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ORIGINAL PAPER

# Family Alliance in Infancy and Toddlerhood Predicts Social Cognition in Adolescence

Hervé Tissot[1,2] · Noémie Lapalus[1] · France Frascarolo[1] · Jean-Nicolas Despland[1] · Nicolas Favez[1,2]

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## Abstract

Infants developing in a cooperative family alliance (FA), characterized by cohesion and mutual support between family members observable during mother–father–child interactions, will likely experience more affect sharing and empathy early in life. Previous studies showed that these experiences might have a positive impact on the development of social cognition, as the development of FA from 3 to 18 months was shown to predict theory of mind (ToM) competences at age 4.5. This study aimed to extend these results to adolescence, as we hypothesized that higher FA in the postpartum would be linked better social cognition skills at age 15 years. We assessed FA during mother–father–child interactions at 3, 9, and 18 months postpartum ($N = 49$) and adolescents' social cognition skills in a computerized emotion recognition task at age 15 years. Results of growth curve models showed that the stable, but not the changing, components of FA from 3 to 18 months, predicted better emotion recognition—particularly for positive emotional expressions—at age 15 years, when controlling for ToM at age 4.5 years. Results are discussed in light of prior research on the links between early family relationships and children's development from early childhood to adolescence.

**Keywords** Family alliance · Theory of mind · Emotion recognition · Social cognition.

## Highlights

- Growth curve models of the development of family alliance showed that family alliance tends to increase between three and eighteen months postpartum.
- Stability in FA, but not the change from early postpartum to toddlerhood, was linked to better social cognition competences at age 15, even when controlling for social cognition at age 4.5.
- Higher family alliance scores specifically predicted higher capacities to identify positive and, to a lesser extent, neutral and negative emotional expressions in the emotion recognition task at age 15.

Family relationships are one of the strongest predictors of children's social, affective, and cognitive development. The importance of children's early relational experiences for their development has been investigated in studies that detailed the dyadic processes embedded in mother–child relationships (Brazelton et al., 1974; Stern, 1977), which are now acknowledged as one of the main contextual factors that influences child development. Since the end of the 1980s, a growing number of researchers started to include fathers and investigated processes that occurred at the family level, which considers the system comprising two parents and a child as a discrete object of study (Belsky & Isabella, 1985; McHale, 1995; Parke et al., 1980). A triadic (or polyadic) system has a complex organization as the number of interrelationships between members of the system increase exponentially as the number of members increase. The complexity of family-level processes is attested to by the specific methods of investigation that had to be developed to capture these phenomena. Indeed, family-level processes—relational phenomena whose properties emerge from group-level

✉ Hervé Tissot
herve.tissot@chuv.ch

1 Department of Psychiatry, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland

2 Faculty of Psychology and Educational Sciences, University of Geneva, Geneva, Switzerland

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interactions—could not be derived from the observation of the separate mother–child, father–child, or mother–father dyads, and even less so by using self-reports (Cox & Paley, 2003). The best way to capture these emergent properties is to observe "the system in action," that is, by direct observation of triadic (or polyadic) interactions during free play or in semi-standardized situations such as the Lausanne Trilogue Play (LTP) paradigm (Corboz-Warnery et al., 1993). Triadic interactive behaviors, such as the parents' coordination in interaction with the child or mutual respect for each other's initiative in the play, have been shown to reflect the quality of family-level processes. A line of research described the quality of triadic interactive behaviors under the construct of family alliance (FA), which refers to the sense of family cohesion emerging from the quality of family communication, coordination, and affect sharing during family interactions (Fivaz-Depeursinge & Corboz-Warnery, 1999). From the interactive behaviors observed during triadic interactions, FA can be assessed and categorized as being either "cooperative," "conflicted," or "disordered," according to the presence and frequency of the following distinctive patterns of behaviors, respectively: (a) cooperation, support, and cohesion, (b) competition and conflict, or (c) exclusion and disengagement. The latter two are considered dysfunctional FA patterns (Favez et al., 2011). Longitudinal studies suggested that FA is stable across the postpartum period, with around 60% of families following a "high stable" evolution pattern (cooperative all along) and around 20% following a "low stable" pattern (conflicted or disordered all along). The remaining 20% of families are less stable and follow a more dynamic pattern of "high to low" alliance (cooperative at 3 months and deterioration from 9 to 18 months; Favez et al., 2006). The low stable and high to low patterns, and more generally both categories of problematic FAs, were shown to be related to more negative outcomes within the family, as they were associated with infants' psychofunctional symptoms and parental psychopathology (Favez et al., 2006, 2011).

After researchers investigated how disturbances in family-level functioning were linked to negative outcomes in children such as psychopathological outcomes, in recent years, interest has grown in understanding the positive impact of family-level functioning on the development of social, affective, and cognitive competences in children. Indeed, family contexts marked by a cooperative FA have been assumed to be primary social contexts that will positively foster child development. For example, 4-month-old infants growing up in cooperative FAs have been shown to display more complex patterns of interactive behaviors such as triangular bids, when infants execute rapid gaze shifting while communicating the same affect to both parents in short periods of time (5 s; Fivaz-Depeursinge et al., 2005). However, studies are still needed to understand how cohesive and supportive family contexts foster child development and support the development of children's cognitive, affective, and social skills.

In this context, our study group started a longitudinal study more than 20 years ago to investigate the normative development of FA from pregnancy to toddlerhood in primiparous families and its impact on several areas of child development. After a first set of data collection at 5 months of pregnancy and at 3, 9, and 18 months postpartum, we undertook a follow-up of the cohort when children were 4.5 years old, just before they entered primary school. In this follow-up, we mostly focused on child outcomes and assessed several areas of child development, including child psychopathology, as well as social and cognitive development. Indeed, as several studies have shown that the development of social cognition in general, and ToM in particular, seem to be influenced by the quality of parent–child dyadic interactions (Dunn & Brophy, 2005; Meins et al., 2013; Symons & Clark, 2000), we were specifically interested at investigating the links between triadic interactions and social cognition. The main hypothesis of this study was that positive family relationships, such as those observable in cooperative FAs, will act as a learning context that will foster the development of social cognition in children. In a first wave of our study, we focused in particular on theory of mind (ToM; Favez et al., 2012). ToM is widely recognized as a key competence related to various areas of child development. Indeed, developmental studies have shown ToM to be related to better executive functions (Austin et al., 2014; Brock et al., 2019; Cassetta et al., 2018), more complex and adaptive communicative behaviors and strategies (Sidera et al., 2018), better capacities to cooperate with others (Etel & Slaughter, 2019), and more prosocial (Derksen et al., 2018; Imuta et al., 2016) and fewer antisocial behaviors such as aggression and bullying (Smith, 2017). The rationale underlying this hypothesis was that children who develop in families with a high stable pattern of FA evolution in the first 18 months more frequently experience moments of affect sharing in multiperson contexts. We hence postulated that the repeated experience of such interactions is a favorable context for learning multiple perspectives. Our results at the 4.5-year follow-up confirmed this hypothesis, showing that preschool children in high stable families showed higher performances in ToM scores, measured during a false-belief task. These results were important, since this research was one of the first to document an influence of family-level processes measured in infancy and toddlerhood on the development of a key socio-cognitive competence measured in early childhood.

However, this first follow-up also raised more questions, such as regarding the duration of the effect of early family relationships on child development. Indeed, if we found a link between FA and ToM at 4.5 years, could we observe a similar link between FA and social cognition measured in late childhood or adolescence? Questions about the links between early socio-affective experiences and long-term development in general have long been debated, but answers to these questions are still unclear. For example, studies about the links between attachment security and empathy and feelings of care for others during adolescence seem to suggest that the positive effect of sensitive parenting received by an individual during early childhood may extend to the long term and lead to more security of attachment in adolescence (Shaver et al., 2016). However, these links have mostly been presumed on the basis of the rational accumulation of separate evidence, such as the fact that attachment in early childhood is related to attachment in adolescence, which in turn is related to empathy. To date, evidence is still lacking regarding the direct influence of the quality of early social experiences on developmental outcomes in adolescents. Concerning the more specific links between early social experience and the development of social cognition from childhood to adolescence, the question is particularly complex. First, very few studies have documented the development of social cognition in a longitudinal study from early childhood to adolescence and adulthood. Moreover, the study of social cognition in adolescents and adults is more focused on interindividual differences between individuals with specific diagnoses, such as autistic spectrum disorders (Brewer et al., 2017; Charman et al., 1998; Livingston et al., 2019), and typically developing individuals than on intraindividual developmental trajectories of social cognition. The present study, in which we aim to investigate the development of social cognition skills in a single sample of children from early childhood to adolescence, is both innovative and exploratory in that matter.

From the results of the previous study that allowed us to uncover links between the evolution of FA measured in the postpartum period and children's social cognition skills measured at age 4.5, we aimed in the present study to extend these previous results to adolescence by conducting a follow-up of the cohort when children were 15 years old. Our goal was to test the hypothesis according to which development in FA during infancy and toddlerhood could predict adolescents' social cognition skills at age 15—while also controlling for ToM competences at age 4.5 years.

## Method

### Participants

Participants were 49 biparental primiparous families recruited during pregnancy through press announcements and flyers distributed at the maternity ward of the Lausanne University Hospital in Switzerland. The children were 27 boys and 22 girls and were born healthy and at full term. The families were mostly middle class (48%) and upper-middle class (50%). The mean age of parents at birth was 31 years for mothers ($M = 30.97$, $SD = 2.71$) and 33 years for fathers ($M = 33.19$, $SD = 5.08$).

### Procedure

The design of the original study included a first set of three waves of data collection in infancy at 3 (T1), 9 (T2), and 18 (T3) months postpartum. Families were contacted again when the child was around 4.5 years old to participate in another wave of data collection (T4). Finally, the whole original sample was contacted when the children were around 15 years old (T5), including the families who did not participate in the data collection at 4.5 years. The sample size varied at different time points and included 49 families at T1, 45 at T2, 37 at T3, 38 at T4, and 36 at T5. We examined child gender, as well as parents' age and socioeconomic status at baseline as potential sources of attrition. We found that attrition at T4 was slightly more frequent in families of girl, but this effect was not significant for attrition at T5.

At T1, T2, and T3, we invited parents and children to a laboratory session during which we asked them to play with their child in a semi-standardized observational situation, the LTP (Corboz-Warnery et al., 1993). The LTPs were video recorded for coding purposes. Parents also received a set of self-report questionnaires, which included questions about sociodemographic variables, that had to be completed separately by each parent within 7 days and returned by mail in postage-paid envelopes. At T4, parents and children came back to the laboratory. Children performed the ToM tasks (see Measures subsection below) with a trained research assistant, while parents were invited to observe their child behind a one-way mirror. Finally, at T5, we met the adolescents alone in the laboratory, where we tested their ability to understand other persons' emotions by using a computerized task (Reading the Mind in the Eyes Test Revised version, or RMET; see Measures subsection below).

### Measures

#### Family alliance at 3, 9, and 18 months

We assessed FA through direct observation in the LTP. This validated observational situation has been designed to assess the quality of triadic interactions in families with infants and toddlers. The family members sit in an equilateral triangular configuration at a distance fostering interaction (80 cm between the center of each seat). The setting can be adapted according to the age of the child: In the "infant setting," the child sits in a baby chair, which can be oriented toward one parent, toward the other, or between the two of them. The chair can also be leaned forward ("sit" position) or backward ("lay" position). In the setting for toddlers, the child sits in a high chair, the parents and the child sit around a small round table, and a set of gender-free toys and objects (three stuffed pigs, three spoons, three socks) are at hand. The LTP scenario is structured in four parts, which allows us to observe all the possible interactive configurations in a triad: In Part 1, one parent plays with the child, while the other one is "simply present" (2 + 1); in Part 2, parents switch roles (2 + 1); in Part 3, they play altogether (3 together); and in Part 4, parents discuss in front of the child (2 + 1). The global duration for the whole task is given to the parents in the instructions: around 8 min at 3 months, 10 min at 9 months, and 12 to 15 min at 18 months (these durations were set according to standard durations of triadic free play in naturalistic conditions). The LTPs were recorded with a multicamera setting to be assessed later.

We used the Family Alliance Assessment Scales (FAAS; Favez et al., 2011) to assess the quality of the FA in the LTP. The first part of the assessment consists of classifying FA as being either "cooperative," "conflicted," or "disordered" from the patterns of interactive behaviors shown by families during the LTP (for detailed prototypical descriptions of the patterns expected in each category, see Favez et al., 2011). The second part of the assessment consists of rating 11 three-point scales that detail specific behaviors shown by families during the LTP: postures and gazes, inclusion or exclusion, implications of each partner in his or her role, task fulfillment, co-construction, parental scaffolding, family warmth, validation of the child's emotional experience, authenticity of the expressed affects, communication mistakes during shared activities, communication mistakes during transitions. A total score is then computed by summing the scores on these 11 scales (range 0–22 points; $\alpha = 0.91$), with higher scores indicating higher coordination throughout the play. Although the results of both assessments can be used as an index of the quality of the FA, we decided to choose the FA score in the subsequent analyses, as it could be considered as a continuous variable and was thus more suitable for the analyses planned in the present study (see Statistical Analyses subsection below). Concerning the coding strategy, a trained research assistant coded all the tapes, while a second research assistant double-coded 17 randomly selected tapes at different ages. The 17 tapes were all from different families and the second coder was blind to the family alliance of the coded families at other time points. They obtained a satisfactory interrater reliability on FA scores with an intraclass correlation coefficient of 0.80.

### Social cognition at 4.5 years: theory of mind

We assessed ToM with false-belief tasks presented to the child. In these tasks, stories were narrated to the child by using puppets. The stories staged a character facing different situations: object transfer tasks (three stories; Wimmer & Perner, 1983), unexpected content (two stories; Perner et al., 1987), and "appearance/reality" distinction (Gopnik & Astington, 1988). Each story is designed to produce a difference between what the child knows and what the character in the story knows. For example, in an object transfer task, the child knows that an object has been moved from one place (A) to another (B) while the character was out of the scene. When the character comes back to the scene, a child who has achieved a ToM is able to tell that the character will look for the object in A and that he or she will be sad or disappointed not to find the object in the place he or she first thought it was. For each story, we asked the child questions about the ToM (e.g., what the character thinks) and about the understanding of emotions (e.g., what is the emotion felt by the character?). One point was given for each correct answer given by the child, resulting in a ToM subscore that ranged from 0 to 9 points and an emotion comprehension score that ranged from 0 to 10 points. The total score of between 0 and 19 was obtained by summing these two scores ($\alpha = 0.70$).

### Social cognition at 15 years: emotion recognition

We assessed the adolescents' social cognition skills through their ability to mentalize and to understand other persons' emotional states by using a computerized task, the RMET (Baron-Cohen et al., 1997, 2001). The test consists of presenting a series of 36 photographs of the eye region of human faces (see Baron-Cohen et al., 2001, for examples). The participant is asked to associate an adjective that describes an emotional or cognitive state with each photograph. The participant has to choose the correct answer among four propositions. For each photograph, only one answer is correct. The photos refer to the inner state of different emotional valences: Eight photos relate to positive states, 12 to negative states, and 16 to neutral states. To rule out an effect of participants' vocabulary skills, the experimenter presented a list of the adjectives used in the test to the adolescents beforehand. A brief definition of each unknown term was given by the experimenter. We computed the overall ratio of correct answers in the test (RMET total score), as well as separate ratios of correct answers according to the emotional valence of each photograph, that is, on items with a positive (RMET positive score), neutral (RMET neutral score), or negative (RMET negative score) emotional valence.

## Statistical Analyses

The analyses consisted of testing different models in which the evolution of FA in the postpartum period predicted the different scores in the RMET at T5, while controlling for the ToM scores at T4. In the present study, we used a latent growth curve model approach to model the evolution of FA from T1 to T3. Latent growth curve models are widely used to study developmental and change processes in psychology, since they allow to include both intra- and inter-individual differences and model the average change in a sample of subjects as well as individual differences concerning that change (for an overview, see Bollen & Curran, 2006). This method consists in specifying a model with two latent variables, namely the Intercept and the Slope factors, which respectively represent the average baseline score and the average amount of change in the score on a given variable. The measure of the "baseline", however, will not be strictly equivalent to the observed variable at the first time point in terms of distribution, as it will not only draws its variance from the first time point, but also from the later time points. The term "baseline", here, represents what is stable, as opposed to what changes, i.e., the Slope factor (Singer & Willett, 2003). In this study, factor loadings between the observed variables (FA at T1, T2, and T3) were all fixed to 1 on the Intercept factor and respectively to 0, 0.4, and 1 on the Slope factor, in order to model accurately the time difference beween the three time points (Model 1). Second, to test the influence of FA evolution on social cognition skills at T5, we specified models in which we regressed RMET scores at T5 on the Intercept and Slope factors, while the ToM total score was set to covary with the Slope and Intercept factors, as well as with RMET scores. We tested four models separately: First, in order to test how the global emotion understanding in the RMET test was linked to the evolution of FA, we tested a model with the RMET total score as dependent variable in the model (Model 2). Then, in order to investigate how the understanding of emotions with different valence might be predicted differently, we tested 3 separate models using the scores on positive (Model 3), neutral (Model 4), and negative RMET items (Model 5) as dependent variables. As the Slope factor in the estimation of Models 2 to 5 appeared to be weakly related to the RMET and ToM scores (see Results section for details), we also tested alternate models (2b, 3b, 4b, and 5b) in which the paths linking the Slope factor to the RMET and ToM scores were constrained to 0.

We assessed the adjustment of the models by referring to the standard criteria defined by Hu and Bentler (1999): Besides a nonsignificant chi square, well-fitting models should show values higher than 0.95 on the comparative fit index (CFI), lower than 0.08 on the standardized root mean residual (SRMR), and lower than 0.06 on the root mean square error of approximation (RMSEA). RMSEA 90% confidence intervals (CIs) should also ideally include 0. Models were estimated by using a full information maximum likelihood estimator. Analyses were conducted with IBM SPSS 25.0 and Mplus version 7.4. Of note, Mplus estimates separate *p* values for unstandardized and standardized parameters and we chose to report the *p* values of standardized parameters when reporting parameter estimation results.

**Table 1** Descriptive statistics

| | *n* | Min. | Max. | *M* | *SD* |
|---|---|---|---|---|---|
| Family Alliance | | | | | |
| FAAS family score T1 | 49 | 3.00 | 21.00 | 12.98 | 5.76 |
| FAAS family score T2 | 45 | 2.00 | 22.00 | 14.31 | 5.89 |
| FAAS family score T3 | 37 | 5.00 | 22.00 | 15.00 | 5.18 |
| ToM T4 | | | | | |
| ToM total score | 38 | 6.00 | 18.00 | 11.39 | 3.63 |
| Emotion Recognition T5 | | | | | |
| RMET total score | 36 | 27.78 | 80.56 | 63.74 | 10.99 |
| RMET positive score | 36 | 12.50 | 100.00 | 66.67 | 21.34 |
| RMET neutral score | 36 | 25.00 | 87.50 | 59.03 | 13.32 |
| RMET negative score | 36 | 41.67 | 91.67 | 68.06 | 12.20 |

RMET scores are expressed in percentages of correct answers on all items (RMET total score) and separately on items with a positive (RMET positive score), neutral (RMET neutral score), or negative (RMET negative score) emotional valence. *FAAS* Family Alliance Assessment Scales, *ToM* Theory of mind, *RMET* Reading the Mind in the Eyes Test, *T1* Time 1 (3 months), *T2* Time 2 (9 months), *T3* Time 3 (18 months), *T4* Time 4 (4.5 years), *T5* Time 5 (15 years).

## Results

### Descriptive Statistics

The descriptive statistics for all the variables under study can be found in Table 1. Concerning FA, mean total scores on the FAAS were comparable to scores found in the other samples of non-referred families (Favez et al., 2011). Concerning ToM scores at 4.5 years, mean scores of the subjects fell in the mid-range, which was consistent with data found in the literature about the mean performance of 4- to 5-year-old children in false-belief tasks, according to which children of this age give correct answers to approximately half of the items (Wimmer & Perner, 1983). Although total scores on the RMET at age 15 years in our population of adolescents were lower than scores reported in the literature in samples of non-referred adults and students, these scores were higher than scores reported in samples of adults with autistic disorders (Baron-Cohen et al., 2001). Interestingly, the proportion of correct answers on neutral items was slightly lower than the proportion of correct answers on positive and negative items. Correlations between the study variables can be found in Table 2. A majority of bivariate associations between the variables under study were significant, positive, and going in the expected direction. There were high and significant correlations between the 3 measures of FA. On the contrary, there were more non significant correlations between the

**Table 2** Correlation matrix for study variables

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. |
|---|---|---|---|---|---|---|---|---|
| 1. FAAS family score T1 | 1 | | | | | | | |
| 2. FAAS family score T2 | 0.672** | 1 | | | | | | |
| 3. FAAS family score T3 | 0.795** | 0.797** | 1 | | | | | |
| 4. ToM total score T4 | 0.397* | 0.255 | 0.412* | 1 | | | | |
| 5. RMET total score T5 | 0.449** | 0.479** | 0.582** | 0.423* | 1 | | | |
| 6. RMET positive score T5 | 0.364* | 0.462** | 0.549** | 0.313 | 0.798** | 1 | | |
| 7. RMET neutral score T5 | 0.370* | 0.241 | 0.537** | 0.428* | 0.844** | 0.555** | 1 | |
| 8. RMET negative score T5 | 0.251 | 0.379* | 0.166 | 0.181 | 0.544** | 0.183 | 0.177 | 1 |

RMET scores are expressed in percentages of correct answers on all items (RMET total score) and separately on items with a positive (RMET positive score), neutral (RMET neutral score), or negative (RMET negative score) emotional valence. *FAAS* Family Alliance Assessment Scales, *ToM* Theory of mind, *RMET* Reading the Mind in the Eyes Test, *T1* Time 1 (3 months), *T2* Time 2 (9 months), *T3* Time 3 (18 months), *T4* Time 4 (4.5 years), *T5* Time 5 (15 years). *$p < 0.05$, **$p < 0.01$.

social cognition measures. First, within the RMET measures, only the correlation between the scores on the positive and neutral items were significantly correlated. Second, as expected, the correlations between the ToM total score at T4 was significantly correlated with the RMET total score, as well as with the RMET neutral score. On the contrary, the correlations between the ToM total score at T4, on the one hand, and the RMET positive and negative scores on the other hand were not significant.

## The Evolution of FA in the Postpartum Period

The results of the estimation of Model 1, in which we specified linear growth of FA from 3 to 18 months, revealed that this model showed excellent adjustment to the data, $\chi^2 = 0.689$, df = 1, $p = 0.407$, CFI = 1.000, SRMR = 0.024, RMSEA = 0.000, 90% CI [0.000, 0.353]. Concerning the parameter estimation, results showed that the mean and variance of the Intercept factor were significant ($M = 13.15$, $p < 0.001$, and $S^2 = 22.46$, $p < 0.01$). These results suggested that, on average, baseline family scores were greater than 0 and that there was a significant heterogeneity in the sample in those baseline scores of FA. The mean of the Slope factor was also significant ($M = 2.41$, $p < 0.001$), which suggested a significant increase of more than 2 points in FAAS family scores from T1 to T3. This increase was more or less similar for every family, since the variance of the Slope factor was not significant ($S^2 = 3.36$, $p = 0.82$). Finally, the correlation between the Slope and Intercept factors was not significant ($r = -0.25$, $p = 0.50$), which indicated that there was no link between baseline FA and its evolution from T1 to T3.

## FA in the Postpartum Period and ToM at Age 15

Information about the adjustment of all the models presented in this section and the respective fit indices can be found in Table 3.

### Predicting the RMET total score

The results of the estimation of Model 2 (Fig. 1) globally showed that this model was well adjusted to the data. The fit indices globally indicated a good fit of the model, with a nonsignificant chi square, a CFI above 0.95, and an SRMR below 0.08, although the value of the RMSEA was slightly too high. The results of the parameter estimation showed that the Intercept factor predicted a higher RMET total score ($b = 1.317$, $\beta = 0.585$, $p < 0.001$), whereas the Slope factor was not significantly related to the RMET total score ($b = 1.010$, $\beta = 0.234$, $p = 0.367$). The ToM total score, entered as a covariate in the model, was significantly correlated to the Intercept factor ($r = 0.376$, $p = 0.015$), but not with the Slope factor ($r = 0.038$, $p = 0.879$) nor with the RMET total score ($r = 0.236$, $p = 0.141$). To confirm the null links between the Slope factor and social cognition variables, we specified an alternative model (Model 2b) in which the regression weight linking the Slope factor to the RMET total score, as well as the covariance between the Slope factor and the ToM total score, were constrained to 0. The results showed that the adjustment of Model 2b was better than that of Model 2, with all fit indices, including the RMSEA, indicating a good adjustment of the model. A chi-square difference test between Model 2 and 2b resulted in a nonsignificant chi square, which confirmed that Model 2b should be preferred and that the links between the Slope factor and both social cognition variables could therefore be considered as null.

### Predicting the RMET positive score

The results of the estimation of Model 3 showed that this model was globally well adjusted to the data. Most fit indices indicated a good fit of the model, with a nonsignificant chi square, a CFI above 0.95, and an SRMR

**Table 3** Fit indices for models 2, 2b, 3, 3b, 4, 4b, 5, and 5b

| | $\chi^2$ | *df* | *p* | CFI | SRMR | RMSEA | |
|---|---|---|---|---|---|---|---|
| | | | | | | Est. | 90% CI |
| Predicting RMET total score | | | | | | | |
| Model 2 | 4.352 | 3 | 0.226 | 0.984 | 0.067 | 0.096 | 0.000, 0.276 |
| Model 2b | 4.886 | 5 | 0.429 | 1.000 | 0.064 | 0.000 | 0.000, 0.196 |
| $\chi^2$ diff. between Model 2 and 2b | 0.534 | 2 | 0.766 | – | – | – | – |
| Predicting RMET positive score | | | | | | | |
| Model 3 | 4.769 | 3 | 0.190 | 0.979 | 0.065 | 0.110 | 0.000, 0.285 |
| Model 3b | 5.762 | 5 | 0.330 | 0.991 | 0.065 | 0.056 | 0.000, 0.212 |
| $\chi^2$ diff. between Model 3 and 3b | 1.000 | 2 | 0.609 | – | – | – | – |
| Predicting RMET neutral score | | | | | | | |
| Model 4 | 5.431 | 3 | 0.143 | 0.971 | 0.099 | 0.129 | 0.000, 0.299 |
| Model 4b | 6.983 | 5 | 0.222 | 0.976 | 0.088 | 0.090 | 0.000, 0.232 |
| $\chi^2$ diff. between Model 4 and 4b | 1.552 | 2 | 0.460 | – | – | – | – |
| Predicting RMET negative score | | | | | | | |
| Model 5 | 6.938 | 3 | 0.074 | 0.949 | 0.077 | 0.164 | 0.000, 0.327 |
| Model 5b | 7.684 | 5 | 0.174 | 0.965 | 0.080 | 0.105 | 0.000, 0.242 |
| $\chi^2$ diff. between Model 5 and 5b | 0.746 | 2 | 0.689 | – | – | – | – |

*CFI* Comparative fit index, *SRMR* Standardized root mean residual, *RMSEA* Root mean square error of approximation, *Est*. Estimate, *CI* Confidence interval, *RMET* Reading the Mind in the Eyes Test, *diff.* Difference.

*Results of the Parameter Estimation for Model 2*

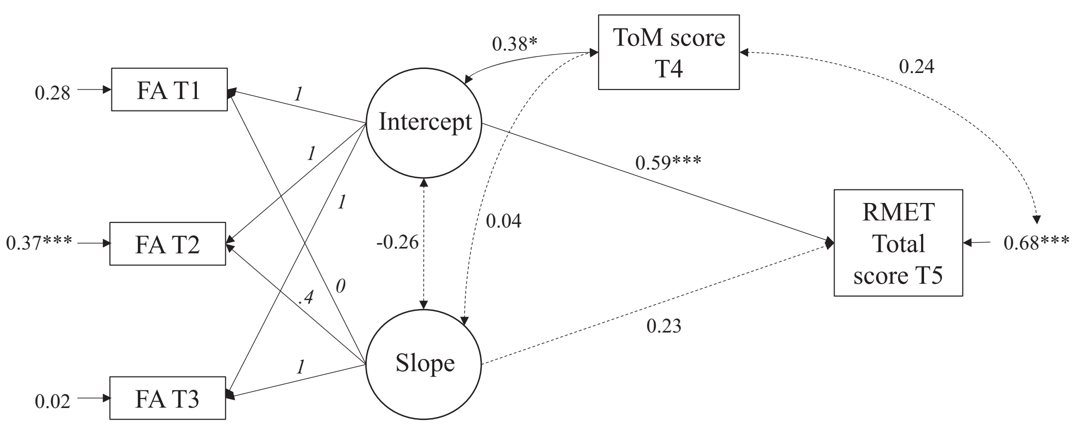


**Fig. 1** Results of the Parameter Estimation for Model 2. (Note. Model fit: $\chi^2 = 4.352$, $df = 3$, $p = 0.226$, CFI = 0.984, SRMR = 0.067, RMSEA = 0.096, and 90% CI [0.000, 0.276]. All estimates are standardized. Nonsignificant paths appear as dotted lines. Parameters in italics were constrained in the specification of the model. Values of FA refer to family scores obtained in the FAAS at 3 (T1), 9 (T2), and 18 months (T3); the ToM score at T4 refers to scores obtained by the child in the false-belief tasks at age 4.5; the ToM total score at T5 refers to the overall ratio of correct answers in the RMET task at age 15. CFI Comparative fit index, SRMR Standardized root mean residual, RMSEA Root mean square error of approximation, CI Confidence interval, FA Family alliance, FAAS Family Alliance Assessment Scales, ToM Theory of mind; RMET Reading the Mind in the Eyes Test). $^{**}p < 0.01$. $^{***}p < 0.001$

below 0.08, although the value of the RMSEA was too high. The results of the parameter estimation showed that the Intercept factor significantly predicted higher RMET positive score ($b = 2.400$, $\beta = 0.547$, $p = 0.015$), whereas the Slope factor was not significantly related to the RMET positive score ($b = 3.713$, $\beta = 0.378$, $p = 0.410$). The ToM total score was significantly correlated to the Intercept factor ($r = 0.375$, $p = 0.016$), but not with the Slope factor ($r = 0.035$, $p = 0.905$) nor with the RMET total score ($r = 0.102$, $p = 0.577$). As the links between the Slope factor and the social cognition variables were not significant, we repeated the procedure conducted with Model 2 and 2b. We specified an alternative model (Model 3b) in which the regression weight linking the Slope factor to the RMET positive score, as well as the covariance between the ToM total score and the RMET positive score, were constrained to 0. The results showed that the adjustment of Model 3b was better than that of Model 3, with all fit indices, including the RMSEA, indicating a good adjustment of the model. A chi-square difference test between Model 3 and 3b resulted in a nonsignificant chi square, which confirmed that Model 3b should be preferred and that the links between the Slope factor on the one hand, and ToM and RMET positive scores were negligible.

### Predicting the RMET neutral score

The estimation of Model 4 yielded mixed results concerning the adjustment of the model. Whereas some indices suggested a good fit of the model, such as a nonsignificant chi square and a CFI above 0.95, values for both the SRMR and RMSEA were slightly too high and suggested a poorer fit. The results of the parameter estimation showed that the Intercept factor significantly predicted the RMET neutral score ($b = 1.201$, $\beta = 0.456$, $p = 0.002$), whereas the Slope factor did not ($b = 0.953$, $\beta = 0.260$, $p = 0.158$). The ToM total score was significantly correlated to the Intercept factor ($r = 0.370$, $p = 0.014$), but not with the Slope factor ($r = 0.024$, $p = 0.891$), while its association with the RMET total score approached significance ($r = 0.284$, $p = 0.079$). Similar to that of Models 2 and 3, the links between the Slope factor and both the ToM total score and the RMET neutral score were weak. The alternative model (Model 4b), in which the paths linking the Slope factor to the ToM total score (covariance) and to the RMET neutral score (regression weight) were constrained to 0, showed a slightly better adjustment to the data than Model 4, which was confirmed by the nonsignificant chi square difference between these two models. However, the global fit of Model 4b still was not satisfying, with both values of RMSEA and SRMR being slightly higher than standard values indicating a good fit.

### Predicting the RMET negative score

The estimation of Model 5 globally suggested that the adjustment of the model was correct: The chi square was not significant, the CFI was above 0.95, and the SRMR was just below 0.08. Similar to that of the other models, the RMSEA indicated a poorer fit of the model. The parameter estimation showed that neither the Slope nor the Intercept factor was significantly associated with the RMET negative score (respectively $b = -0.855$, $\beta = -0.207$, $p = 0.535$, and $b = 0.777$, $\beta = 0.256$, $p = 0.072$), although the latter link approached significance. The ToM total score was significantly correlated to the Intercept factor ($r = 0.377$, $p = 0.015$), but not with the Slope factor ($r = 0.056$, $p = 0.800$) nor with the RMET total score ($r = 0.117$, $p = 0.548$). Similar to the other models, as the links between the Slope factor and the other variables were weak, we specified an alternative model (Model 5b), in which the paths linking the Slope factor to the ToM total score (covariance) and to the RMET neutral score (regression weight) were constrained to 0. This model showed a slightly better fit than that of Model 5. A chi-square difference test confirmed that Model 5b should be preferred and that the influence of the Slope factor could therefore be ignored.

## Discussion

In the present study, we aimed to investigate the links between the development of family relationships in the infancy and toddlerhood and child social cognition in adolescence. Previous findings showed that the quality of early relationships in the postpartum period, measured in terms of FA as the degree of coordination during mother–father–child interactions, predicted the child's ToM abilities at age 4.5 years (Favez et al., 2012). We intended to extend these results by testing the hypothesis according to which a higher quality FA during the postpartum period could predict better performances of 15-year-olds in a computerized task that measured emotion recognition—as an index of social cognition—in adolescents and adults, while controlling for ToM at age 4.5 years. These hypotheses were partially confirmed.

The first main finding of the present study was that the FA predicted the capacity of adolescents to identify and classify emotional states in others. This result suggested in particular that an FA of better quality, characterized by greater coordination, support, and affect sharing, might offer the child a context to develop competences such as greater understanding of others' emotional states, the ability to take the other's perspective, and perhaps greater empathy. Moreover, children with a higher FA were particularly competent in the understanding of positive emotional states, while their greater capacity to identify negative emotions only approached statistical significance. Considering the aforementioned characteristics of high-functioning FAs, it is likely that children in such families will more often experience positive affect sharing, which may explain why FA was particularly linked to the recognition of positive emotions. On the other hand, parents in cooperative FAs might also offer more adjusted response to children's negative emotions and show better capacities to help the child regulate these emotions, which may explain the greater (although not significant at the $\alpha = 0.05$ level) capacity of these children to identify negative emotions. Concerning the identification of neutral emotional expressions, the parameter estimation showed a potential similar positive link with FA. However, the adjustment of the model testing this hypothesis was slightly more dubious than models predicting the identification of positive and negative emotions. Causes of this lower adjustment may by several, including sample size or the fact that neutral emotional expressions seemed to be, on average, more difficult to identify for all the adolescents in the sample than positive and negative expressions. In any case, the positive association between FA and the ability to identify neutral emotional expressions should only be cautiously considered.

The second main finding of this study was that only the baseline FA, that is the stable part of the FA, but not its evolution along the first 18 months, was shown to be linked to social cognition at age 15 years. Although we found a significant increase in FA from 3 to 18 months, this improvement was not linked to later social cognition competences. This result implies that a child who faced early relational difficulties in the family will be more likely to develop lower social cognition skills than will a child who did not face such early difficulties, even though these difficulties were resolved in the next few months.

These findings converged with those of other studies, that have already documented links between early parent–child interactions and children's socio-affective development until adolescence (Feldman, 2007a, 2007b, 2010; Pratt et al., 2017), although most of them were focused on mother–child relationships, ignoring the role of fathers and of family-group processes such as family alliance. Although directions for these links are difficult to determine, many scholars in the field suggest that family interactions might crucially affect the child in various areas of development in the long term. What remains unclear is the timing related to the potential influence of relational factors such as FA. First, it is possible that early family relationships directly affect primary structures or functions that are involved in the early construction of social cognition. Studies that used functional magnetic resonance imaging have shown that many structures and brain regions, including the mirror neuron system (MNS; Mahy et al., 2014), the right and left temporo-parietal junctions, the medial prefrontal cortex, and the posterior cingulate cortex (for a review, see Schurz et al., 2014), are involved in the development of social cognition. Although there is still a debate about when these structures (such as the MNS) start to develop, some authors have argued that they may already be active during infancy and even be present at birth (Lepage & Théoret, 2007). The very early—and widely documented—use of imitation by newborns could be considered evidence of very early onset development of structures—including, possibly, the MNS—and functions that predate later social cognition competences. Our results might suggest that relational factors might possibly affect the development of these structures at an early stage, and that resulting differences between infants might persist into adolescence. An alternative but complementary explanation would be to suggest that family-level relationships are, on average, qualitatively stable, perhaps up to adolescence, and that social cognition in adolescence might be associated with the quality of FA in adolescence. This explanation is supported both by previous results suggesting that the quality of FA is stable from pregnancy to 4.5 years (e.g. Favez et al., 2012), as well as by the present study, which showed that the stability, rather than the change, in FA in the first 18 months were linked to social cognition competences in adolescence. Further studies that would aim at confirming this hypothesis should include an assessment of FA in adolescence, with all the methodological challenges that such assessment would imply.

The results of the present study should be interpreted in light of certain limitations. First, it is likely that the effects of early triadic interactions on the development of social cognition might be driven by third variables that we did not take into account in the present study. For example, it is possible that some innate or early characteristics of children, such as temperament or early cognitive development, will have an influence on both early family interactions and later development of social cognition. The influence of dyadic interactions should be specifically taken into account. Indeed, the design of our study did not allow to conclude whether the observed effects were specifically due to the quality of the mother–father–child triad or to a confounding effect of the dyads (mother–child and father–child) within the triads. Indeed, as previous studies have documented the role of dyadic (mother–child) interactions in the development of social cognition in children, further studies should include assessments of both dyadic (mother–child and father–child) and triadic (mother–father–child) interactions to disentangle the specific influence of each relational "level" on the development of social cognition. Second, on a statistical note, the estimation of some of our models yielded values of RMSEA that were above the critical value of 0.06 generally considered as indicative of correct fit (Hu & Bentler, 1999). However, the use of the RMSEA, particularly in the estimation of models with low degrees of freedom in small samples, has been questioned, with authors suggesting that, in these situations, assessing model adjustment based on the RMSEA might lead to rejection of many correct models. They proposed that the RMSEA should then be used in conjunction with other fit indices and that it should not even be considered when other indices, especially the chi-square statistic, seem to point in the direction of a correct fit of the model (Chen et al., 2008; Kenny et al., 2015).

Third, the size of our sample was small and might limit the generalizability of our findings. Regarding a potential lack of statistical power due to the small sample size, we decided to test simple models, including a few covariates, to avoid being underpowered. It is unclear whether our results would have been different had we included more covariates in our models, such as control variables relating to socioeconomic status and personal characteristics of the subjects. However, the sample size offered enough power to estimate a basic model to test our hypotheses. Moreover, considering the duration of our study and the degree of involvement required, especially in the first waves of data collection, we believe that keeping around 40 families involved over more than 15 years was already considerable. Nevertheless, our findings need to be confirmed in a larger scale study. Fourth, concerning the RMET, in spite of the procedure we set up before the test to avoid any influence of the vocabulary skills of the participants, we cannot be sure that this bias has been completely ruled out. It is indeed possible that not all subjects asked for definitions of terms they did not understand, due to feelings of shame potentially associated with a request for help from the experimenter.

Despite these limitations, our study is one of the first of its kind to show links between the quality of mother–father–infant interactions and social cognition skills measured in the child more than a decade later, when he or she was 15 years old. Adolescents who had experienced more cohesive interactions with their two parents together in the first 18 months of their life were more skilled in identifying emotional states in others, in particular positive emotional states. Not only do we concur with authors who state that babies, from the very beginning, are social beings, but we also argue, on the basis of our findings, that very early social experiences shape some of the child's social, affective, and cognitive abilities that will later be useful for engaging in more effective social relationships with others. These results may have particular implications for professionals who work in close contact with parents and babies, especially in the first months of life. Indeed, encouraging or helping families to engage in more cohesive, supportive, and emotionally positive interactions with their infant right from birth, not only when each parent is alone with the child, but also when they are all together, might have positive effects in the long run. Moreover, our results confirm the need to include fathers in research or clinical work and to include family-level relationships in our models of comprehension of risk and resilience factors that influence infant mental health.

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## Compliance with ethical standards

**Conflict of interest** This study was conducted in accordance with ethical standards for research on human subjects. Participants were volunteer subjects. The parents, as well as the adolescent at T5, signed an informed consent for their participation. They had the possibility to withdraw from the study at any time and to ask for the complete destruction of their data. The procedure and the research protocol described have been reviewed and accepted by the Ethics Committee of XXXXXXX. The authors of the present study reported no conflict of interest.



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