Harsh parenting practices mediate the association between parent affective profiles and child adjustment outcomes: Differential associations for mothers and fathers

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Abstract

The children's early emotional environment strongly influences their later behavioural development. Yet, besides maternal depression, limited knowledge exists about the effect of other emotions and the role of fathers. Using 290 triads (mother/father/child), we investigated how positive (SEEKING, CARING, PLAYFULNESS) and negative (FEAR, ANGER, SADNESS) dimensions of mothers' and fathers' affectivity relate to their offspring's externalizing and internalizing behaviours directly as well as indirectly via parenting practices. Parental variables were measured when children were four years old and children's behaviours were measured at eight years of age. Latent Profile Analysis identified three parental affective profiles: *low negative emotions*, *balanced*, and *high emotional*. Structural equation models showed that, for boys, mothers' *low negative emotions* and *high emotional* profiles predicted later internalizing behaviours (direct effect; β=-0.21 and β=0.23), while fathers' *low negative emotions* profile predicted externalizing behaviours indirectly (β=-0.10). For girls, mothers' profiles (*low negative emotions* and *high emotional*) predicted both internalizing (β=-0.04 and β=0.07) and externalizing (β=-0.05 and β=0.09) behaviours indirectly, but no effects of fathers' profiles were found. Mothers' and fathers' affective profiles contributed to the behavioural development of their offspring in different ways, according to the type of behaviour (internalizing or externalizing) and the child's sex. These findings may help in tailoring existing parenting interventions on affective profiles, thus enhancing their efficacy.

Keywords: Externalizing behaviours; internalizing behaviours; affective profiles; Latent Profile Analysis; parenting.

Introduction

The children's early emotional environment has a strong influence on children's later behavioural development. A number of studies have shown that maternal mood disorders and neuroticism (i.e., a personality trait describing the propensity to experience negative emotions) are risk factors for both internalizing and externalizing problems in children and adolescents (Birmaher et al., 2009; Ellenbogen & Hodgins, 2004; Goodman et al., 2011). These studies documented both direct and indirect effects on offspring behaviour and psychopathology. Parenting practice is among the most investigated mechanism to explain the indirect influence of parental emotionality on offspring behavioural outcomes. For example, parents with depressive symptoms have been found to exhibit more negative parenting (e.g., harsh/coercive) compared to non-depressed parents, which in turn was associated with negative offspring outcomes (Elgar, Mills, McGrath, Waschbusch, & Brownridge, 2007). Similarly, neuroticism was consistently associated with behavioural problems in children via the mediating effect of negative parenting (Prinzie et al., 2004; Prinzie et al., 2005; van Aken et al., 2007).

However, the study of the effect of parent's emotionality on offspring behavioural outcomes has essentially focused on parental psychopathology (e.g., major depression) or personality traits related to negative affectivity (e.g., neuroticism; Elgar et al., 2007; Prinzie et al., 2004; van Aken et al., 2007). Nevertheless, the available evidence on parent's positive emotions suggests their importance in children behavioural regulation. For instance, maternal agreeableness traits moderated associations between child dysregulation and several aspects of adjustment at school in toddlers (Hipson, Gardiner, Coplan, & Ooi, 2017). In the same way maternal joy positively impacts mothers' sensitive parenting (Dix, Gershoff, Meunier, & Miller, 2004). These findings emphasize the need to investigate both positive and negative emotions when studying the role of parents' affectivity on offspring behaviours.

Person-centred statistical techniques (such as Latent Profile Analysis, LPA) offer powerful tools to investigate the association among several emotional dimensions, especially the interplay between positive and negative emotions within the individual. Uncovering distinct patterns of association among the positive and negative emotions of each individual may enable to distinguish homogeneous typologies (i.e., affective profiles) that could each have a distinct effect on his/her offspring's behavioural development.

Additionally, most studies focused on the role of mothers' affectivity and parenting (Parent, Forehand, Pomerantz, Peisch, & Seehuus, 2017), and little is known about the role that fathers play. It is unknown whether mother's and father's emotionality play similar or different roles, especially in a model that considers both parents together. A growing body of research, however, suggested important differences between mothers and fathers (Majdandžić, Möller, de Vente, Bögels, & van den Boom, 2014; Möller, Nikolić, Majdandžić, & Bögels, 2016). For instance, a recent meta-analysis found that the association between parenting and child anxiety was stronger for fathers than for mothers (Möller et al., 2016).

Finally, most studies have examined only one child outcome (i.e., internalizing or externalizing behaviour), overlooking that behavioural dimensions are most often interrelated, especially in childhood (Achenbach, Ivanova, Rescorla, Turner, & Althoff, 2016).

This study aimed to address those gaps in the literature. The objective was to investigate the associations between mothers' and fathers' affective profiles and offspring externalizing and internalizing behaviours, and it these association are mediation by harsh parental practices. Based on the discussed evidence, we hypothesized (1) parental negative and positive emotionality to have opposite effects, and (2) harsh parenting to mediate the association between parents' emotionality and offspring behaviours. We expected this mediation effect to be stronger for fathers than mothers.

Methods

Participants

Participants included families with a child born between June 2003 and April 2004 in Montreal, Canada, enrolled in the EMIGARDE cohort. Parent's affective dimensions and parenting practice were measured when children were four years of age and children's behaviour at eight years of age (hereafter referred to as T1 and T2). At T1, data was available for N=395 triads, i.e. child, father and mother. Parent's affective dimensions were assessed in a subsample of parents, thus the final sample resulted in *n*=290 triads (141 children were boys, 48.6%; **Table 1**).

The study was approved by the Sainte-Justine Hospital research center and McGill Institutional Review Boards. Informed consent was obtained annually from all participants.

Measures

Parents' affective profiles. The Affective Neuroscience Personality Scales (ANPS) (Pahlavan, Mouchiroud, Zenasni, & Panksepp, 2008) was used to assess parental affective personality. The ANPS measures the behavioural correlates of six emotional brain systems (Panksepp, 2005): SEEKING/interest (e.g., being curious, exploring, positively anticipating new experiences), CARING/nurturance (e.g., drawn to children and pets, feeling soft-hearted toward animals and people in need, feeling empathy), PLAYFULNESS/joy (e.g., having fun, playing games with physical contact), FEAR/Anxiety (e.g., feeling tense, worrying, struggling with decisions), ANGER/rage (e.g., feeling hot-headed, easily irritated/frustrated, expressing anger), and SADNESS/panic/separation distress (e.g., feeling lonely, crying frequently, thinking about past relationships). Each subscale consists of 14 items, rated on a four-point scale (0=*totally disagree* to *3=totally agree*; α range=0.77-0.89; Orri et al., 2016; Pingault, Falissard, Côté, & Berthoz, 2012; Pingault, Pouga, Grèzes, & Berthoz, 2012). The averaged ANPS scores between T1 and T2 were used for each parent. Latent Profile Analysis, a specific

case of mixture model, was applied to the six ANPS subscales following previous publications (Orri et al., 2017; see also: Supplementary material **S1**).

Children's behaviour: At T2, mothers assessed internalizing and externalizing behaviours using the Behaviour Questionnaire, developed for the Canadian National Longitudinal Study of Children and Youth, which incorporates items from the Child Behavior Checklist (Achenbach, Edelbrock, & Howell, 1987), the Ontario Child Health Study Scales (Offord, Boyle, & Racine, 1989), and the Preschool Behavior Questionnaire (Behar, 1977). Externalizing behaviours included hyperactivity (six items; e.g., "could not sit still, was restless or hyperactive"; α=0.79) and physical aggression (ten items; e.g., "reacted in an aggressive manner when teased"; α=0.84). Internalizing behaviours included anxiety (five items; e.g., "was too fearful or anxious"; α=0.76) and emotional problems (four items; e.g., "seemed to be unhappy or sad"; α=0.63). Items were rated on a three-point scale (0=*never* to 2=*often*), and each subscale ranged 0-10.

Parenting: At T1, harsh parenting was measured using items from Strayhorn and Weidman's Parent Practices Scale, previously used in the Canadian National Longitudinal Study of Children and Youth. The items measure harsh/coercive behaviours such as giving punishments that depend on the parents' mood, and using physical punishment (e.g., "When he/she broke the rules or did things that he/she was not supposed to, how often did you use physical punishment?"). The items were rated by mothers and fathers (separately) using a four-point scale (i.e., 0=1-2 times/week to 4=several times/day; subscale range: 0-10; α=0.65).

Statistical Analysis

Associations between the estimated latent affective profiles of parents and their offspring's behaviour were studied using multiple-group Structural Equation Modelling (SEM) with Maximum Likelihood estimation. Parents' affective profiles were entered in the model as binary indicator variables (hard coding) to simplify the model. This was justified by the high

entropy of our model (0.87) suggests good classification, thus minor bias when ignoring classification uncertainty. We used children's sex as the grouping variable in order to estimate gender-specific regression paths. Goodness-of-fit was evaluated using the χ^2 test (p>0.05=good fit), the Comparative Fit Index (CFI>0.95=good fit) and the Root Means Square Error Approximation (RMSEA<0.06=good fit). Two latent variables were used to represent externalizing behaviours (hyperactivity and physical aggression subscales) and internalizing behaviours (emotional problems and anxiety subscales).

The statistical significance of the indirect effects (of parents' affective profiles on children's behaviour via harsh parenting) was tested using a 95% bias-corrected and bootstrapped confidence intervals. The proportion of the total effect mediated (P_M; i.e., the proportion of effect of parents' affective profiles on children's behaviour operating through the mediator) was calculated by the ratio of the indirect effect to the total effect, and expressed as a percentage. Analyses were performed using R 3.3 (R Core Team, 2016) and M*plus* 7.4 (Muthén & Muthén, 1998-2015).

Results

Parents' Affective Profiles

Three parental affective profiles were identified using LPA (**Figure 1**; see also Orri et al., 2017 and **S1**): *low negative emotions* (Mothers: *n*=58, 21.9%,; Fathers: *n*=65, 24.5%,), *balanced* (Mothers: *n*=172, 64.9%; Fathers: *n*=165, 62.3%), and *high emotional* (Mothers: *n*=35, 13.2%; Fathers: *n*=35, 13.2%).

Model Fit and Overall Description of the Model

Our model (**Figure 2**) showed an excellent fit to the data: $\chi^2(74)=65.86$, p=0.739; RMSEA=0.000, CI_{90}=0.000-0.036; CFI=1.000 (see also **S1**). Different patterns of associations

were found that are described in the following paragraphs, which depended on the gender of both the parent and the child (**Table 2**).

Associations between Parents' Affective Profiles and Harsh Parenting

Compared to the *balanced* profile (reference group), the *low negative emotions* profiles were associated with low levels of harsh parenting, while the *high emotional* profiles were associated with high levels of harsh parenting. This was found for both boys and girls. The association was statistically significant for mothers in the *high emotional* profile for boys (B=0.84 [0.16;1.52], β=0.20, *p*=0.016) and girls (B=0.90 [0.35;1.50], β=0.27, *p*=0.002), as well as for fathers in the *low negative emotions* for boys, but not for girls (boys, B=-0.66 [-1.13;-0.16], β=-0.24, *p*=0.007; girls, B=-0.10 [-0.59;0.38], β=-0.04, *p*=0.623).

Associations between Harsh Parenting and Children's Behaviour

For boys and girls, harsh parenting was associated with higher externalizing and internalizing behaviours. Concerning fathers' harsh parenting, the association was statistically significant for externalizing behaviours (boys, B=0.62 [0.19;.98], β=0.43, *p*=0.003; girls, B=0.41 [0.12;0.72], β=0.35, *p*=0.007), but not for internalizing behaviours (boys, B=0.16 [-0.25;0.56], β=0.10, *p*=0.460; girls, B=-0.12 [0.19;0.43], β=0.08, *p*=0.462). Mothers' harsh parenting was associated with girls' externalizing (B=0.36 [0.08;0.66], β=0.35, *p*=0.018) and internalizing (B=0.27 [0.02;0.54], β=0.21, *p*=0.043) behaviours, but not with boys' externalizing (B=0.26 [-0.14;0.66], β=0.18, *p*=0.208) or internalizing (B=0.04 [-0.33;0.46], β=0.02, *p*=0.860) behaviours.

Associations between Mothers' Affective Profiles and Children's Behaviour

Mother's *high emotional* profile had a direct (B=1.04 [0.36;1.84], β=0.30, *p*=0.005) and indirect (B=0.32 [0.002;0.73]; β=0.09; P_M=23.5%) effect through harsh parenting on girls' externalizing scores, while mothers' *low negative emotions* profile had an indirect effect

through harsh parenting on girls' externalizing scores (B=-0.15 [-0.59;-0.02]; β=-0.05; P_M=44.0%). No effect of the mothers' profiles on boys' externalizing behaviours was found.

Concerning internalizing behaviour, direct effects of mothers' *low negative emotions* (B=-0.99 [-1.79;-0.24], β=-0.21, *p*=0.012) and *high emotional* profiles (B=1.54 [0.28;2.86], β=0.22, *p*=0.018) were found for boys, while only indirect effects through harsh parenting of mother's *low negative emotions* profile (B=-0.11 [-0.49;-0.02]; β=-0.03; P_M=25.5%) and (as a trend) *high emotional* profile (B=0.24 [-0.03;0.60]; β=0.06; P_M=36.9%) and were found for girls.

Associations between Fathers' Affective Profiles and Children's Behaviour

We found no direct effects of fathers' profiles on their child's (boy or girl) externalizing behaviours. However, a significant negative indirect effect of the fathers' *low negative emotions* profile on externalizing behaviours via harsh parenting was evidenced for boys (B=-0.41 [-1.04;-0.17]; β=-0.10; P_M=67.2%), but not for girls. Regarding internalizing behaviours, no effects (direct or indirect) were found for either boys or girls.

Discussion

This study investigated the direct and indirect (via harsh parenting) associations between parents' emotionality (i.e., ANPS-defined affective profiles) and children's externalizing and internalizing behaviours in middle childhood.

The three empirically derived affective profiles are qualitatively similar for mothers and fathers, and the negative emotions (FEAR, ANGER, and SADNESS) are those that most discriminate between the three profiles. The *low negative emotions* profile (in which positive emotions are frequent) and the *high emotional* profile (in which negative emotions are frequent) have opposite effects. The former is associated with low scores on both internalizing and externalizing behaviours, and the latter with high scores. In the same way, compared to parents

having a *balanced* profile, those having a *low negative emotions* profile used less harsh parenting practices, whereas those having a *high emotional* profile used more harsh parenting practices. These findings are consistent with the literature showing the deleterious effects of mothers' negative affect traits through mental disorders (e.g., depression), or negative-valence personality traits (e.g., neuroticism), on their offspring's outcomes on the one hand (Birmaher et al., 2009; Ellenbogen & Hodgins, 2004; Goodman et al., 2011), and harsh parenting on the other hand (Bornstein, Hahn, & Haynes, 2011; Lovejoy, Graczyk, O'Hare, & Neuman, 2000; Prinzie, Stams, Deković, Reijntjes, & Belsky, 2009). However, it is worth noting that the *high emotional* mothers present high levels of CARING, which describes nurturing individuals who are inclined to take care of children and respond to offspring's emotional needs (Panksepp, 2006). These same characteristics are infrequently associated with harsh parenting practice. We found that the *high emotional* profile was associated with high use of harsh parenting practice and high externalizing/internalizing behaviours, suggesting that the effect of negative emotions reduced the expected positive effect of CARING. In particular, parents having both high levels of CARING and high levels of FEAR and SADNESS might overprotect their child using more harsh/coercive practices. For instance, they might prevent the child from adequately exploring the environment since this requires the parent to tolerate anxiety regarding potential danger (Teetsel, Ginsburg, & Drake, 2014).

Although mothers' and fathers' profiles were qualitatively similar, our findings suggest that they contribute differently to their offspring's behavioural development (internalizing or externalizing behaviours), act through different mechanisms (direct or indirect), and depend on the sex of the child. For boys, the association between mothers' *low negative emotions* and *high emotional* profiles and internalizing behaviours (direct effect) were stronger than for the corresponding fathers' profiles. The indirect effect of fathers' *low negative emotions* profile on externalizing behaviours was stronger than the corresponding indirect effect of the mothers'

profile. For girls, only mothers' profiles (*low negative emotions* and *high emotional*) showed significant associations with internalizing and externalizing behaviours. The effect sizes of these associations were larger than the ones observed for the corresponding fathers' profiles. This findings is in contrast with previous studies that highlighted no differences in the influence of mothers and fathers' neuroticism on externalizing behaviours or child maladjustment (Elgar et al., 2007; Prinzie et al., 2005).

Concerning the nature of the associations, direct effects were found for mothers' profiles only (on internalizing behaviours for boys and externalizing behaviours for girls), but not for fathers' profiles, (only indirect effects were shown on externalizing behaviours for girls). Although the size of the indirect effects of *low negative emotions* profiles were small, these are not negligible. Indeed, since the signs of the terms composing this effect are opposite (*low negative emotions* profiles decrease the use of harsh parenting, while harsh parenting increase the behavioural scores), this suggests that this affective profile may have an important role in reducing the use of harsh parenting, although the negative effect of harsh parenting on children's behaviour remains. Additionally, the proportion of the effect mediated were important (23.5% to 67.2%), which indicated that these are important mechanisms to take into account to understand the pathways through which parents' affectivity influences their child's behaviours.

Unravelling the mechanisms through which parental affectivity influences the children's behavioural development could have important implication for designing effective interventions. For example, most interventions focusing on parenting typically employ a 'one size fits all' approach without accounting for the characteristics of the parents nor the impact of parental sex on child outcomes, both of which may help to improve current intervention efforts. If personality-targeted interventions have revealed their efficacy in contexts such as the reduction of alcohol use among adolescents (Newton et al., 2016), yet, to our knowledge, they

have never been used for parenting interventions. The initial evidence offered by our study may help to pave the way for future work in this area. For instance, the use of genetically-informed designs (e.g., twin or adoption studies) may help to better understand heritable patterns linking parents' emotionality and children's behaviour, and may help to disentangle genetic versus environmental contributions of these associations. Furthermore, as prior studies supported a transactional model of influence between parenting practices and children behaviour in the development of psychopathology (Stone, Mares, Otten, Engels, & Janssens, 2016), a more sophisticated modelling approach that includes transactional effects may provide useful information for the understanding of such complex associations.

Limitations

First, our sample was not randomly selected, and the ANPS was only administered to a subsample of parents. Included parents had higher levels of education compared to the general population, thus the results may not be generalizable. Second, child outcomes relied exclusively on maternal reports, raising the possibility of shared method variance. Third, as our study had only two time-points, alternative models could not be examined.

Conclusions

Mothers' and fathers' affective profiles contribute differently to children's externalizing and internalizing behaviours, with different associations for boys and girls. As hypothesized, harsh parenting emerged as an important mediation mechanism. However, contrary to our hypotheses, direct associations were found for mothers' profiles in the prediction of boys' internalizing and girls' externalizing behaviours, suggesting other mechanisms are involved. This exploratory study needs replication in larger and representative samples.

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Table 1. Demographic and clinical characteristics of our participants

	Sample *n*=290
Family characteristics	
Insufficient income, N(%)*	21 (7.2)
Mother characteristics	
Age at childbirth, years, mean(SD)*	33.6 (4.8)
Smoking during pregnancy, N(%)*	27 (6.9)
Depression during pregnancy (CESD≥16), N(%)*	52 (18.0)
Education, N(%)*	
University degree	147 (51.0)
Post-secondary education	27 (9.3)
High school degree	63 (21.7)
No secondary education	4 (1.4)
Harsh parenting, mean(SD)**	3.3 (1.2)
Father characteristics	
Age at childbirth, years, mean(SD)*	36.4 (5.9)
Education, N(%)*	
University degree	121 (41.7)
Post-secondary education	28 (9.7)
High school degree	70 (24.1)
Partial secondary education	10 (3.4)
Harsh parenting, mean(SD)**	2.6 (1.2)
Child characteristics	
Age, years, mean(SD)**	4.35 (0.27)
Sex (boys), N(%)	141 (48.6)
Peabody Picture Vocabulary Test, mean(SD)**	49.9 (19.2)
Hyperactivity, mean(SD)	3.2 (2.2)
Physical Aggression, mean(SD)	1.4 (1.5)
Anxiety/depression, mean(SD)	2.5 (2.1)
Emotional problems, mean(SD)	2.6 (1.8)

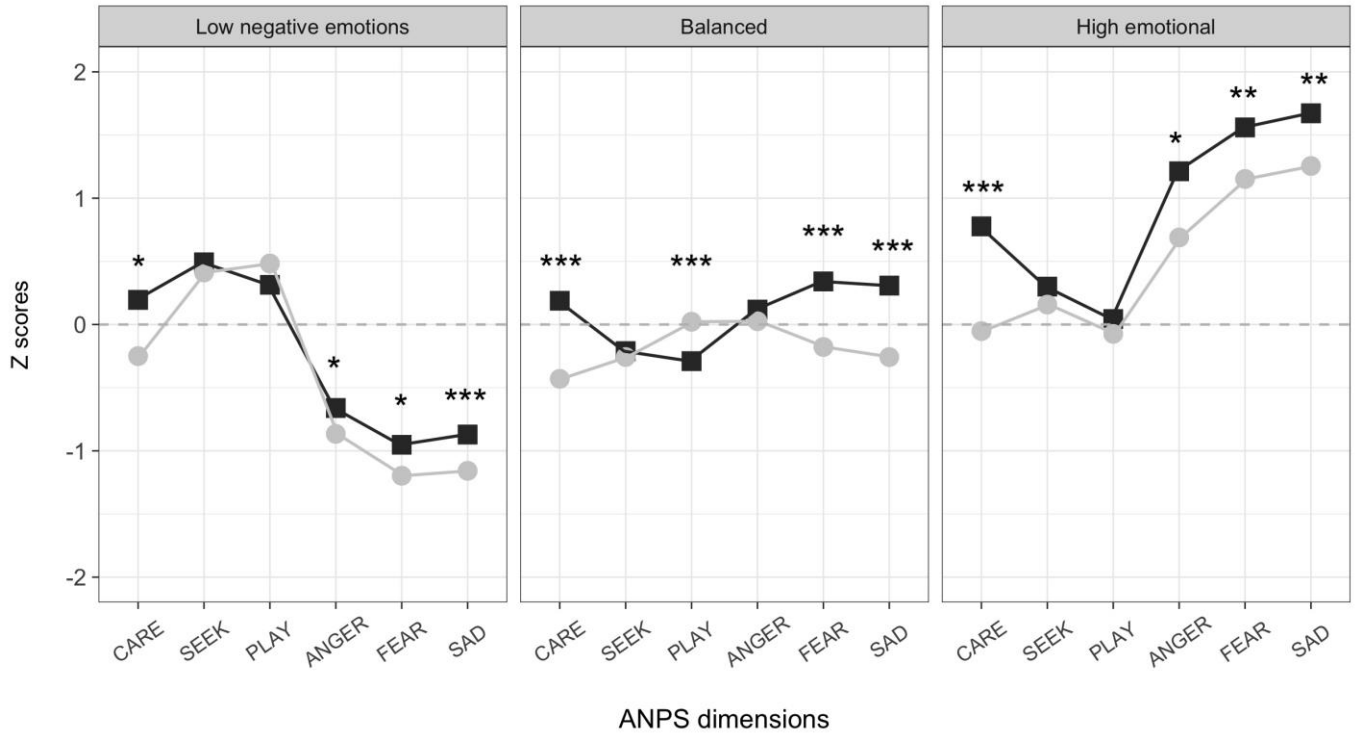
The variables are measured when children are eight years of age unless otherwise specified, namely: *Measured when children are two years of age; **Measured when children are four years of age; #Mean value between the measures when children are four and eight years of age (if only one measure was available, that measure was used). Some percentages are <100% because of missing data. CESD= Centre for Epidemiological Studies Depression scale.

Table 2. Estimated direct and indirect effects in the structural equation model, *n*=290

	Boys (*n*=141, 48.6%)			Girls (*n*=149, 51.4%)		
	B (SE)	95%CI	β	B (SE)	95%CI	β
Externalizing behaviours						
Direct effects:						
Mother Low negative emotions	-0.63 (0.42)	-1.42; 0.22	-0.15	-0.19 (0.30)	-0.77; 0.41	-0.06
Mother High emotional	0.57 (0.69)	-0.71; 2.06	0.09	1.04 (0.38)	0.36; 1.84	0.30
Father Low negative emotions	-0.20 (0.50)	-1.20; 0.77	-0.05	0.08 (0.32)	-0.55; 0.71	0.03
Father High emotional	-0.26 (0.49)	-1.26; 0.68	-0.05	0.39 (0.44)	-0.46; 1.26	0.10
Indirect effects via parenting:						
Mother Low negative emotions	-0.08 (0.09)	-0.50; 0.01	-0.02	-0.15 (0.11)	-0.59; -0.02	-0.05
Mother High emotional	0.22 (0.20)	-0.20; 0.65	0.04	0.32 (0.19)	0.002; 0.73	0.09
Father Low negative emotions	-0.41 (0.18)	-1.04; -0.17	-0.10	-0.041 (0.11)	-0.43; 0.11	-0.01
Father High emotional	0.08 (0.24)	-0.54; 0.52	0.02	0.08 (0.17)	-0.31; 0.42	0.02
Internalizing behaviours						
Direct effects:						
Mother Low negative emotions	-0.97 (0.39)	-1.79; -0.24	-0.21	-0.32 (0.37)	-1.06; 0.36	-0.08
Mother High emotional	1.54 (0.65)	0.28; 2.86	0.22	0.41 (0.41)	-0.42; 1.20	0.10
Father Low negative emotions	-0.43 (0.50)	-1.53; 0.42	-0.10	-0.36 (0.34)	-1.01; 0.34	-0.09
Father High emotional	0.15 (0.59)	-0.89; 1.48	0.03	-0.20 (0.48)	-1.17; 0.73	-0.04
Indirect effects via parenting:						
Mother Low negative emotions	-0.01 (0.07)	-0.34; 0.07	0.00	-0.11 (0.09)	-0.49; -0.02	-0.03
Mother High emotional	0.03 (0.19)	-0.43; 0.40	0.00	0.24 (0.16)	-0.03; 0.60	0.06
Father Low negative emotions	-0.10 (0.15)	-0.62; 0.09	-0.02	-0.01 (0.05)	-0.30; 0.03	0.00
Father High emotional	0.02 (0.10)	-0.18; 0.30	0.00	0.02 (0.08)	-0.13; 0.29	0.01

B=Unstandardized estimate; SE=Standard Error; 95%CI=bias-corrected bootstrap CI; β=standardized estimate

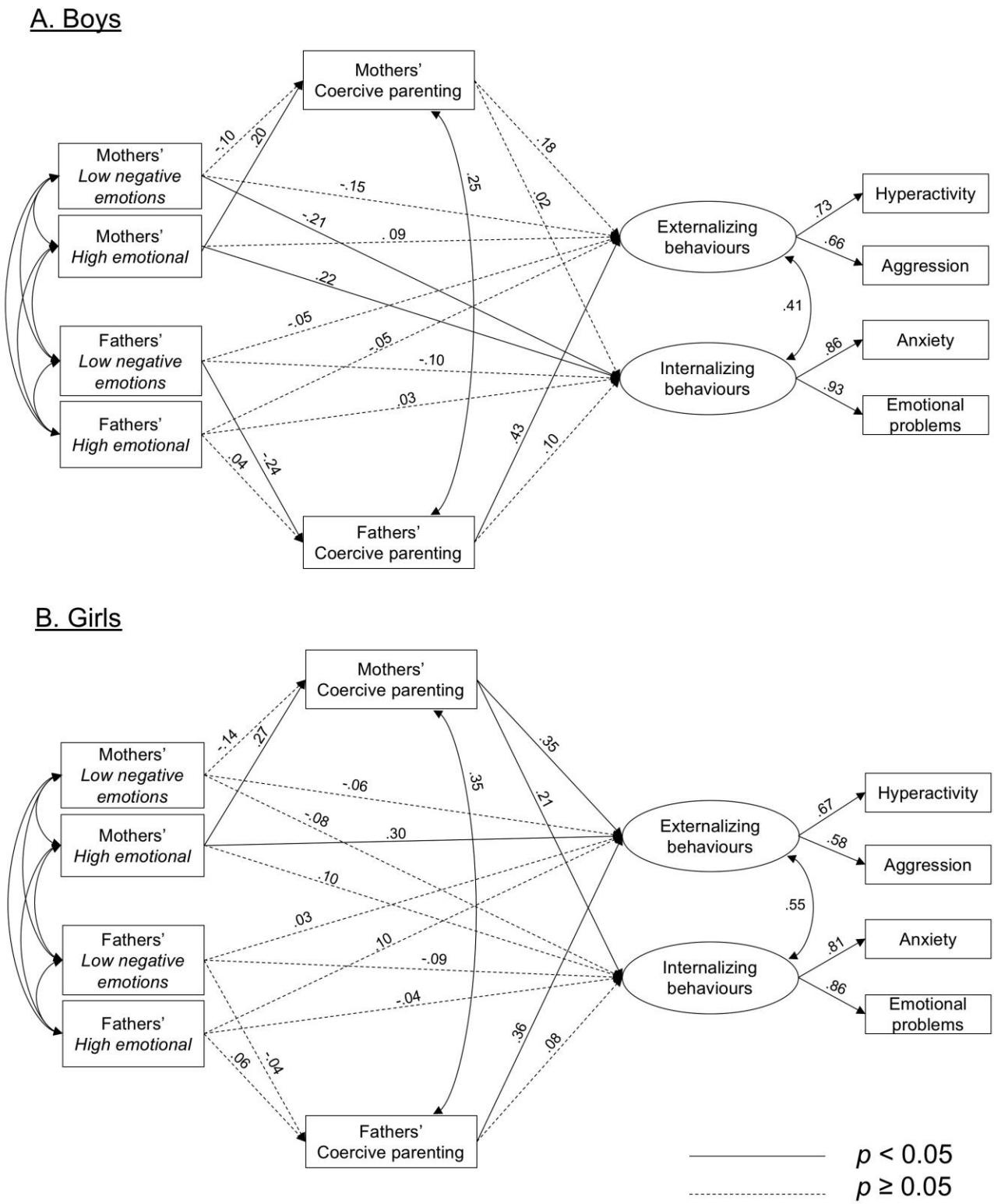
Figure 1. Affective profiles of mothers (black) and fathers (grey), *n*=290



CARE=CARING; SEEK=SEEKING; PLAY=PLAYFULNESS; SAD=SADNESS.

t-tests *p*-values for mothers-fathers differences: *$p<0.05$;**$p<0.01$;***$p<0.001$.

Figure 2. Multiple groups structural equation model, *n*=290



The figure shows the standardized regression coefficients of the model for boys (A) and girls (B).

Supplemental material

Complementary information on the LPA

The LPA model used in the present study builds upon previous investigations summarized here (please refer to Orri et al., 2017 for additional details).

LPA models with 1 to 5 latent classes were thus sequentially fitted separately for each gender group and separately for T1 and T2. The best model was chosen according to the procedure delineated by Nylund (Nylund, Asparouhov, & Muthén, 2007), evaluating several fit indices: i) the Bayesian Information Criterion (BIC; smaller values indicate better model; Schwarz, 1978), ii) the Vuong-Lo-Mendel-Rubin Likelihood Ratio Test (LMR; Lo, Mendell, & Rubin, 2001) which compares the fit of models with N or N-1 classes (a p-value<0.05 suggesting that the additional class improves the fit of the model), and iii) the entropy, indicating the accuracy with which models classify individuals into their most likely class (range 0-1, higher values indicating better classification accuracy). Among those indices, the BIC seems to be the most reliable for continuous latent class models according to simulation studies (Nylund et al., 2007). The interpretability of the classes based on theoretical considerations, the shape of the profiles (i.e. the pattern among the six indicators), and the classes' size (i.e. number of participants within each class), were also taken into account when deciding about the number of latent classes. Indeed, relying exclusively on fit indices can lead to misinterpretation of the empirical results. Results indicated that a 3-class model was the best fitting model for each gender and time point.

We decided to study ANPS profiles in men and women separately because significant gender differences in the ANPS dimensions have been regularly found in the literature (Davis, Panksepp, & Normansell, 2003; Orri et al., 2016; Pahlavan, Mouchiroud, Zenasni, & Panksepp, 2008; Pingault, Pouga, Grèzes, & Berthoz, 2012). To corroborate this choice, we tested measurement invariance across genders using Multiple Groups Latent Profile Analysis and following the three steps delineated by Collins & Lanza (2009). Results indicated lack of measurement invariance, i.e., whether a qualitative similarity exists between mothers and fathers, quantitative differences were found.

Finally, in our study, parent's ANPS scores were obtained by averaging the scores at T1 and T2. This decision was based on several considerations:

1. **Theoretical consideration**. The ANPS was elaborated in order to measure personality traits, by definition stables over time. Numerous clinical, neurobiological, and animal studies support the ANPS theoretical underpinnings (Carré et al., 2015; Davis & Panksepp, 2011; Davis, Panksepp, & Normansell, 2003; Farinelli et al., 2015; J Panksepp & Biven, 2012; Panksepp, 1998, 2003, 2005, 2006; Panksepp & Panksepp, 2013; Pingault, Pouga, Grèzes, & Berthoz, 2012; Reuter, Weber, Fiebach, Elger, & Montag, 2009; Savitz, Van Der Merwe, & Ramesar, 2008b, 2008a; Toronchuk & Ellis, 2013).
2. **Empirical findings supporting the longitudinal invariance and stability of the ANPS.** In order to support the theoretical consideration exposed in the previous point, Orri et al. (Orri et al., 2016) conducted a psychometric study on ANPS data from the cohort EMIGARDE. First, we studied longitudinal measurement invariance using Confirmatory Factor Analysis. Longitudinal measurement invariance assesses whether scales measure the same construct regardless of the measurement occasion. Unless a scale is known to be invariant, we cannot determine if the observed score difference between two waves of measurement is due to a real difference or to changes in the structure of the construct across groups or times of assessment. Our findings indicated that the ANPS have full measurement invariance at both the level of the measurement model and the level of the means and covariance structure. Furthermore, we assessed the 4-year stability of ANPS means using Intraclass Correlation Coefficient. Corroborating the measurement invariance analysis, we found that the Intraclass Correlation Coefficients for all the 6 dimensions were good to excellent (between .67 and .78).

   Both findings support the fact that the ANPS measures personality traits (i.e., stable over time). We reported below the descriptive statistics for the ANPS dimensions at T1 and T2, as well as the mean comparison.

	Mothers			**Fathers**		
	T1	T2	p	T1	T2	p
CARING	28.4 (5.1)	28.8 (5.0)	.425	25.2 (5.6)	25.0 (5.4)	.641
SEEKING	27.8 (5.1)	27.8 (4.7)	.931	27.8 (5.3)	27.6 (4.7)	.625
PLAYFULNESS	26.9 (5.8)	26.1 (5.5)	.154	28.0 (5.9)	27.4 (5.5)	.278
ANGER	16.6 (6.2)	15.9 (6.1)	.210	15.3 (6.1)	15.0 (6.2)	.607

FEAR	21.0 (7.1)	20.5 (7.0)	.449	17.2 (6.6)	16.9 (6.8)	.674
SADNESS	20.1 (5.6)	19.6 (5.5)	.290	16.8 (5.5)	16.9 (5.2)	.858

3. **Empirical findings supporting the stability of ANPS latent profiles.** In a second study the same authors investigated the ANPS personality profiles in two cohorts, including the EMIGARDE cohort (Orri et al., 2017). Using Latent Profile Transition Analysis (a longitudinal extension of LPA, in which transitions between latent classes from T1 to T2 are allowed for each subject of the sample), this study showed that ANPS personality profiles are stable over time. The latent transition probability matrix (which expresses the probability of a change of latent class membership over time conditional on previous class membership) is reported below, and shows that the subjects had almost perfect probability for being classified by the model as members of the same cluster over four years.

			ANPS Profiles at T2		
			Profile 1	*Profile 2*	*Profile 3*
ANPS Profiles at T1	**Mothers**				
		Profile 1	**97.6**	2.4	0
		Profile 2	0	**85.1**	14.9
		Profile 3	1.0	3.5	**95.7**
	Fathers				
		Profile 1	**100.0**	0	0
		Profile 2	0	**100.0**	0
		Profile 3	4.8	0	**95.2**

Note: Each cell in the matrix represents the probability (in %) to be classified in the profile in column j (at T2), conditioned to the probability to have been classified in the profile in the row i (at T1) [P(C_j | C_i)]. The diagonal element of each matrix (bold) represents no transition. The transition probability for women and men are also conditioned on gender [P(Cj | Ci, Gender)].

Final fit indices for the LPA model used in the study are the following:

Model	LL (k)	BIC	Entropy
1 class	-5875.035 (26)	11912.185	-
2 class	-5701.943 (39)	11656.787	0.834
3 class	**-5579.686 (53)**	**11503.058**	**0.865**
4 class	-5531.343 (67)	11497.157	0.854
5 class	-5498.881 (81)	11523.017	0.852

LL=log-likelihood; k=number of parameters; BIC=Bayesian Information Criterion. The selected model is in bold font.

Complementary information on the SEM

Covariates*:* Insufficient family income (according to 2003-2004 Canadian thresholds and published in official reports; Statistics Canada, 2008), parental education, maternal smoking during pregnancy and maternal depression during pregnancy (measured with the Centre for Epidemiological Studies Depression scale, cut-off≥16; Lewinsohn, Seeley, Roberts, & Allen, 1997) were used as covariates, as well as an index of the child's cognitive ability: the Peabody Picture Vocabulary Test administered to the child at three years (Dunn, Thériault-Whalen, & Dunn, 1993). Among those variables, only maternal age was significantly associated with the externalizing score for boys (β=-0.23, p=0.018) and paternal age was significantly associated with fathers' harsh parenting for girls (β=-0.22, p=0.009), so they were both retained. The model explained a significant portion of the variance for the two outcomes, although the R2 for externalizing behaviours (boys: R2=0.37, p=0.001; girls: R2=0.55, p=0.000) was higher than the R2 for internalizing behaviours (boys: R2=0.14, p=0.034; girls: R2=0.13, p=0.038).

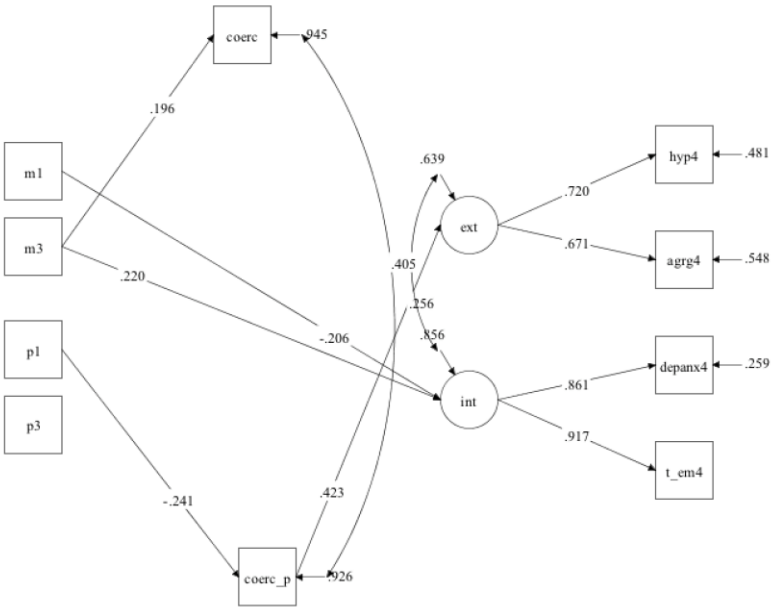
Latent variable identification: To estimate the latent factors, we fixed to one the unstandardized loadings of the hyperactivity (for externalizing behaviours) and anxiety (for internalizing behaviours) indicators.

Model fit without non-significant paths: The model fit indices if all the non-significant effects are fixed to zero are as follows: $\chi 2(80)=62.27$, p=0.929; RMSEA=0.000, CI90=0.000-0.015; CFI=1.000.

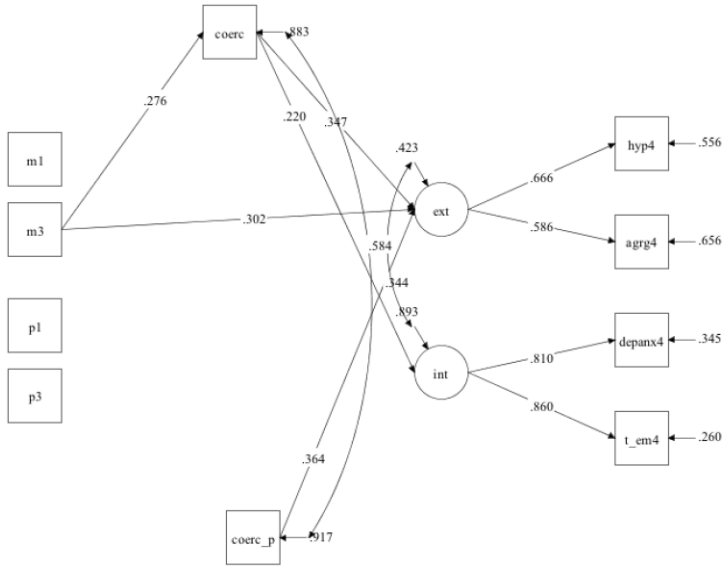
Missing data. Missing data (including these of 25 children missing at follow-up) were handled using Full Information Maximum Likelihood, as standard in SEM. However, in order to provide evidence of robustness of our findings, we re-estimated our model using multiple imputations for the outcome variables.

Results are consistent with those reported in the main analysis, suggesting robustness of our findings (figures below, where only significant paths are displayed for clarity sake):

Boys:



Girls:



Despite FIML and multiple imputations are broadly equivalent in terms of precisions and bias, we based our primary analyses on FIML. Indeed, additional problems emerge using multiple imputation in such a complex modelling. Especially, in Mplus it is not possible to use bootstrap for testing the significance of the indirect effect. This is a major concerns as demonstrated in several papers (Hayes, 2017; MacKinnon, Fairchild, & Fritz, 2007; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Mackinnon, Lockwood, & Williams, 2004).

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