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How do early family systems predict emotion recognition in middle childhood?

Petra Laamanen[1] | Noona Kiuru[2] | Marjo Flykt[1,3] | Mervi Vänskä[1] | Jari K. Hietanen[1] | Mikko J. Peltola[1] | Enni Kurkela[1] | Piia Poikkeus[4] | Aila Tiitinen[4] | Jallu Lindblom[1,5]

[1] Faculty of Social Sciences/Psychology, Tampere University, Tampere, Finland

[2] Department of Psychology, University of Jyväskylä, Jyväskylä, Finland

[3] Department of Psychology and Logopedics, Faculty of medicine, University of Helsinki, Helsinki, Finland

[4] Department of Obstetrics and Gynecology, Helsinki University Central Hospital Hospital and University of Helsinki, Helsinki, Finland

[5] Department of Clinical Medicine, University of Turku, Turku, Finland

Correspondence
Petra Laamanen, Faculty of Social Sciences/Psychology, Tampere University, Tampere, FI-33014, Finland.
Email: petra.laamanen@tuni.fi

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Abstract

Facial emotion recognition (FER) is a fundamental element in human interaction. It begins to develop soon after birth and is important in achieving developmental tasks of middle childhood, such as developing mutual friendships and acquiring social rules of peer groups. Despite its importance, FER research during middle childhood continues to be rather limited. Moreover, research is ambiguous on how the quality of one's early social-emotional environment shapes FER development, and longitudinal studies spanning from infancy to later development are scarce. In this study, we examine how the cohesive, authoritarian, disengaged and enmeshed family system types, assessed during pregnancy and infancy, predict children's FER accuracy and interpretative biases towards happiness, fear, anger and sadness at the age of 10 years ($N = 79$). The results demonstrated that children from disengaged families (i.e., highly distressed relationships) show superior FER accuracy to those from cohesive families (i.e., harmonious and stable relationships). Regarding interpretative biases, children from cohesive families showed a greater fear bias compared to children from disengaged families. Our findings suggest that even in a relatively low-risk population, variation in the quality of children's early family relationships may shape children's subsequent FER development, perhaps as an evolution-based adaptation to their social-emotional environment.

KEYWORDS
early social-emotional environment, emotion recognition, family system, middle childhood, person-oriented

1 | INTRODUCTION

The ability to accurately read others' emotions is a foundation for the development of a more complex social understanding (Camras & Halberstadt, 2017; Herba & Phillips, 2004). *Facial emotion recognition* (FER) refers to perceiving and identifying facial expressions, consisting of behavioural and neural processes that are shaped by social experiences (Adolphs, 2002; Camras & Halberstadt, 2017). The development of FER begins during infancy and is shaped by the child's early social-emotional environment (Dykas & Cassidy, 2011; Leppänen, 2011). Yet, previous research on the social predictors of FER is limited in major ways. First, most research has focused on extreme conditions, such as parental maltreatment (e.g., Pollak et al., 2009). Second, the few studies concentrating on low-risk populations have mostly investigated dyadic parent–child relationships (e.g., Steele et al., 2008), thus not considering the effects of a broader family system. Finally, most studies have focused on the short-term effects of family relationships (Castro et al., 2015; Schermerhorn, 2019), not elucidating the extent to which early family experiences influence FER in later developmental stages. Accordingly, in the present person-oriented study, we examine how family system types, based on intimacy and autonomy in parent–child and marital relationships during pregnancy and a child's first year of life, predict the child's FER in middle childhood.

1.1 | Significance of emotion recognition in middle childhood

The way children recognise emotional expressions affects their social interactions with others (Crick & Dodge, 1994; Lemerise & Arsenio, 2000). For instance, children with better abilities in identifying others' emotions tend to have better social skills (Izard et al., 2001; Trentacosta & Fine, 2010). Difficulties in recognising emotions may cause problems in understanding peer group dynamics, increasing the risk for peer victimisation (Pozzoli et al., 2017). Consequently, a child already less accurate in FER or one tending to interpret expressions in a biased manner (e.g., neutral faces as angry) may end up with fewer social connections and opportunities for practice. Inadequate FER may also contribute to psychological and behavioural problems. For example, low FER accuracy is associated with internalising symptoms in middle childhood (Castro et al., 2018) and a recent study suggests that this link might be mediated by peer problems (Dede et al., 2021). Altogether, these findings indicate that FER is an important part of children's social-emotional development, highlighting the need to understand its social antecedents.

1.2 | The role of the early social-emotional environment in FER development

Human infants have a biological preparedness to learn emotional signals, and this ability is shaped by their social-emotional environment (Leppänen, 2011). For example, greater maternal mirroring of infants' emotional expressions, typical in the context of sensitive caregiving, appears to strengthen the development of neural mechanisms involved in facial expression processing (Rayson et al., 2017). Attachment research has shown that infants form mental representations of attachment relationships, which help them adapt to their caregivers' interaction style and also guide their social perceptions later in life (Bowlby, 1973; Dykas & Cassidy, 2011). Securely attached infants, who have likely experienced responsive caregiving, tend to develop adequate or optimistic social information processing, whereas insecurely attached infants, who have likely experienced insensitive caregiving, tend to develop negatively biased social information processing by middle childhood (Dykas & Cassidy, 2011; Ziv et al., 2004). Indeed, one of the few existing longitudinal studies suggest that a secure mother–infant attachment at 12 months predicts higher FER accuracy in 6-year-olds (Steele et al., 2008). Furthermore, a poor mother–infant interaction quality seems to predict lower FER accuracy in 8- to 12-year-old children (Flykt et al., 2021). Finally, cross-sectional studies show an association between attachment disorganisation and lower FER accuracy in 6- to 7-year-old children (Colle & Del Giudice, 2011; Forslund et al., 2020).

The affective social competence model (Camras & Halberstadt, 2017) emphasises the role of parental socialisation practises (e.g., emotion-related beliefs and behaviours) in providing another perspective to understand the role of the social-emotional environment on children's FER development. For example, parental beliefs that emotions are dangerous or problematic seem to lead to more accurate FER in middle childhood (Castro et al., 2015). Whilst seemingly paradoxical, this may be explained by parents with negative emotional beliefs masking or suppressing their emotional expressions (Dunsmore et al., 2009). Thus, in concordance with research on emotional expressivity, children may develop more accurate FER as an adaptation to ambiguous and low-intensity expressiveness in their family environment (Castro et al., 2015; Halberstadt & Eaton, 2002).

Studies on child abuse and neglect also characterise the ways in which extreme family conditions shape children's FER development. On the one hand, from an evolutionary perspective (Del Giudice et al., 2013), a low threshold for detecting and recognising threat signals, even at the expense of false alarms, may serve as an adaptive function for a child's survival (e.g., helps them avoid danger). In line with this, physically abused children tend to show atypical processing of threat-signalling emotions, such as a high sensitivity to detect cues of anger in facial expressions (Pollak et al., 2009; Pollak & Sinha, 2002) or even a bias for interpreting expressions as angry when they are not (Ardizzi et al., 2015; Pollak et al., 2000). On the other hand, children from emotionally and physically neglecting families may end up with poor recognition skills because of reduced learning opportunities about emotions (McLaughlin et al., 2017). Indeed, children who have experienced severe neglect are overall less accurate in emotion recognition tasks (Pollak et al., 2000; Sullivan et al., 2008), and those with experiences of both neglect and physical abuse have difficulties in recognising positive emotions, in particular (Camras et al., 1983; Koizumi & Takagishi, 2014). Taken together, these findings indicate that early interpersonal experiences contribute to a child's later FER development; however, the direction of effects is rather ambiguous, and longitudinal research remains limited.

1.3 | Dynamic family systems as developmental environments

Most previous family research on FER development has focused on parent–child relationships (e.g., Steele et al., 2008). Yet, children are also highly responsive to the relationship between their parents (Davies et al., 2004). For example, children exposed to interparental conflict tend to misinterpret neutral expressions as happy or angry, which may reflect their sensitivity for detecting emotional cues whilst anticipating parental conflicts (Schermerhorn, 2019). Furthermore, according to family systems theory, families are dynamic systems in which all dyadic relationships constantly influence one another (Cox & Paley, 2003; Minuchin, 1985). This is demonstrated, for instance, in a spill-over effect, in which problems in the interparental relationship can transfer to parenting (Krishnakumar & Buehler, 2000) and in more complex relational patterns in which one parent discourages the other parent's interactions with their infant (Schoppe-Sullivan et al., 2008).

Following family systems theory (Minuchin, 1985), the person-oriented approach enables capturing complex family system types by identifying homogenous groups of families based on multiple dyadic relationships (Bergman & Magnusson, 1997; Mandara, 2003). In other words, rather than focusing on separate relational dimensions, the approach identifies prototypical family relationship patterns, summarising complex information into a manageable number of groups. Previous studies have often identified three or four family system types (e.g., Johnson, 2003; Sturge-Apple et al., 2010). Briefly, cohesive families represent a highly functional type with emotionally warm, well-structured and harmonious relationships. By contrast, disengaged families have emotionally cold, distant and conflictual relationships. In enmeshed families, relationships are overinvolved and intrusive, and weak family boundaries heighten family spill-over from interparental problems to parenting. Some studies recognise a compartmentalising type, in which the interparental relationship is conflictual, yet the quality of parenting is relatively intact, reflecting strong family boundaries (Sturge-Apple et al., 2014).

The person-oriented focus leads to an intriguing hypothesis that qualitatively different family types may have differential effects on children's social-emotional development. If children adjust their social-emotional development to match their family environment, this could be optimally tested using a person-oriented approach. Indeed, some studies suggest that children from enmeshed families tend to develop internalising symptoms, whereas those from disengaged families tend to develop externalising symptoms (Davies et al., 2004; Sturge-Apple et al., 2010). To our knowledge, however, no previous study has applied a person-oriented approach to examine how family types influence children's FER development.

The current study utilises family system types previously identified in Lindblom et al. (2014). The study aimed to identify naturally occurring family types by considering both marital and parenting relationship patterns and their changes during the transition to parenthood (i.e., during pregnancy and child's first year). The identification of family system types was based on parental evaluations of their sense of autonomy (i.e., individuality, competence and self-reliance) and intimacy (i.e., emotional closeness and acceptance) in the relationship (Mattejat & Scholz, 1994). Autonomy and intimacy are considered as core dimensions of family systems, reflecting interpersonal boundaries and relatedness that are crucial for adaptive family functioning (Luyten & Blatt, 2013; Olson, 2000).

The four family types identified in Lindblom et al. (2014) were labelled as cohesive, authoritarian, enmeshed and disengaged (see Figure 1). Compared with the other types, cohesive families have the highest intimacy and autonomy levels throughout the transition to parenthood, which indicates warmth and stability in the family system. Validation analyses have confirmed that the parents in these families have the highest marital adjustment and lowest parenting stress at the child's age of 2 months (Lindblom, Peltola, et al., 2017). Disengaged families have the lowest intimacy and autonomy levels, especially in the marital subsystem, and there is a substantial decrease in intimacy over time, indicating highly distressed relationships. The parents in these families have the lowest marital adjustment and highest parenting stress (Lindblom, Peltola, et al., 2017). In enmeshed families, parents report low levels of autonomy combined with high levels of intimacy, reflecting overly permeable family boundaries and entangled relationships. Both parents report high marital adjustment, whereas mothers in particular report moderate levels of parenting stress (Lindblom, Peltola, et al., 2017). Finally, authoritarian families show a relative lack of intimacy, combined with average autonomy levels, reflecting strong family boundaries. Fathers were more autonomous than mothers in the marital relationship, whereas mothers were more autonomous in parenting, indicating a hierarchical structure within the family (hence the label). Both parents report low marital adjustment, suggesting difficulties in the marital relationship, yet their parenting stress is lower than that of disengaged families (Lindblom, Peltola, et al., 2017). Thus, this family dynamic is similar to that of compartmentalising families (e.g., Sturge-Apple et al., 2014).

1.4 | The present study

Previous research has implied that children's FER development reflects a fine-tuned adjustment to the social-emotional climate and challenges present in their family environment. Subsequently, qualitatively different family system types could have differential effects on children's FER development. This study aimed to test how four family system types (i.e., cohesive, authoritarian, disengaged and enmeshed) from pregnancy through the child's first year of life prospectively predict children's FER accuracy and biases at the age of 10 years.

Our first research question is how early family system types predict children's FER accuracy, that is, an overall ability to correctly identify emotional expressions. According to our *positive support hypothesis*, the cohesive family system type predicts the most accurate FER, as an emotionally warm and stable family climate fosters

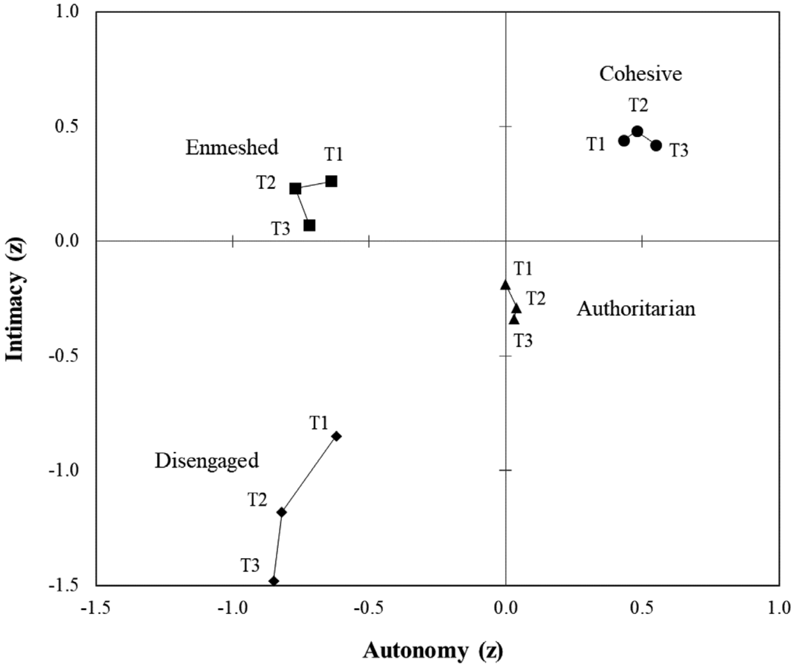

FIGURE 1 Early family system types and their longitudinal trajectories from pregnancy (T1) to child's ages of 2 months (T2) and 12 months (T3). Copyright © John Wiley & Sons, Inc. All rights reserved. Adapted from "Dynamic family system trajectories from pregnancy to child's first year" by J. Lindblom, M. Flykt, A. Tolvanen, M. Vänskä, A. Tiitinen, M. Tulppala, and R-L. Punamäki, 2014, *Journal of Marriage and Family*, 76, p. 802. *Note*. Values are averaged over the parent (father or mother), relationship (parental or marital) and reporter (father or mother), providing a simplified overview of the family system types

children's social-emotional development (e.g., through sensitive caregiving and coherent parental facial mirroring of infants' emotional experiences). By contrast, according to our *developmental tuning hypothesis*, authoritarian, disengaged and enmeshed family types show superior FER accuracy compared to children from cohesive families to better cope with and adapt to their distressed family climate (e.g., interparental conflicts, unpredictable interactions and intrusiveness). Although the lack of previous person-oriented studies precluded us from posing specific hypotheses, we explore whether emotion-specific differences in FER accuracy exist between the family types.

Our second research question is how early family system types predict children's FER biases, that is, a tendency to interpret ambiguous facial expressions as one specific emotion (e.g., anger), when an expression contains a given emotion only at a low intensity level or not at all. According to our *threat salience hypothesis*, children from disengaged families, in which emotionally threatening family interactions are most likely to occur, are expected to show a greater bias towards anger than children from other family types are. This hypothesis was derived from maltreatment studies in which threat-provoking experiences were found to predict bias towards anger. We further explore whether other emotion-specific differences in FER biases exist between the family types.

Previous literature suggests that a child's gender (Lawrence et al., 2015; McClure, 2000) and a target model's gender may affect FER (Harris et al., 2016). Furthermore, having an older sibling may be beneficial for the development of FER (Taumoepeau & Reese, 2014). The child's own gender, the model's gender and parity were therefore all used as covariates in the analyses.

2 | METHODS

2.1 | Participants

This study was part of the Miracles of Development research project that followed Finnish families (N = 710) from pregnancy to children's age of 17–19 years. Approximately half of the couples were naturally conceiving (NC, n = 374, 53%); the other half achieved pregnancy with assisted reproductive treatment (ART, n = 336, 47%). The participants were recruited from infertility clinics (ART group) and from Helsinki University Central Hospital whilst attending routine ultrasonographic examinations (NC 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 higher educational levels than the corresponding population (Statistics Finland, 2009). Couples were asked to fill out questionnaires about family relationships during pregnancy (T1; 18–20 weeks of gestation) and when the child was 2 months (T2), 12 months (T3) and 7–8 years old (T4). For a more detailed description of the larger longitudinal sample, see Lindblom et al. (2014).

At the age of 10 years (T4; M = 10.62 years, SD = .61, range: 9.44–11.79 years), a subsample of children (n = 79) performed a computerised FER task either at home or at the university facility. We collected a subsample of 20 children from the four family system types, with equal representation of fertility history (NC vs. ART) and gender. One family cancelled their participation at the end of the data collection period, leading to 19 children from disengaged families. This subsample was similar to the larger sample in terms of children's gender, mother's age, parents' educational levels and fertility history and parity (all $ps > .05$). The participating clinics' ethics committees approved the study at all timepoints (T1–T4).

2.2 | Assessment of family relationships (T1–T4)

Family relationships were measured with the Subjective Family Picture Test (Mattejat & Scholz, 1994) during T1–T4. It is a questionnaire method to assess each family member's perception of autonomy (four pairs of items; e.g., self-confident–uncertain) and intimacy (four pairs of items; e.g., loving–rejecting) using a seven-point bipolar scale (ranging from −3 to 3). We used both mothers' and fathers' perceptions of four relationships: mother-to-father, father-to-mother, mother-to-child and father-to-child. In other words, both self and partner reports were used, resulting in eight mother-reported and eight father-reported relationships at each timepoint. During pregnancy (T1), parents were asked to report their expectations of their future relationship with their unborn child. High scores on autonomy reflect a relational sense of individuality, competence and self-reliance. High scores on intimacy reflect emotional closeness, acceptance and relatedness.

To identify the latent family system types at T1–T3, Lindblom et al. (2014) used factor mixture modelling, based on 48 sum variables. Cronbach's alphas for self- and spousal reports of autonomy and intimacy ranged from .68 to .91 in marital and from .52 to .82 in parenting relationships. The analysis yielded seven family system types, which accounted for 91% of the whole sample. Both entropy (.924) and average latent class probabilities (.911–.975) indicated accurate classification. The present study focused on a subsample of children selected from four prototypical family types representing quadrants of autonomy and intimacy (see Figure 1). In the larger sample, cohesive families accounted for 35%, authoritarian for 14%, disengaged for 5% and enmeshed for 6%. Because of the complexity of the family systems, they were described at the aggregated level of whole family autonomy and intimacy. For more details about the procedure, see Lindblom et al. (2014).

2.3 | Emotion recognition task (T4)

FER accuracy and interpretative biases were assessed using morphed pictures from the Facial Expressions of Emotion: Stimuli and Tests (Young et al., 2002). In this set, prototypical facial expressions of adult posers were selected from the Pictures of Facial Affect series (Ekman & Friesen, 1976) and, within each individual identity, were morphed into blends of two emotions (e.g., happiness–anger) ranging from one end to the other in 20% increments. A more detailed description of the morphing process and examples of stimuli can be found in Young et al. (1997). As children typically recognise prototypical emotions rather accurately by middle childhood (Lawrence et al., 2015), morphed faces were used to make the task more challenging and prevent the ceiling effect. In the present study, we used morphs of facial expressions by two posers, a male ('JJ') and a female ('MO'). The participants were shown 44 morphed face pictures (22 pictures with a male and 22 with a female adult). A total of 36 pictures presented blends from two prototype emotions (i.e., happiness, anger, fear and sadness) with three different emotion percentages (i.e., 30:70, 50:50, 70:30). Eight pictures, two for each emotion, presented a blend of a neutral face (30%) and an emotional (70%) expression. Thus, each emotion appeared in 20 trials: two times in 30:70 neutral-emotion blends, six times in 70:30 emotion blends (e.g., 70% of happiness and 30% of anger), six times in 50:50 emotion blends and six times in 30:70 emotion blends. The stimuli were presented in a pseudorandomised, balanced order to the participants. The participants were instructed to select one of the four emotion labels (i.e., neutral was not an option) they considered the face was representing by using a computer keyboard. There was no time limit for responding; after the response, a new picture appeared on the screen.

For the analysis of recognition accuracy, 44 trials were used to form a variable for total accuracy. Each response was recoded into correct (1) and incorrect (0). Following Dapelo et al. (2016), in trials with 70:30 blend, the emotion presented at 70% proportion was considered correct, and in trials with 50:50 blend, both emotions were considered correct. For the analysis of interpretative biases, four discrete bias variables were formed (i.e., happiness, anger, fear and sadness). We used trials in which a target emotion was depicted at 30% proportion and trials in which the target emotion was not present at all (i.e., 30 out of 44 trials). For example, for analysing a happiness bias, all trials in which happiness was presented at 50% or 70% proportion were excluded, but all other emotion blends were included. This was done to tease apart the tendency to select a specific emotion regardless of whether it was only subtly expressed or not expressed at all. Each response was recoded into '1' if a participant responded the target emotion and '0' if not.

2.4 | Demographic variables

Information on the children's ages and genders, mothers' ages during pregnancy, infertility history and primi- vs. multiparity status was collected at T1. Parents' education levels at T1 (1 = higher education, 2 = secondary education or 3 = only primary education) were averaged over both parents. For one participant, the information on mother's age was not available, thus this missing score was imputed with the sample mean for the analyses.

2.5 | Analysis plan

Logistic regression models using generalised estimating equations (GEEs) in IBM SPSS Statistics 25 were constructed to assess how family system types predict children's FER. GEE is an extension of the generalised linear model that can be used for analysing correlated binary response data with missing values (Hanley, 2003; Liang & Zeger, 1986). The logistic regression models were fit using an exchangeable correlation structure and individuals were specified as clusters to account for the nested structure of the data. Following the suggestions of Stevens et al. (2017), the two-stage Benjamini and Hochberg procedure (TST; Benjamini et al., 2006) was applied to correct for multiple comparisons using the multtest package in R version 3.6.1 (Pollard et al., 2005). TST appears to control the false discovery rate well, despite the correlation between the tests. TST was applied to five main analyses (i.e., FER accuracy analysis and four emotion-specific bias analyses) and post hoc tests when a significant effect in the main analysis was found. Only corrected *p* values are presented regarding these analyses.

Descriptive statistics regarding family types were analysed using the Kruskal–Wallis test and cross-tabulation tests. The total number of trials in the emotion recognition task was 3476, with 14 missing values (.4%).

To answer the first research question regarding FER accuracy, the accuracy of response (i.e., correct or incorrect) was predicted with Family Type as a between-subject factor, and the child's gender, model's gender and parity were controlled for. That is, the probability of responding correctly when being a member of a certain family was modelled. For the accuracy analysis, all 3476 trials were used. An explorative analysis was performed using only 70:30 blends (2528 trials) to examine the emotion-specific effects on FER accuracy. A response was coded as correct if a participant responded the emotion present at 70% proportion. The model was the same as in the main analysis, except for adding a main effect of Emotion and Family Type × Emotion interaction. To answer the second research question regarding FER biases, the responses were analysed separately for each emotion by running four separate GEE models (2370 responses in each). Again, Family Type was a between-subject factor, and the child's gender, model's gender and parity were controlled for. The probability of selecting the target emotion at 0% or 30% proportion when being a member of a certain family was modelled. The results are presented as odds ratios (ORs) and 95% confidence intervals (CIs).

3 | RESULTS

3.1 | Descriptive statistics

Family system types were similar in terms of children's age and gender, mothers' age and parents' educational level and infertility history. However, 40% ($n = 8$) of the cohesive and authoritarian families and 21% ($n = 4$) of the disengaged families were primiparous, whereas 75% ($n = 15$) of the enmeshed families were primiparous, $\chi^2(3, n = 79) = 12.1$, $p = .007$. In the whole sample, the mean age of the mothers was 33.45 years ($SD = 3.64$). Most parents had either higher (mothers: 40.5%, fathers: 36.7%) or secondary (mothers: 51.9%, fathers: 49.4%) education levels. Only 2.5% of the mothers and 3.8% of the fathers had only primary education. Neither of the demographic variables related to any of the FER variables (all *p*s > .1). The mean accuracy score was 83%, $SD = 9$, range = 55%–98%. Regarding FER biases, examination of CIs showed that the children showed greater bias towards fear, $M = .12$, $SD = .07$, 95% CI [.10, .13], than happiness, $M = .04$, $SD = .04$, 95% CI [.03, .05] anger, $M = .04$, $SD = .07$, 95% CI [.03, .06] or sadness, $M = .03$, $SD = .05$, 95% CI [.03, .05].

3.2 | How does early family system type predict FER accuracy?

In response to our first research question, the results showed an effect of Family Type on the child's FER accuracy, Wald $\chi^2(3) = 11.59$, $p = .014$. As shown in Figure 2, the results indicated that compared with children from cohesive families, those from disengaged families were more accurate in FER, OR = 1.69, Wald $\chi^2(1) = 11.02$, $p = .005$, 95% CI [1.24, 2.30]. There was also a trend-level difference, OR = 1.52, Wald $\chi^2(1) = 4.59$, $p = .080$, 95% CI [1.04, 2.22], suggesting that children from enmeshed families may be more accurate compared with children from cohesive families.

In the explorative emotion-specific accuracy analysis (including only 70:30 blends), there was a main effect of Emotion, Wald $\chi^2(3) = 89.23$, $p < .001$. The children were most accurate in recognising happiness, $M = 97\%$, $SE = 1\%$, 95% CI [.95, .99], followed by fear, $M = 85\%$, $SE = 2\%$, 95% CI [.81, .88], sadness, $M = 76\%$, $SE = 2\%$, 95% CI [.71, .80] and then anger $M = 65\%$, $SE = 2\%$, 95% CI [.61, .70]. However, there was no Family Type × Emotion interaction ($p = .771$). For descriptive purposes, emotion-specific accuracy percentages according to Family Type are presented in a confusion matrix (Table S1). Inspection of the matrix suggests that in children from cohesive families, the lower accuracy is highlighted in anger and sadness recognition.

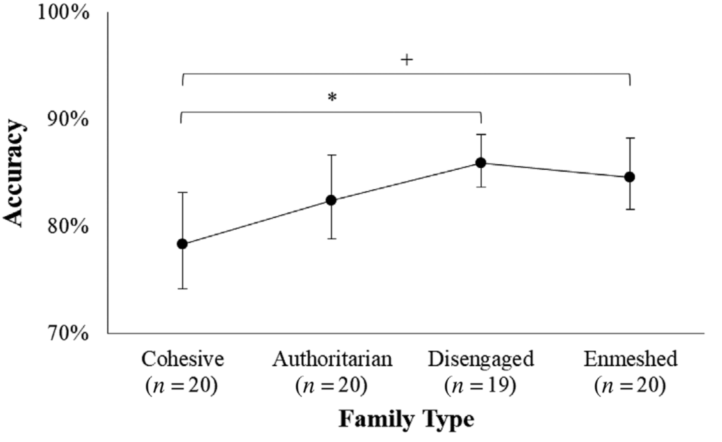

FIGURE 2 Effects of family type on children's overall FER accuracy.
Note. Values represent estimated marginal mean percentages and CIs (95%). *$p < .05$. + $p < .1$

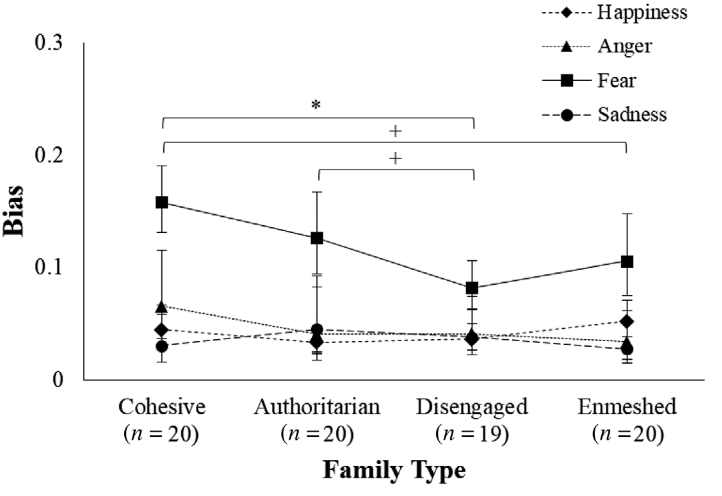

FIGURE 3 Effects of family type on children's emotion-specific FER biases.
Note. Values represent estimated marginal mean probabilities and CIs (95%). Significance marks indicate differences between family types in the fear bias. *$p < .05$. + $p < .1$

3.3 | How does early family system type predict FER biases?

In response to our second research question, the results showed an effect of Family Type on the fear bias, Wald $\chi^2(3) = 16.63$, $p = .003$. Children from cohesive families show a greater bias to respond fear (when fear is not clearly expressed in the picture) than those from disengaged families do, OR = 2.10, Wald $\chi^2(1) = 15.77$, $p < .001$, 95% CI [1.46, 3.03]. There was also a trend-level indication that children from cohesive families show a greater bias to respond fear than those from enmeshed families, OR = 1.58, Wald $\chi^2(1) = 4.36$, $p = .061$, 95% CI [1.03, 2.44]. A trend-level difference was likewise observed between children from authoritarian and disengaged families, OR = 1.62, Wald $\chi^2(1) = 4.48$, $p = .061$, 95% CI [1.04, 2.53], suggesting that children from authoritarian families were more biased to respond fear. The estimated marginal mean probabilities and their CIs for each family type according to the emotion-specific biases are presented in Figure 3. No differences were found between the children from different family types in their FER biases regarding happiness, anger and sadness, all *ps* > .220.

3.4 | Additional analyses

We ran additional analyses to test whether our results might be due to continuity of early family relationships (T1–T3) to middle childhood (T4). Using principal component analysis, the 16 variables of the family relationships at T4 were reduced into two principal components. The five main GEE analyses were repeated using the two principal components as covariates. The results remained the same regarding effects of early family type on the child's FER accuracy, Wald $\chi^2(3) = 19.35$, $p < .001$, and fear bias, Wald $\chi^2(3) = 26.67$, $p < .001$, and regarding the pairwise comparisons, $ps < .01$. Thus, our main results were unlikely driven by the concurrent family relationships in middle childhood. For more details, see Supplementary Material.

4 | DISCUSSION

This study tested whether and how early family relationships from pregnancy through the child's first year of life predict children's FER in middle childhood. A person-oriented approach allowed us to summarise complex information on families' relational patterns and to focus on naturally occurring family systems. Regarding the effects of family types on children's FER accuracy, the results provided some support for the *developmental tuning hypothesis* but not for the *positive support hypothesis*. Children from families characterised by highly distressed relations, that is, the disengaged family type, showed enhanced FER accuracy in middle childhood compared with children from cohesive families. Furthermore, the results provided no support for our *threat salience hypothesis*, as the anger bias was not greater in children from the disengaged family type than in children from other family types. Instead, children from cohesive families showed a greater bias towards fear than those from disengaged families did, perhaps reflecting their overall lack of experience in interpreting negative emotions. Overall, although the results provide only a modest indication of family type-specific effects on children's FER, they suggest that children may adjust their FER to their early social-emotional family environment.

4.1 | Early family types and FER accuracy

Partially confirming our *developmental tuning hypothesis*, the results showed that children from disengaged and, at a trend-level, enmeshed families were more accurate in FER than those from cohesive families were. These findings partly concur with those of maltreatment studies suggesting heightened perceptual sensitivity for negative expressions in children growing up in highly stressful environments (Pollak et al., 2009). Our results could not statistically significantly confirm that this effect was driven by negative emotions only, yet the descriptive confusion matrix indicates that the differences between children from cohesive and disengaged families might be the most pronounced in anger and sadness recognition. Future studies with larger sample sizes are needed for more in-depth examinations of emotion-specific differences.

Importantly, our results extend previous research by demonstrating that the enhancement of FER accuracy can also take place within relatively low-risk families if the relationships are emotionally threatening or intrusive. Yet, contrary to the *developmental tuning hypothesis*, children from authoritarian families did not differ in their FER accuracy from those of cohesive families. From a family system perspective, children in authoritarian families were possibly not exposed to severe family distress because of strong family boundaries. This corresponds with previous research on compartmentalising families in which children's well-being is relatively high, despite interparental conflicts in the family (Sturge-Apple et al., 2010).

Against our *positive support hypothesis*, early cohesive family systems did not predict children's high FER accuracy. This finding is interesting, as previous studies report associations between responsive and sensitive caregiving and children's high FER accuracy (Steele et al., 2008). A possible explanation is that in families with emotionally warm and balanced relationships, the attitudes towards emotional expressions are likely to be supportive, encouraging open emotional expression in both interparental and parent–child interactions. Hence, in the presence of clear and high-volume emotional expressions, children might put less effort into acquiring accurate FER, as the information is easily accessible anyway (Castro et al., 2015; Halberstadt & Eaton, 2002). Further research is needed to test this speculative explanation more directly and to gain specific information about the developmental mechanisms underlying children's FER accuracy.

4.2 | Early family types and FER biases

Our *threat saliency hypothesis* did not receive support, as children from disengaged families did not show an increased anger bias (nor biases towards other emotional expressions). This stands in contrast with maltreatment research, which has shown that a severely stressful social-emotional environment predicts children's bias towards anger (e.g., Ardizzi et al., 2015; Pollak et al., 2000). Our interpretation is that the highly distressed climate in disengaged families was sufficient to enhance children's FER accuracy, but more extreme conditions may be needed to result in anger biases (i.e., perception of anger in expressions in which it is hardly present). This may indicate that children's FER development in disengaged families was tuned to accurately perceiving the emotions present within their family environment.

Surprisingly, children from cohesive families showed a greater fear bias than those from disengaged families. A trend-level difference in the same direction was present between cohesive and enmeshed families and between authoritarian and disengaged families. These results indicate that children's heightened fear bias occurred only in the more stable family systems. Whilst this was unexpected, it concurs with the interpretation that children from cohesive families lack expertise in recognising negative emotions and may thus more easily mix other emotions with fear. Interestingly, one study reported that in middle childhood, children tend to show a bias toward fear instead of anger and that this bias tends to disappear during the transition to adulthood (Thomas et al., 2007). From this perspective, children from cohesive families seem to demonstrate more age-typical FER biases, perhaps reflecting slower maturation of the neural circuits underlying FER (Callaghan & Tottenham, 2016). Further research with larger samples is needed to confirm that this unexpected finding did not occur by chance because of our relatively small sample size.

4.3 | Children's FER development in the early social-emotional environment

Our findings support the view that children's early social-emotional environment shapes FER development. Yet, our expectation that different family system types would predict emotion-specific effects in FER did not receive strong support. It seems that the developmental tuning of FER is more clearly driven by the amount of family distress (e.g., high vs. low functioning) than by the qualitative differences between families (e.g., enmeshed vs. authoritarian). The direction of effects in our study, however, supports the view that very young children already adapt their FER development to match the emotional climate and challenges in their family environment (Camras & Halberstadt, 2017; Dykas & Cassidy, 2011).

In a distressing family environment, facial expressions are likely to become important cues of the forthcoming emotional threat, allowing children to act in a way that promotes their sense of safety (Davies et al., 2018). The results from our previous study on attentional biases are consistent with this interpretation (Lindblom, Peltola, et al., 2017). Children from both cohesive and disengaged families showed initial orienting towards angry faces (i.e., orienting to a target presented 500 ms after the angry face). Yet, differences emerged during a later stage of processing, as children from cohesive families showed no attentional biases, but those from disengaged families showed such biases away from the faces. This indicates that emotional threat cues evoke strong coping responses amongst children from distressed families, providing further support for the view that these children perceive facial expressions as highly salient information.

It is important to note that the current study focused on relatively low-risk families, which may partially explain why family distress fostered children's FER development; this stands in contrast to maltreatment studies showing detrimental effects on FER (Camras et al., 1983; Pollak et al., 2000; Sullivan et al., 2008). One potential explanation for this difference relates to the evolutionary processes regulating FER development (Del Giudice et al., 2013). Reacting to very subtle cues of threat (e.g., anger bias) increases false alarms and thus depletes one's psychophysiological resources. Yet, this strategy can be worthwhile within very dangerous environments, where missing threat cues can have severe consequences on survival. Within moderately threatening environments, a highly accurate and unbiased FER can be more adaptive, as threat responses are evoked only as a response to unambiguous threat cues.

Previous research has shown that unpredictable family interactions and harsh parenting seem to accelerate the development of the neural emotion circuitry important for FER (Callaghan & Tottenham, 2016; Cohodes et al., 2020) and to provoke more rapid development towards adult-like coping and sexual maturation (i.e., fast life history strategy; Del Giudice et al., 2013). This perspective concords with our main results in that children from families with warm and stable relationships showed the lowest accuracy in FER and immature, age-typical FER biases. Importantly, accelerated maturation may have a high cost on other emotional development domains (Del Giudice et al., 2013). Our previous study suggests that children from disengaged (and enmeshed) families have poorer emotion regulation skills and more depressive symptoms in middle childhood compared with children from cohesive families (Lindblom, Vänskä, et al., 2017). Further research is needed to empirically examine how alterations in FER processes may relate to children's well-being and to the proposed biological mechanisms.

4.4 | Strengths and limitations

To our knowledge, this study is one of the first to investigate the longitudinal effects of the early family environment on children's FER in middle childhood. By identifying the family system types based on the quality of multiple family relationships from pregnancy through children's first year, we focused on naturally occurring early family environments. However, only self-report questionnaires were used in measuring family relationships and combining them with observational assessments in future studies might improve assessment reliability. Also, while the additional analyses indicated that the effects of early family system types on FER remain the same after controlling for the concurrent family relationships, larger longitudinal samples with shorter follow-up periods (e.g., including toddlerhood) and more accurate measurement of family structure continuity (e.g., latent transition analyses) are needed to better scrutinise the developmental timing effects on FER.

The nature of the person-oriented approach produces variability in which family types emerge from the data and how they are interpreted. However, our previous studies provide preliminary validation for the family system types in terms of their external family correlates (Lindblom, Peltola, et al., 2017) and child outcomes (Lindblom, Vänskä, et al., 2017). Whilst the person-oriented approach enabled us to condense complex information about family relationships into manageable types, the focus on the overall family pattern precluded us from testing the separate effects of interparental and parenting subsystems on children's FER. Also, we did not test the possible mechanisms (e.g., family conflicts or parental facial mirroring of an infant's emotional experiences) linking family system types to children's FER. Further studies are needed to analyse whether the effects are driven by specific relationships or mechanisms and to confirm the four family system types and their effects on children's FER.

The participants in the study represented a relatively low-risk population, so caution is needed when generalising our findings to high-risk populations. In addition, our sample size was relatively small, which may preclude capturing small effects, especially those regarding emotion-specific accuracy and biases. Finally, we used blended expressions (Young et al., 2002) to assess FER in subtle and ambiguous expressions. Whilst our aim was to mimic real-world situations, the static black and white images may have felt artificial to the children. Also, using only two adult models might have restrained the variety in expressions. We encourage researchers to use more recently developed methods for assessing FER, such as involving dynamic facial expressions (Halberstadt et al., 2020) or multimodal paradigms (Camras & Halberstadt, 2017).

5 | CONCLUSION

In this study, we extended the scope of previous research on children's social-emotional environment by suggesting that distressed early family relationships shape the development of children's FER, even in a low-risk family context. This novel finding supports the intriguing hypothesis that differences in children's FER can be understood as an adaptation to their early social-emotional environment. It seems that children can develop to be highly sensitive to emotional cues, particularly to negative ones, even without exposure to apparent traumatic interpersonal experiences. This might indicate an accelerated transition to more adult-like FER for children growing up in stressful environments, whereas children from emotionally warm and supportive relationships seem to undergo a slower transition. From the clinical perspective, it is very important to note that even less severe disturbances in an infant's social-emotional environment may change the track of their development, with potentially important consequences for their later social and emotional functioning. This emphasises the demand for early support and interventions for families under distress during the transition to parenthood.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

Research data are not shared due to the sensitive nature of the data.

ORCID

Petra Laamanen https://orcid.org/0000-0002-4963-9062

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SUPPORTING INFORMATION

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