catalog of all empirical research studies published until 2020 that have reported observational measures of child–parent attachment relationships. These studies were obtained through searches in the following databases: Medline, EMBASE, PsychINFO, Web of Science, and Dissertation Abstracts International. The concepts of "strange situation" and "attachment" were searched via using truncation symbols to capture all possible endings and spellings (e.g., attach*), and no language or publication restrictions were applied. From the studies identified via CASCADE, studies that assessed attachment to both mothers and fathers using observational measures were selected for eligibility screening. Given that updating CASCADE is still underway, we conducted a Google Scholar search for all studies from 2020 to present with the title containing the terms attachment network*, or attachment configuration*, or a combination of the following terms: "attachment" AND "mother" AND "father." No new studies or data sets that met our inclusion criteria for the current IPD meta-analysis were identified. See Figure 1 for the study selection flow chart.

Data Items

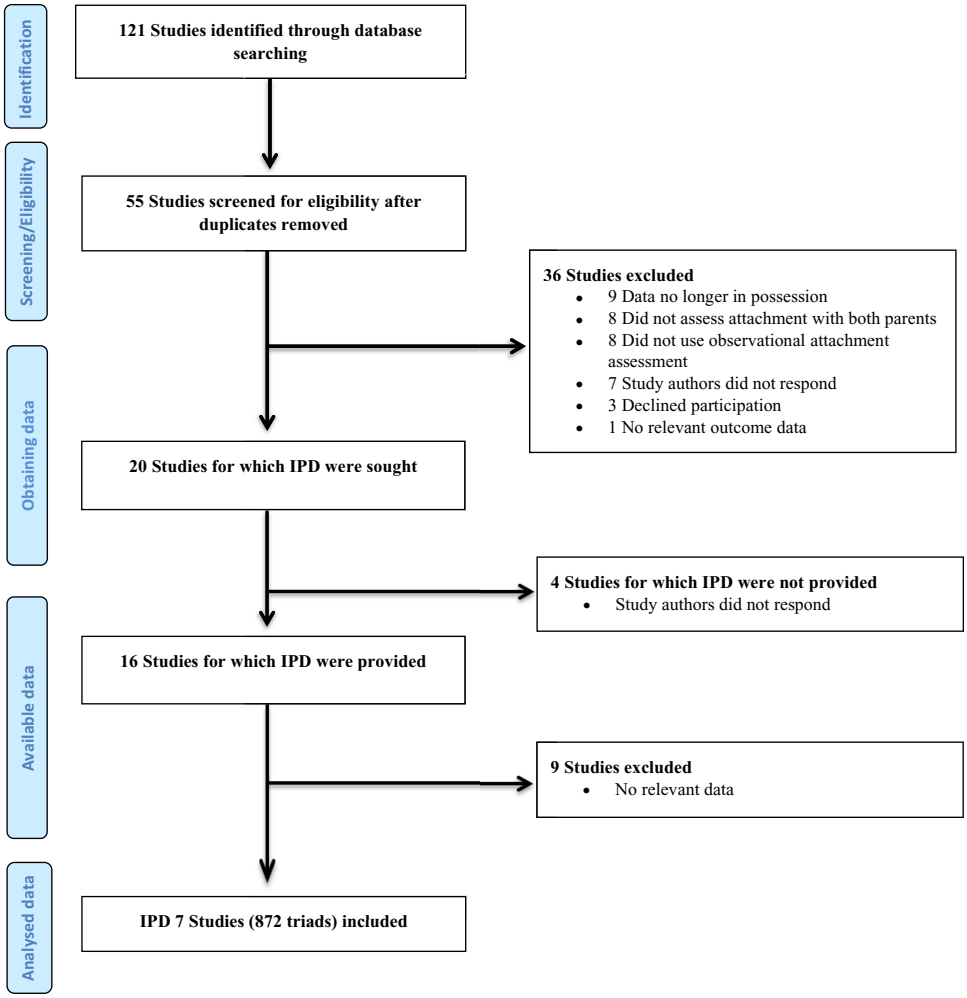
Observational attachment measures in this study included the SSP (Ainsworth et al., 1978), and two modified SSP coding systems for preschool children (the MacArthur Preschool Attachment Coding System [PACS], Cassidy et al., 1992; preschool assessment of attachment [PAA], Crittenden, 1992). Of note, our comprehensive literature review included studies that assessed attachment with both mothers and fathers via the observer-based Attachment Q-Sort (AQS; Waters & Deane, 1985). However, the principal investigators of these studies either did not assess temperament, or were not responsive to our invitation to partake in the current IPD meta-analysis. In addition to temperament assessment data (see Data Harmonization below), study authors provided demographics related to the child (i.e., sex, race, age at the times of first attachment and temperament assessments, and psychosocial risk status) and parents (i.e., age at the time of the first attachment assessment, education, employment status, relationship status, whether the parent was the biological parent of the child or not, and employment status). When individual-level demographic data were missing, we extracted it from the study-level information in the published papers or via communication with the authors. All data were checked for numerical anomalies. Where available, the descriptive statistics of the requested variables were compared with the data reported in the publications.

Data Harmonization

With respect to attachment measures, we used SSP and modified SSP (i.e., PACS and PAA) classifications to assign children to four binary attachment classifications with each parent: secure/insecure, avoidant/non-avoidant, resistant/nonresistant, and organized/disorganized. We then grouped children into an attachment configuration group depending on the analytic outcome (e.g., children who were classified as secure with both parents were assigned a score of 2 when regressing the number of secure attachment relationships on negative emotionality, and 0 when regressing the number of avoidant attachment relationships on negative emotionality). Of note, the secure/insecure grouping was made regardless of whether children had a primary disorganized attachment classification or not, using the secondary subclassification of disorganized-secure (categorized as secure), disorganized-avoidant (categorized as insecure), and disorganized-resistant (also categorized as insecure) classifications. The rationale underlying our decision to group relationships with a primary disorganized classification based on the secondary attachment classification is twofold. First, such grouping is consistent with the original conceptualization of disorganized attachment

Figure 1

PRISMA-IPD Flowchart of Study Selection and Data Selection Process



Note. PRISMA-IPD = preferred reporting items for systematic reviews and meta-analysis of individual participant data. See the online article for the color version of this figure.

as a (momentary) disruption of an underlying organized attachment pattern (Main & Solomon, 1990). Including disorganized dyads according to their secondary classification provides insight into the role negative emotionality plays in predicting attachment quality with mothers and fathers as per the three-way classification system. Second, secure, insecure-avoidant, and insecure-resistant attachment indicators during the SSP are empirically independent of attachment disorganization indicators (Fraley & Spieker, 2003), and the latent structure of attachment quality observed in the SSP may be represented by two weakly correlated dimensions—one dimension an avoidant versus secure and the other a disorganized versus secure dimension (Van IJzendoorn & Makino, 2023). Having said that, disorganized attachment classifications can also be viewed as insecure regardless of whether the secondary attachment classification is secure or not. We thus conducted an exploratory analysis in which we classified children with disorganized attachment classifications as having an insecure attachment relationship with the specific parent regardless of their forced organized (i.e., secure, insecure-avoidant, or insecure-resistant) classifications.

To harmonize the overarching negative emotionality temperamental dimension, we used the three-step IPD data harmonization procedure proposed by Verhage et al. (2022). We defined negative emotionality as the tendency to experience negative emotions across time (i.e., a personality trait or a temperament characteristic; Bates, 1989). For the current IPD meta-analysis, we derived data from studies that assessed the temperament dimension of negative emotionality via the following parent-reported temperament assessment: Infant Characteristics Questionnaire (ICQ; Bates et al., 1979); Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003); Infant Behavior Questionnaire-Very Short Form (IBQ-VSF; Putnam et al., 2014); Children's Behavior Questionnaire (CBQ; Rothbart et al., 2001); and Children's Behavior Questionnaire-Very Short Form (CBQ-VSF; Putnam & Rothbart, 2006). For a full description of the negative emotionality data harmonization process, see the preregistration link: https://osf.io/q35cd (Dagan et al., 2023a).

We gave preference to preattachment (vs. concurrent with or post-attachment) temperament assessments in children's lives since such

Table 1
Negative Emotionality Scores per Number of Attachment Classifications

Number of classifications	Secure			Insecure-avoidant			Insecure-resistant			Disorganized		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
0	145	3.39	0.84	657	3.12	0.79	603	3.15	0.80	614	3.02	0.73
1	305	3.16	0.77	168	3.20	0.74	196	3.10	0.77	218	3.46	0.90
2	422	3.07	0.78	47	3.44	0.95	73	3.31	0.81	40	3.45	0.70

Note. The reported statistics are derived from the first imputed data set. The secure group includes children with a primary disorganized attachment classification.

assessments are considered more reflective of the temperamental dimension of negative emotionality and less affected by environmental factors. As such, compared to concurrent with or postattachment temperament assessments, preattachment temperament assessments more accurately serve the focal analysis of this study, that is—the predictive power of negative emotionality on the children's attachment relationships with mothers and fathers. In case multiple temperament assessments of the same type were conducted before the first attachment assessment, we created a composite score by averaging these to increase reliability (*r*s between within-study assessments = .53–.74). If preattachment assessments were not available, we elected to use negative emotionality assessments which were conducted concurrently with any of the attachment assessments. We resorted to postattachment negative emotionality assessments only in the absence of temperament assessments prior to or concurrent with the attachment assessments. Except for one study (Lickenbrock & Braungart-Rieker, 2015), wherein child negative emotionality was assessed via mothers' self-reports, negative emotionality in all other studies included in the current report was reported by both mothers and fathers. Following the previous study by the Collaboration for Attachment to Multiple Parents and Outcomes Synthesis (Dagan, Sagi-Schwartz, & van IJzendoorn, 2021), in the case of multiple informants, we averaged parents' reports to arrive at a single negative emotionality score. Across all attachment classifications, both mother-reported and father-reported child temperament were significantly correlated and to a similar magnitude, regardless of whether children had concordant or discordant attachment relationships with their parents (see eSupplement 1 in the online supplemental materials). For mean and standard deviations of negative emotionality scores per the number of each attachment classification, see Table 1.

Handling Missing Data

We used multiple imputation for missing predictor (i.e., negative emotionality; 4.70% missing) and outcome (i.e., number of attachment relationships; total insecure-avoidant = 3.67% missing, total insecure-resistant = 3.10% missing, and total disorganized = 7.22% missing) variables, accounting for the multilevel structure of the data (i.e., participants within studies). We created 10 imputed data sets, and used Rubin's rules (D. B. Rubin, 2004) to combine the multiple imputed estimates. To reflect the common 1–7 Likert scale used by all temperament assessment tools that we pooled for this study, we restricted the imputed negative emotionality values such that any imputed value below 1 received the score of 1, and any imputed value above 7 received the score of 7. Similarly, given that the number of children in any particular attachment category with mother and father in this study ranged from 0 to two, we restricted the imputed total attachment classification range to a minimum of 0 and a maximum of two, such that any imputed value below 0 received the score of 0, and any imputed value above 2 received the score of 2. We pooled all complete-case data sets into a single data set via the "mitml" (Grund et al., 2016) and "mice" (van Buuren & Groothuis-Oudshoorn, 2011) packages in R to conduct multiple imputation, while accounting for the multilevel structure of the data set.

Analytic Approach

To test whether children's temperamental dimension of negative emotionality is associated with the number of secure, insecure-avoidant, insecure-resistant, and disorganized attachment relationships they have with their mothers and fathers, we conducted a series of four linear regression analyses, with the number of attachment relationships' quality (secure, insecure-avoidant, insecure-resistant, and disorganized) regressed on negative emotionality scores, using linear mixed models. Consistent with these research questions, we included the entire sample in each of the regression models (i.e., children were grouped into one of three attachment configuration groups [0, 1, or 2] depending on whether the model's dependent variable was the number of secure, insecure-avoidant, insecure-resistant, or disorganized attachment relationships). We used the "emmeans" package (Russell, 2020) in R (R Core Team, 2022) to compute parameter estimates pooled from the 10 imputed data sets. We followed guidelines by Judd et al. (2017) to compute Cohen's *d* effect size derived from mixed-model designs, and calculated 95% confidence intervals (CIs) based on the estimated effects and *p* values (Altman & Bland, 2011). Given that traditional null hypothesis testing only allows inferences about the presence of effects but not about their absence, we followed nonsignificant temperament predictor estimates with equivalence testing, using the "negligible" package (Alter & Counsell, 2023) in R, with equivalence bounds set for field-specific small effect sizes (Schuengel et al., 2021; $-0.20 < d < 0.20$) and α of .05. In the current investigation, a significant equivalence test indicates that an absence of a significant association between negative emotionality and the number of attachment relationship classifications is trivially small, allowing us to interpret the observed effect as negligible. In cases where both the null hypothesis test and the equivalence test are nonsignificant, the evidence for the presence or absence of an effect is regarded as inconclusive. We performed all subsequent analyses (except for the descriptive analyses) with both imputed and complete-cases merged data sets.

To explore the potential moderating effect of the timing of temperament assessment (i.e., pre-, concurrent with, or postattachment assessment with both parents) on the associations between negative emotionality and the secure, insecure-avoidant, insecure-resistant,

and disorganized number of attachment relationships, we added the interaction term Negative Emotionality × Temperament Assessment timing as a fixed effect to the respective models. We also explored the potential moderating effect of the child's age (during the time of the first observational attachment assessment) on the associations between negative emotionality and the number of each of the attachment classifications (these analyses were not preregistered).

We also conducted a mixed-model multinomial logistic regression to assess the concordance between mother–child and father–child attachment relationships, using SPSS, Version 27. Then, we explored the potential role of negative emotionality in the concordance of child–mother/child–father attachment relationships by performing two additional analyses. First, we conducted a set of four hierarchical multiple logistic regressions. To assess whether child–mother and child–father attachment relationships are associated with one another, in the first step we regressed the binary child–father attachment (e.g., secure vs. insecure) on child–mother attachment (e.g., secure vs. insecure). When a significant concordance between child–mother and child–father attachment classifications was established, we added a second step where we entered both child–mother and child's negative emotionality as predictors of child–father attachment to assess the change in the child–mother regression weight. Given that an alternative interpretation of the behavior observed in the SSP has been that insecure-resistant behaviors may in fact be explained by negative temperament rather than characteristics of the specific parent–child relationships (Thomas et al., 1982; Kagan, 1982), we also tested whether the mean negative emotionality scores differed between children with two insecure-resistant attachment relationships and children with either one or no insecure-resistant attachment relationships.

Results

Participants Characteristics

The pooled analytic sample size in the current study ($k = 7$; $N = 872$) was composed of children from Canada and the United States. Most children were White (82.80%), and approximately half (49.20%) were female. On average, children were approximately 16 months old (15.86 months, $SD = 16.36$) at the time of the temperament assessment used for the current study, and approximately 19 months at the first attachment assessment (18.71 months, $SD = 13.28$). The mean ($M = 0.97$, $SD = 0.45$) and mode of the time gap between attachment assessments with mother and father—which were conducted in a counterbalanced fashion—was 1 month. Based on our binary (i.e., yes/no) "at-risk" criteria, which assessed for the presence of parental risk (e.g., childhood abuse and parental psychopathology) and child risk (e.g., preterm birth) factors, the majority of the children were coded as "normative-risk." Virtually all parents were birth parents, and shared a household at the time of the attachment assessments with their children. Mothers and fathers were on average highly educated (80% of mothers and 73% of fathers had posthigh school education), and employed (62% of mothers and 87% of fathers). For a description of the characteristics of studies included in this IPD meta-analysis, see Table 2.

Analyses of Research Questions

In the following, we report the results based on the imputed pooled data set models (see full results in Table 3). For a complete-

Table 2
Study Samples Description

First author	Country of study	Triad *N*	Attachment measure	Temperament measure	Mean interval between attachment assessments (months)	Mean interval temperament-attachment[a] (months)	Timing of temperament assessment relative to attachment	Mean child age[b] (months)	Child female (%)	Mean mother age	Mean father age
Bureau	Canada	144	PACS	CBQ-VSF	0.00	0.00	Concurrent	46.89	57.60	35.14	36.98
Eiden	United States	222	SSP	ICQ	1.00	0.00	Concurrent	12.27	49.50	29.45	31.25
Laurent	United States	62	PAA	CBQ	0.56	15.11	After	20.89	59.70	24.06	24.55
Lickenbrock	United States	117	SSP	IBQ-R	2.00	8.00	Before[c]	12.00	48.70	29.92	31.19
Olsavsky	United States	49	SSP	IBQ-VSF	1.56	13.34	Before	15.57	33.30	29.63	28.19
Schoppe-Sullivan	United States	94	SSP	ICQ	1.00	9.93	Before	12.42	48.90	31.46	34.08
Volling	United States	184	SSP	ICQ	1.00	6.50	Before[c]	12.00	48.90	31.57	33.97

Note. CBQ-VSF = The Children's Behavior Questionnaire-Very Short Form; IBQ-R-VSF = Infant Behavior Questionnaire-Revised-Very Short Form; ICQ = Infant Characteristics Questionnaire; PAA = preschool assessment of attachment; PACS = MacArthur Preschool Attachment Coding System; SSP = strange situation procedure.
[a] Intervals were calculated from temperament assessment to the midpoint between attachment assessments with mothers and fathers. [b] At first observational attachment assessment. [c] A mean score of temperament assessments that were conducted at multiple time points prior to the attachment assessments with mothers and fathers was used.

Table 3
Multilevel Regression Analysis Estimates for Negative Emotionality as a Predictor of the Number of Attachment Relationships (N = 872)

Secure					Insecure-avoidant					Insecure-resistant					Disorganized				
B	*SE*	*df*	*t*	*p*	*B*	*SE*	*df*	*t*	*p*	*B*	*SE*	*df*	*t*	*p*	*B*	*SE*	*df*	*t*	*p*
−0.12	0.04	167	−2.98	.003	0.02	0.03	484	0.46	.37	0.07	0.03	129	2.01	.04	0.05	0.03	143	1.44	.15

case set of results we refer the reader to eSupplement 2 in the online supplemental materials. We found that negative emotionality significantly predicted the number of secure, $B = -0.12$, $t(167) = -2.98$, $p < .01$, $d = -0.12$ ($r = -.06$), 95% CI [−0.01, −0.23], and insecure-resistant, $B = 0.07$, $t(129) = 2.01$, $p = .04$, $d = 0.11$ ($r = .05$), 95% CI [0.01, 0.22], attachment relationships. However, negative emotionality was not a significant predictor of the number of insecure-avoidant, $B = 0.02$, $t(484) = 0.46$, $p = .37$, $d = 0.04$ ($r = .02$), 95% CI [−0.07, 0.15], nor disorganized, $B = 0.05$, $t(143) = 1.44$, $p = .15$, $d = 0.08$ ($r = .04$), 95% CI [−0.03, 0.19], attachment relationships. The equivalence test was nonsignificant in both cases, $t(484) = 1.44$, $p = .24$, for insecure-avoidant attachment relationships; $t(130) = 2.03$, $p = .42$ for disorganized attachment relationships, suggesting that tests of not only the presence but also the absence of nonnegligible associations between negative emotionality and the numbers of insecure-avoidant and disorganized attachment relationships, respectively, are inconclusive in this sample. Of note, when classifying children with disorganized attachment relationships as having an insecure attachment relationship with the specific parent regardless of their forced organized (i.e., secure, insecure-avoidant, or insecure-resistant) classifications, results remained virtually identical to those we obtained in our preregistered analytic plan (for descriptive statistics see eSupplement 3 in the online supplemental materials). That is, negative emotionality significantly predicted the number of secure attachment relationships a child has within their attachment network, $B = -0.11$, $t(167) = -2.96$, $p < .01$, $d = -0.16$ ($r = .08$).

In addition, we found no moderation effects for the timing of temperament assessments on the associations between temperament and attachment relationship quality. The interaction between negative emotionality and temperament assessment timing was nonsignificant when predicting the number of secure, $F(2, 51) = 0.69$, $p = .51$, insecure-avoidant, $F(2, 218) = 0.52$, $p = .60$, insecure-resistant, $F(2, 51) = 0.02$, $p = .98$), and disorganized, $F(2, 178) = 0.73$, $p = .49$, attachment relationships. Similarly, we found no moderation effects for the child's age during the first observational attachment assessment on the associations between temperament and attachment relationship quality. The interaction between negative emotionality and child's age was nonsignificant when predicting the number of secure, $F(1, 845) = 3.56$, $p = .06$, insecure-avoidant, $F(1, 861) = 0.13$, $p = .72$, insecure-resistant, $F(21, 842) = 2.84$, $p = .09$, and disorganized, $F(1, 834) = 2.45$, $p = .12$, attachment relationships.

Concordance Between Mother–Child and Father–Child Attachment Relationship Quality

A mixed-model multinomial logistic regression revealed a significant concordance between mother–child and father–child attachment relationships, $F(9, 860) = 9.84$, $p < .001$, $d = 0.21$, 95% CI [0.08, 0.35]. That is, the quality of mother–child and father–child attachment relationships (i.e., secure, insecure-avoidant, insecure-resistant, or disorganized) depended on one another. See Table 4 for the cross-tabulation of the observed proportions of mother–child and father–child attachment relationships.

Hierarchical multiple logistic regressions revealed that with the exception of child–mother and child–father insecure-resistant attachment relationships, where child–mother attachment relationship did not predict child–father attachment relationship ($B = -0.09$, $SE = 0.30$, $p = .75$), all other attachment classifications showed significant concordance ($p < .001$) between child–mother and child–father attachment relationships (secure: $B = -0.78$, $SE = 0.22$; insecure-avoidant: $B = 1.38$, $SE = 0.25$; disorganized: $B = 1.07$, $SE = 0.25$). The addition of negative emotionality as a model predictor did not seem to change the magnitude of the respective child–mother regression weights (secure: $B = -0.76$, $SE = 0.22$; insecure-avoidant: $B = 1.39$, $SE = 0.25$; disorganized: $B = 1.07$, $SE = 0.25$). In addition, children who were classified as insecure-resistant

Table 4
Cross-Tabulation of the Observed Proportions of Mother–Child and Father–Child Attachment Relationships

Mother–child attachment relationship	Father–child attachment relationship									
	A		B		C		D		Total	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
A	23	23.7	33	6.2	8	6.8	13	10.6	77	8.8
B	56	57.7	385	72.1	54	45.8	65	52.8	560	64.2
C	9	9.3	61	11.4	44	37.3	13	10.6	127	14.6
D	9	9.3	55	10.3	12	10.2	32	26.0	108	12.4
Total	97	100.0	534	100.0	118	100.0	123	100.0	872	100.0

Note. A = insecure-avoidant; B = secure; C = insecure-resistant; D = disorganized.

with both their mother and father had, on average, significantly higher negative emotionality ratings ($n = 58$, $M = 3.29$) compared to children who were classified as insecure-resistant with only one or none of their parents, $n = 787$, $M = 3.15$; $t(837) = 2.08$, $p = .04$, $d = 0.19$ ($r = .10$), 95% CI [0.04, 0.35].

Discussion

Alongside a recent rise in research on the correlates and predictive significance of attachment networks to mothers and fathers (Brown et al., 2022; Dagan, Sagi-Schwartz, & van IJzendoorn, 2021; Deneault et al., 2022; Iwanski et al., 2021; Kuo et al., 2019), we assessed the degree to which child temperament is associated with these attachment networks. In line with our hypotheses, negative emotionality was modestly associated with a higher number of children's insecure-resistant attachment relationships, but not with the number of insecure-avoidant and disorganized attachment relationships children had with mothers and fathers.

Inconsistent with our hypothesis, negative emotionality was significantly associated with a lower number of secure attachment relationships with mothers and fathers, although this association was weak in magnitude; as in the case of insecure-avoidant and disorganized attachment relationships, negative emotionality explained less than 1% of the variability in the number of insecure and insecure-resistant attachment relationships. The finding from the current study regarding the associations between negative emotionality and insecure-resistant, but not insecure-avoidant or disorganized attachment relationships aligns with previous meta-analytic associations found in analyses of separate parent–child attachment relationships (Goldsmith & Alansky, 1987; Groh et al., 2017). Taken together, these findings support the notion that temperament-attachment associations are partially linked in an oblique manner (for a review, see Van IJzendoorn & Bakermans-Kranenburg, 2012). That is, temperament may be associated with the type of insecure attachment relationship (Vaughn et al., 2008) and/or intensity level of emotional reactivity observed in children with different attachment classifications (Belsky & Rovine, 1987). Above and beyond the insecure attachment types, the small yet significant association between negative emotionality and the number of secure attachment relationships also prompts a reconsideration of the role temperament plays in the formation of (in)secure attachment relationships in general.

Whereas temperament is not a relational construct per se, the negative emotionality temperamental dimension may influence the quality of child–parent interactions in ways that may increase the probability of insensitive parenting (e.g., angry or fussing child behavior may elicit angry or coercive parental behavior, or ignoring the child; Belsky, 1984; Micalizzi et al., 2017). Insensitive parenting, in turn, is associated with insecure mother–child and father–child attachment relationships (Bakermans-Kranenburg et al., 2003; Van IJzendoorn & De Wolff, 1997), and thus may explain the significant links we observed in this study between negative emotionality and the number of (in)secure attachment relationships. Indeed, our exploratory analyses revealed that children with two insecure-resistant attachment relationships to mother and father were reported by both parents to have higher negative emotionality scores compared to their counterparts with one or no insecure-resistant attachment relationship within their network, and that these parental reports of negative emotionality were correlated to a similar magnitude regardless of whether children had concordant or discordant attachment relationships with their parents. Consistent with results regarding the association between negative temperament and child–mother attachment relationships (Groh et al., 2017), these findings suggest that perceived temperament plays a modest yet significant role in the concordance between child–mother and child–father insecure-resistant attachment relationships. One way of interpreting these findings is through the lens of inconsistent or limited caregiving sensitivity, which may increase the chance of developing insecure-resistant attachment relationships (Ainsworth et al., 1978; Cassidy & Berlin, 1994; Main, 2000). Exhibiting behaviors that are associated with negative emotionality—such as fussing, crying, and showing intense negative emotions—may elicit contingent caregiving as a response to children's intense cues for help, and simultaneously decrease the consistency of such caregiving provision due to parental exhaustion or limited capacity. Such inconsistent quality and/or frequency of parental responses to the child's emotional needs may in turn increase the probability that insecure-resistant attachment relationships develop with multiple caregivers.

We suggest caution, however, in interpreting the current findings as necessarily indicating a causal relationship between negative emotionality and the number of insecure-resistant attachment relationships. More than half of the children in this study were assessed for temperament concurrently with, or postattachment assessments with their parents, and 35% of the analytic sample ($N = 305$) had noncongruent attachment network configurations (i.e., secure attachment relationship with one parent and insecure attachment relationship with the other parent). Alongside genetic factors related to the temperament dimension of negative emotionality, additional explanations may be offered to better understand the mother–child and father–child attachment relationship concordance.

One explanation for the mother–child and father–child attachment relationship concordance may be assortative mating, whereby partner selection takes place between individuals with similar characteristics. Evidence for such above-chance level concordance between parents is observed in their correlated attachment representation qualities (Bretherton, 2010). Relatedly, mothers and fathers may exhibit similar parenting styles, which may also influence the concordance of the child's attachment relationship quality with both. A concordance between married couples' attachment representations (Van IJzendoorn & Bakermans-Kranenburg, 1996), which themselves are associated with parenting quality (e.g., parental responsiveness; Van IJzendoorn, 1995; Verhage et al., 2016), may support such a notion. That is, the parenting behaviors of one partner may serve as a model influencing the parenting behaviors of the other. Still, the small yet significant associations between negative emotionality and the number of secure and insecure-resistant attachment relationships may indicate some genetic influence on the development of insecure-resistant attachment relationships, even though early-life twin studies have failed to reject the null hypothesis of zero heritability in attachment quality (Bakermans-Kranenburg & Van IJzendoorn, 2016; Verhage et al., 2017).

Study Limitations and Future Research

In the current study, we took advantage of a relatively large, pooled sample ($N = 872$), which provided us with the opportunity to reliably assess associations between children's negative

temperament and the attachment network consisting of mother–child and father–child attachments. Nonetheless, two limitations should be noted. First, children assessed in this study were predominantly from White, highly educated, two-parent, mother-father households in Canada and the United States. As such, the results of this study are limited in their generalizability. Clearly, future efforts are needed to replicate and expand our findings to more diverse populations, not only socioculturally but also in terms of the composition of children's attachment networks (e.g., same-sex parents). Temperament profiles have been shown to differ by SES, such that children from low SES tend to have higher negative emotionality (Jansen et al., 2009; Strickhouser & Sutin, 2020). In addition, cross-cultural studies on temperament indicate comparatively lower negative emotionality in individualistic cultures, such as Canada and the United States, where studies included in the current IPD meta-analysis were conducted (e.g., Desmarais et al., 2021; Krassner et al., 2017; K. H. Rubin et al., 2006). In order to test if the results of this study are generalizable, future studies should include more culturally and socioeconomically diverse populations when assessing the associations between attachment networks and children's negative temperament.

A second potential limitation of the current study is the relatively narrow operationalization of the facets of temperament that we used to effectively harmonize negative emotionality data across multiple studies. In addition, all available studies that met inclusion criteria for the current IPD meta-analysis used parent-reported assessments of children's temperament, operationalized via either Rothbart's (1989) temperament questionnaires (multiple versions of the IBQ and the CBQ) or Bates et al. (1979) ICQ. It is possible that assessment of negative emotionality during behavioral tasks (e.g., the Laboratory Temperament Assessment Battery, or Lab-TAB; Goldsmith & Rothbart, 1991), or via other temperament assessment traditions (e.g., Kagan et al., 1984 Behavioral Inhibition) would have yielded different results. In line with Kagan's preference of observational temperament assessment, Runze and Van IJzendoorn (2023, current issue) showed that parental perceptions may be biased, and response biases may be genetically predisposed.

Conclusions

The abundance of research examining the extent to which children's temperament is associated with the quality of attachment relationships indicates the importance of this question in developmental psychological science. The current IPD meta-analysis adds a new perspective on the long-standing debate regarding the association between temperament and attachment, indicating that children's temperamental dimension of negative emotionality is associated with the number of insecure, and specifically insecure-resistant attachment relationships with mother and father. The current evidence further establishes the relatively small contribution of temperament to understanding individual differences in attachment behavior. In addition, results from this study prompt a more in-depth examination of the mechanism underlying the small yet significantly higher risk children with increased negative emotionality have for developing multiple insecure attachment relationships.

Despite weak main associations between negative emotionality and attachment relationships, there is a continuing need to integrate these two important developmental constructs as potential moderators in a broader family system perspective. As such, a useful framework for future research is the differential susceptibility framework (Belsky et al., 2007; Ellis et al., 2011), which proposes that temperamental characteristics (especially negative emotionality; Slagt et al., 2016) may serve as a susceptibility factor that heightens children's sensitivity to the influence of their relationships with caregivers for better and for worse. In addition, recent methodological advances (Dong et al., 2022) regarding Thomas and Chess's (1977) goodness-of-fit model, proposing that temperamental characteristics may confer optimal development depending on their match or mismatch with the caregiving environment, may also serve as a framework for understanding the interaction effects of temperament and attachment relationship quality on children's developmental trajectories. Given the increasing body of research supporting both (a) the interactions between temperament and infant–parent attachment relationships as predictors of developmental outcomes, and (b) the predictive power of attachment networks with mothers and fathers on multiple developmental outcomes, the examination of the interaction between temperament and attachment networks provides an important avenue for understanding how they influence children's developmental trajectories.

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