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Early family system types predict children's emotional attention biases at school age

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Running head: EARLY FAMILY TYPES PREDICT ATTENTION BIASES

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Abstract

The family environment shapes children's social information processing and emotion regulation. Yet, the long-term effects of early family systems have rarely been studied. This study investigated how family system types predict children's attentional biases toward facial expressions at the age of 10 years. The participants were 79 children from Cohesive, Disengaged, Enmeshed, and Authoritarian family types based on marital and parental relationship trajectories from pregnancy to the age of 12 months. A dot-probe task was used to assess children's emotional attention biases toward threatening (angry) and affiliative (happy) faces at the early (500 ms) and late (1250 ms) stages of processing. Situational priming was applied to activate children's sense of danger or safety. Results showed that children from Cohesive families had an early-stage attentional bias toward threat, whereas children from Enmeshed families had a late-stage bias toward threat. Children from Disengaged families had an early-stage attentional bias toward threat, but showed in addition a late-stage bias away from emotional faces (i.e., both angry and happy). Children from Authoritarian families, in turn, showed a late-stage attentional bias toward emotional faces. Situational priming did not moderate the effects of family system types on children's attentional biases. The findings confirm the influence of early family systems on the attentional biases, suggesting differences in the emotion regulation strategies children have developed to adapt to their family environments.

Keywords: attentional bias, emotion regulation, early experiences, family types, family relationships

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Early family environment is an important context for children's socioemotional development. Within the family, children learn to adapt their emotional responses to match the demands of interpersonal relationships, which may shape children's social information processing and result in attentional biases to certain emotional cues (Dykas & Cassidy, 2011; Pine, 2007). Emotional attention biases, such as attending toward or away from anger cues, help children to focus on relevant social signals and regulate emotional responses. Yet, overly strong attentional biases may distort children's social perceptions with maladaptive consequences for wellbeing (e.g., Gulley, Oppenheimer, & Hankin, 2014).

Research on the contextual factors shaping children's attentional biases has largely focused on atypical rearing environments, such as institutional neglect (Tottenham et al., 2010) or family maltreatment (Shackman, Shackman, & Pollak, 2007). However, less is known about the role of normative family environments in predicting children's emotional attention biases. This study focuses on normative early family systems consisting of both the parenting and the marital relationships. We analyze how different family system types during pregnancy and infancy predict children's attentional biases toward emotional expressions at 10 years of age. Furthermore, we use a situational priming procedure to examine whether attentional biases are conditional to children's activated mental representations.

Children's Adaptation to Early Family Environment

During early childhood, stress-regulatory systems are under profound development and are especially malleable to interpersonal experiences (Loman & Gunnar, 2010). Such malleability may foster children's adaptation to the prevailing ecological and familial environment by tuning their stress responsivity (Del Giudice, Ellis, & Shirtcliff, 2013). Attachment theory illustrates how children adapt their emotional responses to different styles of caregiving in order to ensure parental protection (Ainsworth, Blehar, Waters, & Wall, 1978). More recently, emotional security theory has extended this view to the larger family

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system by suggesting that children adapt their emotion regulation strategies to fit the quality of family interactions, such as interparental interactions and conflicts (Davies, Sturge-Apple, & Martin, 2013). Children may learn to heighten their emotional responses to intervene in interparental conflicts or suppress responses to avoid drawing parental aggression to themselves. Complex family patterns, involving family boundaries and power hierarchies, likely determine children's reliance on specific emotion regulation strategies, but the precise associations are currently not well known (Davies et al., 2013).

Attentional Biases and Emotion Regulation

Attention is an important mechanism of emotion regulation as it influences the extent to which emotion-provoking information undergoes deeper processing or is disregarded (Todd, Cunningham, Anderson, & Thompson, 2012). Children can direct attention away to down-regulate or toward certain emotional information to up-regulate their emotional states (Hakamata et al., 2010). However, children's emotional states can bias their attention toward emotion-congruent information (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn 2007).

Emotional attention biases are commonly assessed using the dot-probe task (MacLeod, Mathews, & Tata, 1986). The task simultaneously presents one neutral and one emotional stimulus (e.g., facial expressions), which compete for attention. The participant is instructed to indicate the location of a probe that is appearing randomly at the location of either the neutral (neutral cue trials) or the emotional stimulus (emotional cue trials). Attention-bias scores are computed as differences in response times between the neutral and emotional cue trials, indicating either a tendency to attend toward (positive score) or away (negative score) from the emotional stimulus. Importantly, the direction of attentional biases can be investigated at different time points by varying *stimulus onset asynchrony*, the time between the appearance of the emotional stimulus and the probe.

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Attentional biases at the early stage of processing (e.g., stimulus onset asynchrony of 500 ms) have been suggested to reflect relatively automatic responses that serve adaptive threat detection (Cisler & Koster, 2010; LoBue & Rakison, 2013). Children growing up in highly threatening environments, e.g., in abusive families, often show a strong attentional bias toward threat (i.e., angry faces) at this stage of processing (Shackman et al., 2007). Yet, some studies have found physically abused children to attend away from threat (Pine et al., 2005), and children from normative families to attend toward threat at the early stage of processing (Lindström et al., 2009). Such mixed findings suggest that there is high heterogeneity in how children attend toward threat at the early stage of processing, perhaps reflecting developmental differences in the monitoring of and automatic responding to threats (Del Giudice et al., 2013).

Attentional biases at the late stage of processing (e.g., stimulus onset asynchrony of 1000 ms), in turn, have been suggested to reflect higher-level processing of emotional information involving the activation of learned emotion regulation responses (Bar-Haim et al., 2007; Cisler & Koster, 2010). Avoiding threat at a later stage of processing is considered to indicate defensive exclusion of threatening information and is characteristic of avoidantly attached children and adults (Dewitte, Koster, De Houwer, & Byusse, 2007; Dykas & Cassidy, 2011). In contrast, maintaining attention toward threat may indicate difficulties in emotion regulation (Derryberry & Reed, 2002) and is characteristic of highly anxious and anxiously attached children and adults (Bar-Haim et al., 2007; Dykas & Cassidy, 2011). Finally, disengaging attention from threat after initially attending toward it is considered to reflect adaptive emotion regulation and evaluation of the stimulus as signaling only minor threat (Bar-Haim et al., 2007; Dykas & Cassidy, 2011).

Research on the influence of more normative family relationships on children's attentional biases is surprisingly scarce. Two studies have shown that negative and insensitive

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parenting was associated with children's attentional bias toward threat, whereas supportive and sensitive parenting was associated with a smaller attentional bias toward threat (Gibb, Johnson, Benas, Uhrlass, Knopik, & McGeary, 2011; Gulley et al., 2014). These studies were, however, cross-sectional and focused only on late-stage attentional biases (i.e., stimulus onset asynchrony of 1000 ms). Furthermore, only mother-child relationships were assessed, leaving open the question of how more comprehensive family systems, involving also the father-child and marital relationships, influence children's attentional biases.

Typological Approach to Family Systems

Family systems theory conceptualizes families as holistic and dynamic systems in which all dyadic relationships and the marital and parenting subsystems influence each other (Cox & Paley, 2003). For example, interparental conflicts and power asymmetries tend to disturb family boundaries and increase the risks for problematic parent-child relationships (Fosco & Grych, 2012). Such complex interactions between the family subsystems constitute the holistic and organized family systems. A person-oriented approach is well suited for family research as it enables identifying family system types based on multiple family relationships and their dynamics over time (Bergman & Magnusson, 1997).

Person-oriented studies have typically identified family system types based either on relationship patterns or longitudinal changes in family relationships. Johnson (2003) identified three family types on the basis of parental relationship patterns: *cohesive families* were characterized by high marital functioning and equally strong parenting between both parents, while two types of *triangulating families* were characterized by an overall lack of cohesiveness, poor marital functioning, and weak parenting by either the father or the mother. Favez et al. (2012) identified three family types based on longitudinal changes in family interactions during the transition to parenthood: two types of *stable families* were characterized by either low or high overall interaction quality, and *deteriorating families*

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were characterized by decreasing interaction quality during the postnatal period. Some research is available demonstrating the impact of family system types on children's later mental health, social skills, and cognitive development (e.g., Favez et al., 2012; Johnson, 2003; Sturge-Apple, Davies, Cicchetti, & Fittoria, 2014).

Despite the progress in person-oriented family research, studies modeling both multiple family relationships and their longitudinal changes over time have been lacking. Such an approach would allow to more precisely identify family types based on the complex relationship dynamics, which is thought to reflect the systemic and often implicit rules of each family (Minuchin, 1985). To fill this research gap, in our previous study, we identified family system types as multidimensional relationship trajectories from pregnancy to the child's ages of 2 and 12 months (Lindblom et al., 2014). In that study, 710 couples reported relational autonomy and intimacy in the marital subsystem, i.e., mother-to-father and father-to-mother, and in the parenting subsystem, i.e., mother-to-child and father-to-child, at each of the three assessments. Autonomy refers to the degree of relational self-assurance and independence, and intimacy to the degree of emotional closeness and acceptance (Mattejat & Scholz, 1994). As Figure 1 shows, family trajectories were identified using factor mixture modeling with 24 relationship variables based on mothers' and fathers' reports. The analysis identified seven family trajectories.

The current study examines how four of the identified family system types predict children's emotional attention biases. These family system types, depicted in Figure 2, were selected because of their theoretical clarity and representativeness of the four family quadrants (e.g., Olson, 2000). *Cohesive families* had the highest levels of emotional intimacy and autonomy, and both parents had a relatively similar amount of autonomy in all family relationships. Family autonomy increased slightly from pregnancy to the child's age of 12 months. Such dynamics indicate harmonious and egalitarian family relationships.

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Disengaged families had the lowest levels of intimacy and autonomy, and the marital subsystem especially was characterized by a lack of intimacy and autonomy. Family intimacy declined from pregnancy to the child's age of 12 months. Such dynamics indicate emotionally distant and conflictual family relationships. *Enmeshed families* had low levels of autonomy combined with high levels of intimacy. The mothers especially lacked marital autonomy and the family intimacy declined from pregnancy to the child's age of 12 months. Such dynamics indicate diffuse family boundaries and interparental power asymmetries. Finally, *Authoritarian families* showed a relative lack of intimacy combined with average levels of autonomy. Fathers were more autonomous than mothers in the marital relationship, whereas mothers were more autonomous in parenting. Family intimacy declined only slightly from pregnancy to the child's age of 12 months. Such dynamics indicate strong family boundaries and clear family roles between the parents.

Research Questions

Our *first research question* was how family system types (Cohesive, Enmeshed, Disengaged, and Authoritarian) during pregnancy and infancy predict children's emotional attention biases at the age of 10 years. To assess attentional biases at the early and late stage of processing, we used stimulus onset asynchronies of 500 ms and 1250 ms. Both threatening (angry) and affiliative (happy) emotional faces were used as attentional cues. Given the lack of previous studies regarding family system types and attentional biases, we could not form family system type specific hypotheses. However, we hypothesized that children from Enmeshed, Disengaged, and Authoritarian families would show a) an early-stage attentional bias toward threat, indicating high threat responsivity; b) a late-stage attentional bias away from threat, indicating defensive exclusion of threatening information; or c) a late-stage attentional bias toward threat, indicating inefficient emotion regulation. Further, we hypothesized that children from Cohesive families would show d) no threat-

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related attentional biases or e) a late-stage attention disengagement from threat, indicating efficient emotion regulation.

Some studies suggest that children's emotional attention biases may emerge only in emotionally arousing situations (e.g., Romens & Pollak, 2012). Such situations prime children's mental representations and guide the processing of emotional information (Stupica & Cassidy, 2014). Thus, our *second research question* was whether situational priming moderates the effects of family system types on children's attentional biases. To test this, we used audiotaped stories to prime the following: 1) *threat to intimacy*, 2) *threat to autonomy*, and 3) *secure situation* (i.e., positive fulfillment of both autonomy and intimacy). These themes were selected because the needs for intimacy (e.g., communion with others) and autonomy (e.g., competent sense of self) are the two most basic developmental needs expressed in family relationships (Luyten & Blatt, 2011; Olsson, 2000).

Methods

Participants

The participants of a larger longitudinal sample consisted of married or cohabiting Finnish Caucasian couples (N = 710). This larger sample was used to identify different family system types (Lindblom et al., 2014). Couples completed questionnaires about family relationships during pregnancy (T1; 18–20 weeks of gestation), and when the child was 2 months (T2) and 12 months old (T3). Approximately half of the couples had naturally conceived (n = 374, 53%); the other half had achieved pregnancy after assisted reproductive treatment (n = 336, 48%). Participants were recruited from infertility clinics and while attending routine ultrasonographic examinations. Couples with multiple pregnancies were excluded from the study sample and only women above the age of 25 years were included in the naturally conceived group. The recruited mothers (M = 33.21 years, SD = 3.71) were older than the Finnish national average of mothers giving birth (M = 29.9 years) and had

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higher educational levels than the corresponding population (Statistics Finland, 2013). The ethics committees of the participating clinics approved the study at all timepoints (T1–T4). For a more detailed description of the larger longitudinal sample, see Lindblom et al. (2014).

A subsample of children participated (n = 79) in the current study at the age of 10 years (T4; M = 10.63 years, SD = 0.60, range: 9.58–11.84 years). We aimed to collect a purposive subsample of 20 children from each of the four family system types. Quota sampling was used to ensure that in each family system type, half of the families had a history of infertility and both genders were equally represented. One family cancelled their participation at the end of the data collection period. The final sample consists of children from Cohesive (n = 20), Disengaged (n = 19), Enmeshed (n = 20), and Authoritarian (n = 20) family types. This subsample was similar to the larger sample concerning infertility history, children's gender, parity, mother's age, and parents' educational levels (all *ns*).

At the age of 10 years (T4), children's attentional biases were measured using a dot-probe task either at their homes or at the university facility. Family system types in the final sample were similar regarding children's ages and mother's age and parents' educational levels (all *ns*) during pregnancy (T1). However, 40% (n = 8) of Cohesive, 50% (n = 10) of Authoritarian, and 21% (n = 4) of Disengaged families were primiparous, whereas 75% (n = 15) of Enmeshed families were primiparous, $\chi^2(3, n = 79) = 11.90$, $p = .008$. Thus parity (primi- vs. multiparity) was controlled in the main analyses.

Procedure and Measures

Identification of family system types (T1–T3). Family relationships were measured with the Subjective Family Picture Test (Mattejat & Scholz, 1994) during pregnancy (T1), and when the child was 2 months (T2) and 12 months old (T3). Parents rated four family relationships (mother-to-father, father-to-mother, mother-to-child, and father-to-child) regarding autonomy (four pairs of items; e.g., *self-confident – uncertain*) and intimacy (four

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pairs of items; e.g., *loving – rejecting*) using a 7-point scale. During pregnancy (T1), parents were asked to report their expectations of the future relationships with the unborn child. High scores on autonomy indicate relational self-assurance, agency, and independence. High scores on intimacy indicate emotional closeness, interest, and acceptance.

Factor mixture modeling was used to identify family system types based on relationship ratings of autonomy and intimacy from mothers (24 variables) and fathers (24 variables). The statistical model is shown in Figure 1. The analysis yielded one family trajectory with discrepant reports between the parents, and six family trajectories with similar reports of the family relationship between the parents. These seven trajectories depicting different family system types were described and labeled based on the overall levels (i.e., averaged values over the target parent in the dyad, the parental and marital relationship, and the reporting parent) and longitudinal changes (T1–T3) of autonomy and intimacy. In this study, we focus on Cohesive (n = 274, 39%), Disengaged (n = 41, 6%), Enmeshed (n = 46, 7%), and Authoritarian (n = 107, 15%) family types (group sizes and percentages from the previous study). In all four family system types, mothers' and fathers' reports of the same family relationships were similar. For more details about the procedure, see Lindblom et al. (2014).

Children's attentional biases (T4). A dot-probe task controlled by E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA) was used to investigate children's attentional biases. Children performed the task three times after different situational priming conditions (see the *Situational priming procedure* section). Each of the three blocks included 90 dot-probe trials. The children were instructed to focus their eyes on the fixation cross appearing for 500 ms in the beginning of each trial. This was followed by the presentation of a face pair for 500 ms in 40 of the trials and for 1250 ms in 40 of the trials, i.e., stimulus onset asynchronies (SOAs) of 500 ms and 1250 ms. In 40 trials, the face pair consisted of an

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angry and a neutral face (20 trials in both SOA conditions), while in another 40 trials it consisted of a happy and a neutral face. In 10 filler trials the face pair consisted of two neutral faces.

After the disappearance of the face pair, an asterisk probe was displayed on the left or right side of the screen, replacing one of the faces. The children were instructed to indicate the location of the probe (left or right) as quickly and accurately as possible by using a computer mouse button. The probe appeared either at the location of the neutral or emotional face (40 trials in each) and was presented for a maximum of 3000 ms or until the child responded.

The interval between the child's response and the next trial varied randomly between 750 ms and 1250 ms. All conditions were presented in random order and were completely balanced. A 1-minute break was allowed after every 30 trials. Photographs of five male and five female models from the Karolinska Directed Emotional Faces stimulus set were used as stimuli (Lundqvist, Flykt, & Öhman, 1998), cropped to fit within an oval window (20 x 15 cm) on the monitor.

Before computing attention bias scores, incorrect responses and outlier responses (response times < 150 ms or > 1500 ms) were removed from the data, followed by the removal of responses with response times deviating by ± 2.5 SD from the individual mean. Due to equipment failure, four children completed only two of the three blocks of the experiment. Little's MCAR test showed this missingness to occur completely at random, $\chi^2(8) = 9.70$, $p = .286$. The final data consisted, on average, of 223.77 ($SD = 21.23$) out of 240 trials for each child.

Attention bias scores were computed separately for different stimulus onset asynchronies (500 ms and 1250 ms) and for different emotional faces (angry and happy). This was achieved by subtracting the mean response time for emotional-cue trials from the

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mean response time for neutral-cue trials. Positive and negative bias scores therefore indicate attentional biases toward and away from the emotional faces, respectively.

Situational priming procedure (T4). We created nine stories (three stories per theme) to activate children's mental representations related to 1) threat to intimacy (e.g., parental denigration after being physically hurt); 2) threat to autonomy (e.g., failing a school exam); and 3) secure situation, involving fulfillment of both autonomy and intimacy (e.g., winning in a team game with one's peers). The stories were adapted from previous research (Reijntjes, Stegge, Terwogt, Kamphuis, & Telch, 2006; Rijo, 2000; Zimmer-Gembeck, Lees, Bradley, & Skinner, 2009). A female actress narrated the stories expressing the emotional experiences of the story's protagonist (e.g., sad after parental denigration, anxious when failing a school exam, happy when winning in a team game). Recorded stories (mean length = 1:17 min, ranging from 0:54 to 1:43 min) were edited to contain different protagonist names to match each participant's gender.

In the situational priming procedure, the children heard the three thematically related stories before completing the dot-probe task. The three story themes and the three individual stories within each theme were presented in a balanced, randomized order. However, due to the distressing content of the threat stories, the secure situation stories were always presented between the autonomy-threat and intimacy-threat stories. Immediately after hearing each individual story, children reported their perceptions about the story events regarding the degree of threat ("That would be a bad thing to happen"), personal importance ("I would care if that happened to me"), and whether they had experienced similar events in their own life ("Something similar has happened to me in reality") using 5-point Likert scales (see Hood, Power & Hill, 2009). The primary purpose of these questions was to ensure that the children engaged with the story events and empathized with the story protagonist.

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After each block (i.e., hearing three thematically related stories and completing 90 dot-probe trials), the children had a rest period during which they watched animal videos (4:00 min) with cheerful classical music as a soundtrack. In the beginning of the experiment, children practiced the dot-probe task and the story-related questions with the instructor until they were familiar with the tasks.

Descriptive variables. To cross-validate and describe the early family system types, we examined how the family system types differed in the quality of the marital and the parenting subsystems at the child's age of 2 months (T2). Mothers (n = 75) and fathers (n = 73) reported the quality of their marital relationship using the Dyadic Adjustment Scale (Spanier, 1976) and their parenting experience using the Parenting Stress Index – Short Form (Abidin, 1995). The Dyadic Adjustment Scale provides a total score of *marital adjustment* (mothers: α = .90, fathers: α = .91) representing, e.g., marital consensus and affection. The Parenting Stress Index provides scores for three domains: The *parental distress* domain represents lack of resources as a parent (e.g., feelings of being in trouble with responsibilities; mothers: α = .83, fathers: α = .81). The *parent-child interaction* domain represents unsatisfying relationship with the child (e.g., bothered by not feeling closer with the child; mothers: α = .78, fathers: α = .75). The *difficult child* domain represents child characteristics that contribute to parenting stress (e.g., the child cries and gets nervous easily; mothers: α = .78, fathers: α = .79).

Children's state anxiety at the age of 10 years (T4) was assessed at the beginning of the experiment using the *state anxiety* subscale (n = 79; α = .76) of the State-Trait Anxiety Inventory for Children (Spielberger, 1973). Children's perceptions of the priming story events were assessed using questions concerning perceived *threat*, perceived *importance*, and their *own experiences*, averaged over the three thematically related stories.

Analytic Strategy

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To answer our research questions about how family system types and situational priming predict children's attentional biases, we built linear mixed-effect models using IBM SPSS Statistics 20. Mixed-effect models are effective in handling missing values because they use maximum-likelihood estimation, which utilizes all the information available in the data. Attention-bias scores from the dot-probe tasks were the dependent variables in the models. Emotion (angry or happy face), SOA, i.e., stimulus onset asynchrony (500 ms or 1250 ms), and situational priming (intimacy-threat, autonomy-threat, or secure situation) were used as fixed within-subject factors. Family system type (Cohesive, Disengaged, Enmeshed, Authoritative) was used as a fixed between-subjects factor. Parity and children's state anxiety were used as covariates to control for family differences and to ensure that pre-experiment anxiety did not confound the results. Unstructured covariance structure was used, making no a priori assumptions about correlations between the study variables. To achieve parsimonious models, nonsignificant interactions involving family system types or covariates were removed from the model (except when their higher-order interactions were significant). Post hoc analyses were run using separate mixed-effects modeling for the relevant factors. 95% confidence intervals (CIs) were used to test the absolute presence of attentional biases (i.e., whether the difference in response times between emotional-cue and neutral-cue trials deviated from zero) and Cohen's *d* was reported to indicate effect sizes.

Results

Descriptive Statistics

First, to cross-validate and describe the family system types, we analyzed the differences between the family types in marital quality and parenting stress when the child was 2 months old (T2) and in children's state anxiety at the age of 10 years (T4). As Table 1 shows, family types differed in marital adjustment and in parental distress, but not in parent-child interaction or difficult child characteristics. Parents in Cohesive families had better

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marital adjustment than in Disengaged families, mothers: $t(26.41) = 4.96$, $p < .001$, $d = 1.63$; fathers: $t(32.93) = 4.38$, $p < .001$, $d = 1.44$; or in Authoritarian families, mothers: $t(33.58) = 5.50$, $p < .001$, $d = 1.78$; fathers: $t(34.66) = 3.08$, $p = .004$, $d = 1.01$. Similarly, parents in Enmeshed families had better marital adjustment than in Disengaged families, mothers: $t(25.20) = 4.39$, $p < .001$, $d = 1.44$; fathers: $t(31.83) = 4.22$, $p < .001$, $d = 1.41$; or in Authoritarian families, mothers: $t(34.69) = 4.64$, $p < .001$, $d = 1.51$; fathers: $t(34.50) = 2.74$, $p = .010$, $d = 0.91$.

Concerning parenting stress, Table 1 shows that mothers in Disengaged families experienced greater parental distress than in Cohesive families, $t(24.12) = -3.80$, $p = .001$, $d = 1.25$; in Enmeshed families, $t(24.46) = -2.46$, $p < .001$, $d = 0.81$; or in Authoritarian families, $t(26.13) = 2.18$, $p = .039$, $d = 0.71$. Mothers in Cohesive families experienced less parental distress than in Enmeshed families, $t(35.98) = -2.27$, $p = .030$, $d = 0.74$; or in Authoritarian families, $t(35.33) = -2.43$, $p = .020$, $d = 0.80$. Fathers in Disengaged families experienced greater parental distress than in Cohesive families, $t(32.41) = -4.31$, $p < .001$, $d = 1.46$; or in Authoritarian families, $t(33.89) = 3.36$, $p = .002$, $d = 1.12$. The results validated the family system types by showing large differences in marital adjustment and parental distress. Finally, as Table 1 shows, there were no differences in children's state anxiety as a function of the family types.

Second, we analyzed children's ratings regarding the story events between different priming conditions. The results confirmed that children perceived the events in autonomy- and intimacy-threat stories as highly threatening and personally important (see Table A1 in Appendix). There were no differences in children's perceptions of the story events as a function of family system type (see Table A2 in Appendix). These results provided validation for our priming procedure by showing that children perceived the content of the priming stories as expected.

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Third, we analyzed the effects of situational priming and state anxiety on attentional biases. As Table 2 shows, there was a three-way Priming x SOA x Anxiety interaction on attentional biases, $F(2, 823.89) = 3.12$, $p = .045$. Post hoc analyses showed a SOA x Anxiety interaction in the secure situation condition, $F(1, 77) = 8.73$, $p = .004$, indicating that children with high anxiety showed a greater attentional bias toward angry and happy faces at the stimulus onset asynchrony (SOA) of 1250 ms than at the SOA of 500 ms, *diff* = 19.57, *SE* = 8.99, $t(37) = 2.17$, $p = .036$, $d = 0.35$. These results provided validation for our priming procedure by demonstrating that the task was sensitive for individual differences in state anxiety. Table A3 in Appendix shows attention bias scores, response times, and number of incorrect responses across situational priming conditions.

How Early Family System Types Predict Attentional Biases

In response to our first research question regarding how early family system types predict attentional biases, a linear mixed-effects model was built. Based on descriptive analyses, the effect of state anxiety was covaried by including the three-way Priming x SOA x Anxiety interaction in the model. To improve model parsimony, the two-, three-, and four-way interactions involving both the situational priming and family type were excluded from the model, all being nonsignificant, F's < 1.30, *p*'s > .274, in initial analyses.

The model showed a three-way Family x SOA x Emotion interaction effect on attentional biases, $F(3, 75.08) = 3.79$, $p = .014$. Table 3 and Figure 3 depict the attention bias scores among children from different family types. To further examine the three-way interaction, we first analyzed the two-way Family x SOA interaction separately for angry and happy faces, and then analyzed the two-way Emotion x SOA interaction separately for each family type. The three-way Priming x SOA x Anxiety interaction was also significant, $F(2, 71.30) = 3.88$, $p = .025$, showing effects similar to those reported in the Descriptive statistics.

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First, the results showed a significant two-way Family x SOA interaction in the angry face condition, $F(3, 72.21) = 2.92$, $p = .040$, but not in the happy face condition, $F(3, 72.47) = 0.98$, $p = .406$. Pairwise comparisons between family types showed that at the stimulus onset asynchrony (SOA) of 500 ms, children from Cohesive families, *diff* = -25.20, *SE* = 9.30, $t(73.78) = -2.72$, $p = .008$, $d = 0.86$; and Disengaged families, *diff* = -20.30, *SE* = 9.58, $t(73.36) = -2.12$, $p = .037$, $d = 0.68$, had greater attentional bias toward angry faces than children from Authoritarian families. Examination of the 95% CIs (Table 3) showed that children from Cohesive and Disengaged families had a significant attentional bias toward angry faces at the SOA of 500 ms, whereas children from Enmeshed families had a significant attentional bias toward angry faces at the SOA of 1250 ms.

Second, the results showed a significant two-way Emotion x SOA interaction effect among children from Cohesive families, $F(1, 17.27) = 5.63$, $p = .030$. Pairwise comparisons showed that these children had a marginally greater attentional bias toward angry faces at the stimulus onset asynchrony (SOA) of 500 ms than at the SOA of 1250 ms, *diff* = -17.71, *SE* = 8.83, $t(18.31) = 2.01$, $p = .060$, $d = 0.32$. There was no such effect of SOA for happy faces, *diff* = 2.63, *SE* = 7.48, $t(12.97) = 0.35$, $p = .731$, $d = 0.06$.

There were no significant Emotion x SOA interaction effects among children from Disengaged families, $F(1, 17.12) = 2.09$, $p = .166$; Enmeshed families, $F(1, 19) = 1.66$, $p = .214$; or Authoritarian families, $F(1, 18.58)$, $p = .831$. However, there was a significant main effect of stimulus onset asynchrony (SOA) among children from Disengaged families, $F(1, 17.61) = 9.98$, $p = .006$; and Authoritarian families, $F(1, 16.79) = 6.28$, $p = .023$, indicating that attentional biases occurred similarly for both emotional faces among these children (i.e., angry and happy). Pairwise comparisons showed that children from Disengaged families had a greater attentional bias toward emotional faces at the SOA of 500 ms than at the SOA of 1250 ms, *diff* = -20.53, *SE* = 6.62, $t(17.49) = -3.10$, $p = .006$, $d = 0.71$. In contrast, children

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from Authoritarian families had a greater attentional bias toward emotional faces at the SOA of 1250 ms than at the SOA of 500 ms, *diff* = 9.95, *SE* = 3.57, *t*(*16.38*) = 2.79, *p* = .013, *d* = 0.69. Examination of the 95% CIs showed that children from Disengaged families had a significant attentional bias toward emotional faces at the SOA of 500 ms, *M* = 9.05, *SE* = 2.93, *95%* CI [2.88, 15.24], and away from emotional faces at the SOA of 1250 ms, *M* = -11.48, *SE* = 5.28, *95%* CI [-22.55, -0.41]. Children from Authoritarian families had a significant attentional bias toward emotional faces at the SOA of 1250 ms, *M* = 5.23, *SE* = 2.20, *95%* CI [0.59, 9.87].

Regarding our second research question, we included the interactions between the family system types and situational priming in the mixed-effects model. The results were nonsignificant for the four-way interaction, Priming x Emotion x SOA x Family, *F*(6, 72.97) = 0.60, *p* = .729; for the three-way interactions, Priming x Emotion x Family, *F*(6, 74.34) = 1.29, *p* = .274, and Priming x SOA x Family, *F*(6, 69.70) = 0.46, *p* = .838; and for the two-way interaction, Priming x Family, *F*(6, 67.03) = 0.56, *p* = .745. The results remained nonsignificant after the model was simplified by removing the four-way interaction, all F's < 1.44, *p*'s > .213. Thus, we concluded that situational priming did not moderate the effects of family type on children's attentional biases. Parity did not have significant main or interaction effects on attentional biases.

Discussion

We examined how family system types identified during pregnancy and infancy prospectively predict children's attentional biases at the age of 10 years. The results indicated that children from Disengaged families showed an early-stage attentional bias toward threat (i.e., angry faces), followed by a late-stage attentional bias away from emotional faces (i.e., both angry and happy). Children from Enmeshed families showed a late-stage attentional bias toward threat. Children from Cohesive families showed a late-

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stage attentional disengagement from threat after an early-stage attentional bias toward threat. Finally, children from Authoritarian families did not show threat-related attentional biases, but instead showed a late-stage attentional bias toward emotional faces. Situational priming did not moderate the effects of family types on children's attentional biases. These results suggest that children develop unique attention biases that may reflect the regulatory strategies they use to adapt to their early family systems.

In line with our hypotheses, children from Disengaged families showed an attentional bias toward threat at the early stage of processing, i.e., at the stimulus onset asynchrony (SOA) of 500 ms, but away from emotional faces at the later stage of processing, i.e., at SOA of 1250 ms. Children from Disengaged families have likely grown up in conflictual and emotionally distant family environments. Research on child maltreatment suggests that early-stage vigilance toward cues of interpersonal threat may help children living in abusive families to forecast interpersonal aggression (e.g., Shackman et al., 2007). In line with this, it is possible that children from Disengaged families have developed vigilance toward cues of interpersonal threat in order to forecast threatening family interactions. Interestingly, children from Disengaged families also showed an attentional bias away from emotional faces at the later stage of processing. Attachment research suggests that such attentional avoidance indicates attempts to suppress the processing of emotion-provoking information (e.g., Dewitte et al., 2007). Thus, it is possible that children from Disengaged families attempt to down-regulate their emotional responses by limiting the processing of emotion-provoking information, a salient strategy observed among children in conflictual and unsupportive families (Davies & Sturge-Apple, 2007).

Children from Enmeshed families showed an attentional bias toward threat at the late stage of processing, i.e., at stimulus onset asynchrony of 1250 ms. This result concurs with the previous studies that found an association between insensitive parenting and late-stage

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attentional biases toward threat (Gibb et al., 2011; Gulley et al., 2014). Late-stage attentional bias toward threat has been considered to indicate children's difficulties in regulating exposure to emotion-provoking information (Derryberry et al., 2002). In Enmeshed families, the diffuse family boundaries often increase intrusive parent-child interactions and involve children in marital conflicts (Kerig, 2005). Such stress-inducing family interactions have been shown to influence the development of both cognitive and motivational aspects of self-regulation (e.g., Bernier et al., 2012; Fosco & Grych, 2012). It is possible that the threat-related bias among children from Enmeshed families reflects a cognitive deficit, such as difficulties in inhibiting attentional responses to task-irrelevant stimuli. Alternatively, in line with both the attachment (Dykas & Cassidy, 2011) and emotional security theory (Davies & Sturge-Apple, 2007), the threat-related attentional bias may reflect strategic up-regulation of emotional arousal. Up-regulation of emotional arousal may help children to elicit parental protection and interrupt interparental conflicts, especially in enmeshed families where diffuse family boundaries prevent withdrawal from threatening interactions.

Children from Cohesive families showed an attentional bias toward threat at the early stage of processing, but did not show any attentional biases at the later stage of processing. Such attentional disengagement from threat has been considered to reflect adaptive emotion regulation, involving the evaluation of the stimulus as signaling only a minor threat (Bar-Haim et al., 2007). The harmonious family relationships in Cohesive families have likely increased children's sense of safety and fostered the development of emotion regulation (Davies & Sturge-Apple, 2007). Interestingly, however, children from both Cohesive and Disengaged families showed a similar early-stage attentional bias toward threat. Considering the large difference in the relationship quality between these families, it is tempting to speculate that the threat-related attentional bias has developed to serve different functions among children from these families. In line with an evolutionary perspective (Del Giudice et

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al., 2013), high responsivity toward cues of threat may have served prosocial functions among children in Cohesive families (e.g., sensitivity to the distress of others), while it may have served self-protective functions among children in Disengaged families (e.g., anticipation of threatening encounters).

Contrary to our hypotheses, children from Authoritarian families did not show threat-related attentional biases, but instead showed a modest attentional bias toward emotional faces at the late-stage of processing. Evolutionary perspective provides one possible explanation for this result by suggesting that children growing up in moderately threatening environments develop low responsivity to threat cues, which helps them to avoid unnecessary stress responses (Del Giudice et al., 2013). A moderate degree of negative expressivity in the family has been shown to decrease children's negative emotionality and foster emotional understanding (Halberstadt & Kimberly, 2002). Authoritarian families in our study were characterized by strong family boundaries, likely providing protection against interparental conflicts (e.g., Sturge-Apple et al., 2014). Thus, children in Authoritarian families may have learned that emotional cues do not necessitate responding because they do not forecast threat to the child.

Based on previous research, we have suggested that children's attentional biases have developed to serve different functions within different family system types. However, it should be noted that we could only test the associations between the family system types and attentional biases, but not the functions of these biases. Further studies are thus needed to examine, e.g., whether threat-related attentional biases associate differently with aggressive and prosocial behaviors among children from cohesive and disengaged families, and to what extent cognitive deficits and regulatory strategies mediate the effects of family enmeshment on attentional biases.

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Situational priming did not moderate the effects of early family systems on children's attentional biases. The simplest explanation would be that our procedure failed to activate children's mental representations. Yet, providing some validity for the priming procedure, we found that highly anxious children showed a late-stage attentional bias toward emotional faces only in the secure situation priming condition, and all children perceived the threat story events as highly threatening. One alternative explanation for the null results is that the attentional biases developed within the early family systems may operate constantly, regardless of priming to danger or safety. If this was the case, the attentional biases related to early family environments may have pervasive effects on children's socioemotional functioning.

The strengths of our study involve modelling the children's dynamic family systems using rich information about early family relationships. Importantly, the family system types could already be clearly distinguished from each other during pregnancy; thus, the effects of child characteristics (e.g., temperament) are unlikely to have confounded the results. We also demonstrated the validity of the family types by showing large differences in the marital adjustment and parenting distress between family types when the child was 2 months old. Finally, we controlled for the effects of pre-experimental state anxiety and parity on children's attentional biases, ensuring that these factors did not confound the results.

Despite these strengths, our study also has several limitations. First, we were unable to control the potential continuity of the family system types during the children's later developmental phases. Thus, conclusions regarding the age-specificity of our results should be made with caution. Second, our sample size was relatively small considering the complexity of the experimental design. Further studies with greater statistical power are needed to confirm our results, especially concerning the lack of situational priming effects. Finally, attentional biases may have occurred outside of our assessment points (stimulus

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onset asynchronies of 500 ms and 1250 ms). Eye-tracking methods could be used to obtain more continuous measures of attentional biases.

Research has convincingly shown that children with maltreatment history and those suffering from anxiety show emotional attention biases. Our prospective study contributes to this line of research by showing that more normative family environments also influence children's attentional biases. Our results concur with both the attachment (Dykas & Cassidy, 2010) and emotional security (Davies et al., 2013) theory by showing that the early relational quality of interpersonal relationships is important in shaping children's attentional biases, indicative of children's unique emotion regulation strategies. Our study also extends the focus from the caregiving and interparental relationships to more holistic and dynamic family systems. This may help to understand the patterns in children's social information processing as developmental adaptations to the emotional climate of their families.

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Tables

Table 1. Parental Perceptions of Family Relationships at the Child's Age of 2 Months (T2) and Children's State Anxiety at the Age of 10 Years (T4) According to Early Family System Type.

	Cohesive family (C)		Disengaged family (D)		Enmeshed family (E)		Authoritarian family (A)		K-W test		Pairwise tests
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	$\chi^2(3)$	*p*	
Mother's reports (*n* = 75)											
Marital adjustment	119.00	9.77	96.40	17.44	116.59	9.04	104.16	7.42	32.91	<.001	C, E > D, A
Parental distress	19.21	4.53	28.56	9.45	22.58	4.65	23.05	5.20	14.45	.002	C < E, A < D
Parent-child interaction	17.00	4.83	20.39	4.55	19.95	4.72	18.53	4.28	6.14	.105	
Difficult child	20.05	6.30	21.11	9.58	20.84	4.58	19.74	6.07	1.06	.785	
Father's reports (*n* = 73)											
Marital adjustment	118.69	12.66	100.90	11.39	115.92	9.81	106.13	12.13	20.20	<.001	C, E > D, A
Parental distress	19.45	4.85	26.82	5.25	21.71	4.99	20.77	5.55	15.00	.002	C, A < D
Parent-child interaction	16.61	4.36	20.53	5.50	19.79	3.72	19.23	4.52	7.45	.059	
Difficult child	18.00	3.89	22.52	6.72	20.06	4.39	19.62	3.59	5.15	.161	

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Child's report (n = 79)										
State anxiety	48.65	3.87	49.26	3.49	47.53	3.81	49.20	2.80	2.04	.565

Note. Scores range from 0 (poor) to 151 (good) for marital adjustment. Scores range from 0 (low stress) to 60 (high stress) for parental distress, parent-child interaction, and difficult child. Scores range from 20 (low) to 60 (high) for state anxiety. K-W denotes Kruskall-Wallis test. Pairwise tests refer to Welch's t-test ($p < .05$).

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Table 2. Attentional Biases to Emotional Faces (i.e., both Angry and Happy) Among Children with Low (n = 39) and High (n = 40) State Anxiety in Different Situational Priming Conditions.

	Stimulus onset asynchrony	Intimacy-threat			Autonomy-threat			Secure situation		
		M	*SE*	95% *CI*	*M*	*SE*	95% *CI*	*M*	*SE*	95% *CI*
High anxiety (n = 39)	500 ms	7.61	6.41	[-5.15, 20.30]	0.90	5.37	[-9.78, 11.50]	-3.09	4.94	[-12.91, 6.74]
	1250 ms	3.89	5.02	[-6.11, 13.80]	-4.81	5.80	[-20.30, 1.89]	17.55	6.29	[5.03, 30.05]
Low anxiety (n = 40)	500 ms	-8.28	6.33	[-20.88, 4.32]	4.12	5.18	[-6.19, 14.40]	7.50	4.76	[-1.97, 16.96]
	1250 ms	-2.14	4.94	[-11.97, 7.70]	-9.24	5.59	[-20.37, 1.89]	-3.26	6.07	[-15.33, 8.82]

Note. High and low anxiety groups are based on median split of the children's state anxiety variable. Positive and negative values indicate attentional biases toward and away from emotional expressions, respectively.

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Table 3. Children's Attentional Biases to Angry and Happy Faces at the Stimulus Onset Asynchronies of 500 ms and 1250 ms According to Early Family System Type.

		Cohesive family (n = 20)			Disengaged family (n = 19)			Enmeshed family (n = 20)			Authoritarian family (n = 20)		
	Stimulus onset asynchrony	*M*	*SE*	95% CI	*M*	*SE*	95% CI	*M*	*SE*	95% CI	*M*	*SE*	95% CI
Angry face	500 ms	18.83	6.47	[5.95, 31.70]	15.13	6.65	[1.89, 28.36]	-0.26	6.48	[-13.14, 12.63]	-9.90	6.43	[-22.69, 2.90]
	1250 ms	0.56	6.09	[-11.54, 12.66]	-8.05	6.25	[-20.47, 4.37]	18.00	6.08	[5.90, 30.09]	2.51	6.05	[-9.51, 14.53]
Happy face	500 ms	-4.30	6.23	[-16.70, 8.10]	-1.22	6.41	[-13.99, 11.54]	-1.29	6.25	[-13.73, 11.16]	-4.26	6.20	[-16.59, 8.08]
	1250 ms	2.71	5.87	[-8.98, 14.41]	-10.47	6.03	[-22.49, 1.55]	-3.71	5.87	[-15.40, 7.98]	-1.30	5.83	[-12.91, 10.31]

Note. Positive and negative values indicate attentional biases toward and away from emotional faces, respectively.

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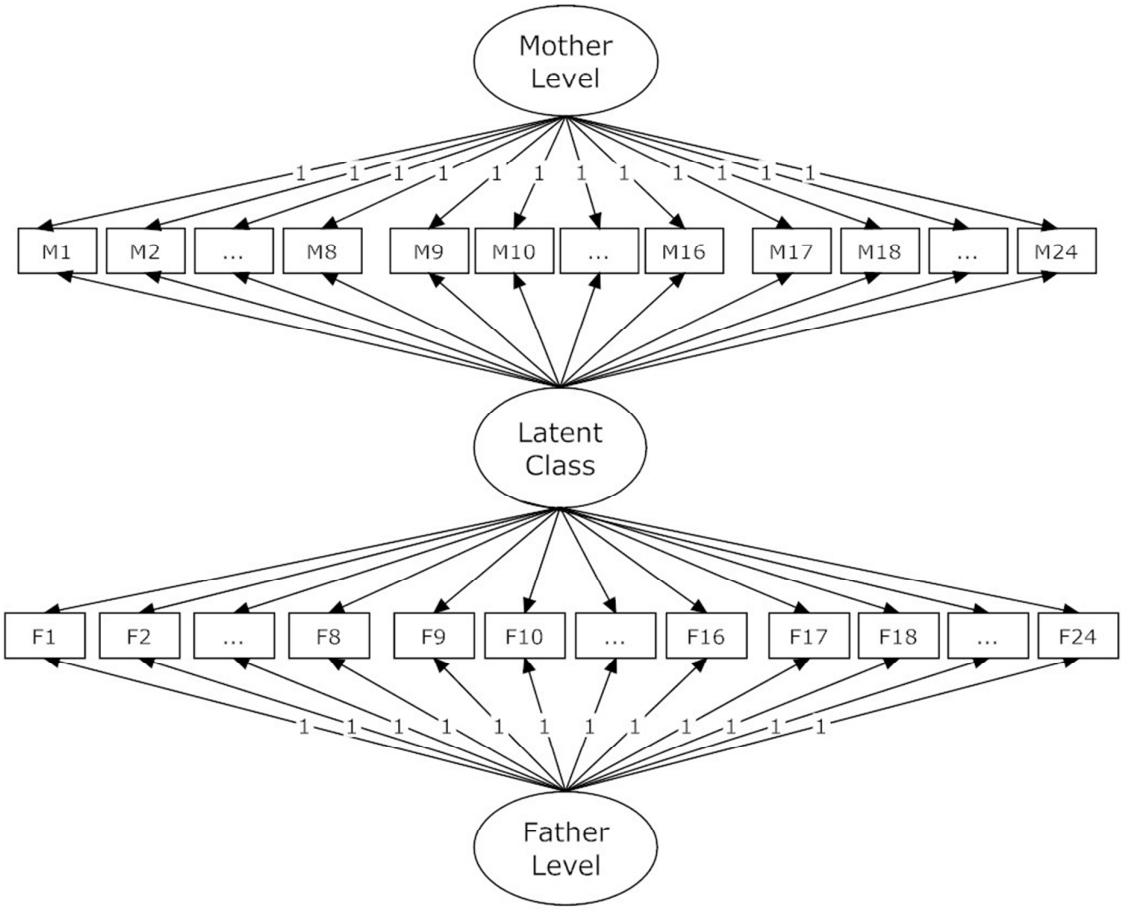
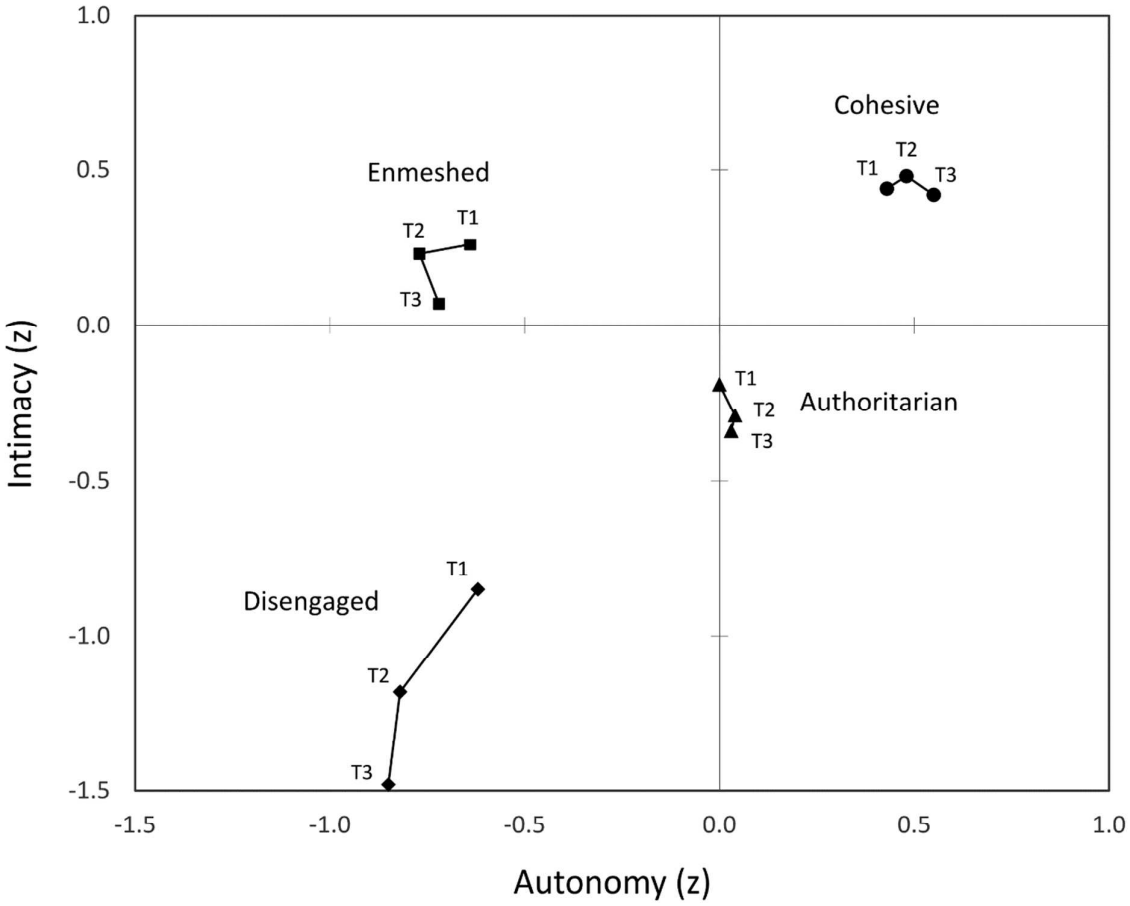
Figures

Figure 1. The Finite Mixture Model Used to Identify Family System Trajectories (Lindblom et al., 2014).



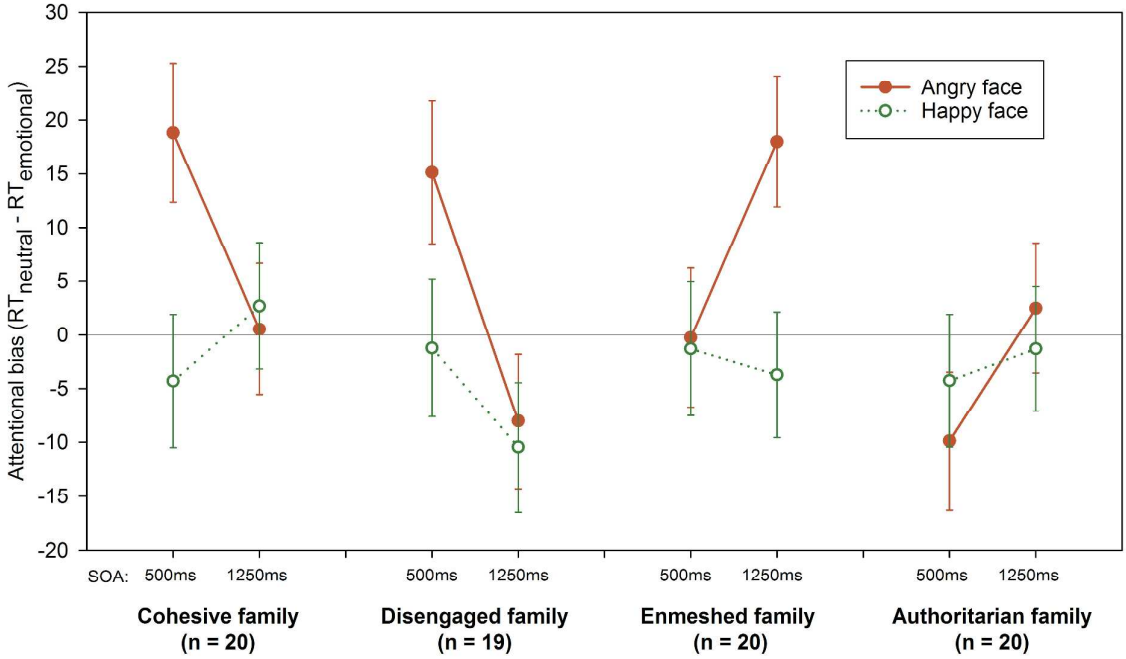
Note. Two general factors (Mother and Father level) were included to prevent the identification of spuriously large number of latent classes. Variables M1 to M24 are based on mothers' and F1 to F24 on fathers' reports of family relationships during pregnancy (T1) and at the child's ages of 2 months (T2) and 12 months (T3). Parent's reports were fixed to be the same when indicated by fit indices.

Figure 2. Early Family System Types and Their Longitudinal Trajectories in Autonomy and Intimacy from Pregnancy (T1) to Child's Ages of 2 Months (T2) and 12 Months (T3).



Note. Values are averaged over the parents (as both targets and reporters) and over the marital and parenting subsystems, providing a simplified overview of the longitudinal dynamics in the family system types. In our previous study (Lindblom et al., 2014), the analyses yielded two enmeshed family types. Here, the Enmeshed family refers to the Enmeshed Declining family type in the previous study.

Figure 3. Children's Attentional Biases to Angry and Happy Faces at the Stimulus Onset Asynchronies of 500 ms and 1250 ms According to Early Family System Type.



Note. SOA = stimulus onset asynchrony. Positive and negative values indicate attentional biases toward and away from emotional faces, respectively. Error bars represent ±1 standard errors.

Review

APPENDIX

Table A1. Children's Perceptions of the Priming Stories.

	Intimacy-threat (I)		Autonomy-threat (A)		Secure situation (S)		Friedman test		Pairwise tests
	M	*SD*	*M*	*SD*	*M*	*SD*	$\chi^2(2)$	*p*	
Threat	4.14	0.76	4.30	0.70	1.39	0.42	117.93	<.001	A > I > S
Importance	4.09	0.68	4.24	0.71	3.74	0.87	30.26	<.001	I, A > S
Own experiences	2.96	0.99	3.10	1.01	2.11	0.77	36.27	<.001	S > I, A

Note. All scores range from 1 (low importance / low threat / no own experiences) to 5 (high importance / high threat / has own experiences). Pairwise tests refer to Wilcoxon-signed ranked tests ($p < .05$): For *threat*, Intimacy-threat > Secure situation, $Z = -7.71$, $p < .001$, $d = -3.49$; Autonomy-threat > Secure situation, $Z = -7.49$, $p < .001$, $d = 3.45$; Autonomy-threat > Intimacy-threat, $Z = -1.98$, $p = .048$, $d = 1.78$. For *importance*, Intimacy-threat > Secure situation, $Z = -4.10$, $p < .001$, $d = 1.04$; Autonomy-threat > Secure situation, $Z = -5.99$, $p < .001$, $d = 1.92$. For *own experiences*, Secure-situation > Intimacy-threat, $Z = -5.52$, $p < .001$, $d = 1.59$; Secure-situation > Autonomy-threat, $Z = -5.77$, $p < .001$, $d = 1.79$.

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Table A2. Children's Perceptions of the Priming Stories According to Early Family System Type.

	Cohesive family (n = 20)		Disengaged family (n = 19)		Enmeshed family (n = 20)		Authoritarian family (n = 20)		K-W test	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	$\chi^2(3)$	*p*
Intimacy-threat										
Threat	3.83	0.92	4.21	0.88	4.43	0.42	4.08	0.62	4.15	.245
Importance	3.95	0.91	4.19	0.59	4.22	0.63	4.00	0.51	6.94	.074
Own experiences	3.05	1.02	3.33	1.08	2.78	0.97	3.03	0.88	3.49	.322
Autonomy-threat										
Threat	4.30	0.94	4.31	0.72	4.47	0.53	4.12	0.58	4.39	.222
Importance	4.11	1.11	4.20	0.54	4.50	0.48	4.12	0.51	3.06	.382
Own experiences	2.85	0.84	2.80	1.22	2.83	1.15	3.11	0.80	3.18	.365
Secure situation										
Threat	1.38	0.33	1.54	0.51	1.25	0.26	1.40	0.49	1.01	.798
Importance	3.83	1.06	3.65	0.88	3.87	0.87	3.62	0.68	3.58	.310
Own experiences	3.77	0.85	4.07	0.65	3.80	0.80	3.95	0.76	1.73	.630

Note. All scores range from 1 (low importance / low threat / no own experiences) to 5 (high importance / high threat / has own experiences). K-W denotes Kruskall-Wallis test.

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Table A3. Raw Attention Bias Scores, Response Times and Incorrect Responses In Different Situational Priming Conditions.

				Intimacy-threat			Autonomy-threat			Secure situation		
	Emotion	SOA	Cue	*M*	*SD*	95% *CI*	*M*	*SD*	95% *CI*	*M*	*SD*	95% *CI*
Attention bias												
	Angry	500 ms		-1.11	58.68	[-116.12, 113.90]	5.29	47.11	[-87.04, 97.62]	12.28	46.72	[-79.30, 103.86]
		1250 ms		4.37	38.62	[-71.34, 80.07]	-7.06	49.18	[-103.46, 89.33]	13.01	59.08	[-102.79, 128.80]
	Happy	500 ms		-0.21	43.26	[-85.00, 84.59]	-0.15	45.79	[-89.89, 89.59]	-7.47	47.51	[-100.60, 85.65]
		1250 ms		-3.51	47.98	[-97.55, 90.53]	-7.16	48.67	[-102.56, 88.23]	0.48	49.20	[-95.95, 96.92]
Response time												
	Angry	500 ms	Emotion	536.06	107.91	[324.57, 747.56]	539.72	119.52	[305.46, 773.98]	528.05	114.48	[303.67, 752.42]
			Neutral	534.95	111.44	[316.54, 753.37]	545.01	118.80	[312.17, 777.86]	540.33	123.03	[299.18, 781.47]
	Angry	1250 ms	Emotion	508.10	102.50	[307.20, 709.00]	526.58	122.09	[287.28, 765.88]	506.11	111.02	[288.51, 723.71]
			Neutral	512.47	96.02	[324.26, 700.67]	519.52	115.46	[293.21, 745.82]	519.12	105.76	[311.83, 726.41]
	Happy	500 ms	Emotion	533.71	97.90	[341.83, 725.59]	543.40	131.55	[285.57, 801.23]	531.69	113.17	[309.88, 753.50]
			Neutral	533.50	99.46	[338.57, 728.43]	543.25	116.49	[314.92, 771.58]	524.22	112.08	[304.55, 743.89]
	Happy	1250 ms	Emotion	513.67	101.73	[314.27, 713.07]	517.89	109.32	[303.62, 732.17]	516.87	113.95	[293.53, 740.21]
			Neutral	510.16	94.75	[324.46, 695.86]	510.73	105.28	[304.39, 717.07]	517.35	96.29	[328.62, 706.09]
Incorrect responses (*n)*				3.91	3.89	[-3.71, 11.53]	4.58	6.53	[-8.22, 17.38]	4.04	3.84	[-3.49, 11.57]
Children (*n*)				75			79			79		

Note. SOA = stimulus onset asynchrony.

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