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No differential susceptibility or diathesis stress to parenting in early adolescence: Personality facets predicting behaviour problems



Clara Chavez Arana^{a,*}, Sarah S.W. de Pauw^b, Marinus H. van IJzendoorn^a, Donna A. de Maat^a, Rianne Kok^a, Peter Prinzie^a

^a Department of Psychology, Education & Child Studies, Erasmus School of Social and Behavioral Sciences, Erasmus University of Rotterdam, the Netherlands

^b Department of Special Needs Education, Ghent University, Belgium

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ABSTRACT

This multi-sample study investigated the main and interactive effects of parenting (responsiveness, over-reactivity) and young adolescents' personality traits (negative-affectivity: irritability and anxiety; and orienting-sensitivity) on behaviour problems during adolescence. Data from two samples (N1 = 222; girls 45.5%; Mean age = 11.54 years; N2 = 252; girls 50.4%; Mean age = 10.85 years) were analysed using a multivariate approach. Parenting and young adolescents' personality traits were assessed at Time-1 and behaviour problems were assessed 2 to 3 years later. Mothers rated their overreactive parenting practices with the Parenting-Scale (both samples); parental responsiveness was measured with the Louvain-Adolescent-Perceived-Parenting-Scale (sample-1) and the Parenting-Practices-Questionnaire (sample-2). Adolescents reported on their behaviour problems with the overlapping items of the Brief-Problem-Monitor (sample-1) and the Youth-Self-Report (sample-2). Young adolescents' personality traits were measured with the Hierarchical-Personality-Inventory-for-Children rated by mothers in sample-1 and by fathers in sample-2. No evidence supporting diathesis stress or differential susceptibility was found. Analyses revealed one interaction suggesting that adolescents with high irritability (≥ 1.4 SD; 9%) with more overreactive mothers presented less internalizing behaviour, when their mothers used less overreactive parenting they showed more internalizing behaviour. High-anxiety predicted internalizing behaviour. High-irritability and low-anxiety predicted externalizing behaviour. High-irritability and orienting sensitivity predicted attention problems. No main effects of parenting on behaviour problems were observed.

There is evidence showing that parents can facilitate or hinder the optimal development of adolescents through parenting (Prinzie et al., 2009). Whether, how and how much parenting influences adolescents' development may be related to individual differences in adolescents' personality or temperament. Recently, researchers nominated sensory processing sensitivity (SPS) as a personality trait that may operate as potential susceptibility marker (Greven et al., 2019). To date, most research on SPS focuses on adults and empirical evidence in adolescents is scarce (Crone et al., 2020). Further, preadolescence is considered an inflexion point in development in which parenting practices may influence the development of behaviour problems over time (Fuentes-Balderrama et al., 2020). Because the influence of parenting on adolescents' behaviour may vary from adolescent to adolescent depending on his or her personality traits, this study aims to investigate in two samples main and interactive effects of parenting and personality facets

on different behaviour problems two to three years later.

1.1. Sensory processing sensitivity

A specific personality (or temperament) constellation of traits receiving increasing attention in both popular and developmental literature is SPS. SPS refers to inter-individual differences in sensitivity to both negative and positive environments (Aron & Aron, 1997; Greven et al., 2019). In the popular literature, SPS is referred to as "hypersensitivity" or "highly sensitive" (Botberg & Warreyn, 2016). Although attention to the "highly sensitive individual" is booming in the popular literature empirical evidence supporting SPS is scarce. In their theory, Aron and Aron (1997) described SPS as an innate trait underpinned by a highly sensitive nervous system. Recently, Assary et al. (2020) provided empirical evidence for the genetic basis of SPS. They

* Corresponding author at: Erasmus University Rotterdam, Erasmus School of Social and Behavioural Sciences, Mandeville Building, P.O. Box 1738, 3000 DR Rotterdam, the Netherlands.

E-mail address: chavezarana@essb.eur.nl (C. Chavez Arana).

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reported a heritability estimate of 0.47 but due to restriction of the range of environments this heritability estimate might be inflated. Convergence of such estimates with structural DNA assessments of heritability usually is low. The theory of Aron and Aron (1997) describes that individuals with high SPS are considered to have a lower perceptual threshold and process stimuli cognitively more thoroughly compared to most people (Aron & Aron, 1997). Due to this lower perceptual threshold, highly sensitive individuals are expected to be easily overstimulated when confronted with a novel situation (Aron & Aron, 1997). They may require more time to observe and are less likely to act when confronted with a novel situation, they also seem to be reluctant to risk taking (Aron & Aron, 1997). Investigating preschool children, De Pauw et al. (2009) conducted a principal component analysis using measures of personality and temperament. They found a six factor solution, with five factors similar to the Big Five described in adults and a sixth factor, labeled as sensitivity, similar to the orienting sensitivity trait from Gartstein and Rothbart (2003). This sensitivity factor encompassed perceptual sensitivity, low intensity pleasure, soothability and smiling traits (De Pauw et al., 2009). In a study on SPS in adults, Evans and Rothbart (2008) unravelled two components of SPS: (1) negative affectivity, referring to the tendency to experience unpleasant affects; and (2) orienting sensitivity, the tendency to become easily aware of slight and low-intensity variations in sensory, emotional and cognitive content. Even though the study of SPS is receiving increased attention, its assessment is not fully established, especially not in children and adolescents (Lionetti et al., 2019).

1.1.1. Negative affectivity and orienting sensitivity

Negative affectivity is related to anxiety and irritability facets of personality (De Pauw, 2010). Based on a principal component analysis (PCA) assessing emerging temperament traits, De Pauw (2010) showed that the non-aggressive (e.g., anxiety) and aggressive features (e.g., irritability) of negative affectivity remain constant in early (1.5–3 years), middle (4–7 years), and late childhood (8–15 years). Moreover, the links between these features of negative affectivity and personality become stronger over time (De Pauw, 2010). The SPS theory describes that highly sensitive individuals are not necessarily introverts, they can be bothered by high levels of stimulation and tend to organize their lives in a way that avoids a sensory overload (Aron & Aron, 1997). In contrast, individuals with low levels of orienting sensitivity would look for more social stimulation and adventures (Aron & Aron, 1997). Due to orienting sensitivity, highly sensitive individuals involuntarily direct their attention to external and internal stimuli (Evans & Rothbart, 2008). As a consequence, they process novel events more in-depth (Bridges & Schendan, 2019).

1.2. Personality facets as potential markers for sensory processing sensitivity

Personality traits can serve as psychological endophenotypes connecting a biological propensity to behavioural manifestations (Soto & Tackett, 2015). Personality traits are scored over a continuum from low to high (Aelterman et al., 2011; Kotov et al., 2017). Maladaptive personality traits are considered risk factors for the development of behaviour problems (Aelterman et al., 2011; Kotov et al., 2017). Several studies have shown that the association between child traits and behaviour problems is maintained even after removing overlapping items between questionnaires (e.g., Lengua et al., 1998). Thus, the identification of maladaptive personality traits can enable the distinction between adolescents with high and low propensity to develop behaviour problems (Aelterman et al., 2011). There is growing consensus that children's personality can be classified into facets hierarchically organized into five broad dimensions: extraversion, benevolence, conscientiousness, emotional stability, and imagination (De Pauw, 2017; Mervielde & De Fruyt, 1999). The Hierarchical Personality Inventory

for Children (HiPIC) has been developed to measure personality in children and adolescents (Mervielde & De Fruyt, 1999; Shiner & Caspi, 2003). Of note, the HiPIC was originally not designed to measure SPS. Within the lexical tradition, the HiPIC was created from spontaneous descriptions of parents about their children (Mervielde & De Fruyt, 1999; Shiner & Caspi, 2003), its development was independent from the SPS construct. Recently, Greven et al. (2019) suggested that SPS could be conceptualized as a blend of personality facets across domains. They described a pilot study with adolescents and young adults (16 to 26 years old) in which high levels of neuroticism, agreeableness and openness and low levels of extraversion were associated with SPS. These associations between personality dimensions and SPS were driven by specific personality facets. They argued that to better understand personality facets that characterize high SPS individuals, analyses at the facet level are needed. In line with Greven et al. (2019), other studies show the usefulness of investigating personality facets which by being specific and concrete provide unique age specific information (De Haan et al., 2017; Prinzie et al., 2014). Further, there is empirical evidence that personality facets are noticeably better predictors of a wide range of outcomes than the broad factors (Paunonen & Ashton, 2001, 2013).

There is growing empirical evidence that personality dimensions and facets are potential markers for differential susceptibility to the environment especially in young children (Belsky et al., 2007; Belsky & Pluess, 2016; Slagt et al., 2016). Interactive effects between parenting and child personality have been described with either vulnerability or differential susceptibility models. There is a scarcity of studies investigating differential susceptibility in early adolescence (Crone et al., 2020). Vulnerability models (dual-risk or diathesis-stress models) recognize that some individuals possess predisposing characteristics (e.g., negative affectivity) that make them more vulnerable to risks in the environment (Belsky et al., 2007). The differential susceptibility model is grounded in evolutionary theories which suggest that individuals with higher susceptibility are more prone to be adversely affected by dysfunctional parenting but are also more prone to benefit from adequate/optimal parenting (Belsky et al., 2007). This has been referred to as the 'for-better-and-for-worse effect' (Belsky et al., 2007). Responsive and overreactive parenting are well studied parenting dimensions (Delhaye et al., 2012; Prinzie et al., 2007). Responsiveness (sometimes also interpreted as sensitivity) versus rejection, refers to parents' attentiveness to their children's needs (Delhaye et al., 2012). Over-reactivity (also known as coercive discipline versus support), refers to the tendency to respond to behaviour problems with irritation, anger and impatience (Prinzie et al., 2007).

1.2.1. Sensory processing sensitivity and behaviour problems

If exposed to a negative environment (e.g., overreactive parenting), highly sensitive individuals are more likely to present negative psychological symptoms (e.g., internalizing behaviour) compared to low sensitive individuals (Brindle et al., 2015). SPS traits have a considerable influence on daily functioning and have been associated with behavioural problems (Boterberg & Warreyn, 2016). Preschool children with high SPS tend to present internalizing and externalizing behaviour when their parents are indulgent and do not establish clear rules (Lionetti et al., 2019). High SPS in children and adolescents is associated with more internalizing and less antisocial behaviour (Boterberg & Warreyn, 2016). In contrast, children and adolescents who lie, deceive, argue, fight or bully more regularly show low SPS. Behaviour problems may vary from adolescent to adolescent depending on his or her SPS (Boterberg & Warreyn, 2016).

1.2.2. Parenting by personality interactions over time

The developmental period in which susceptibility traits are assessed is a relevant factor (Rabinowitz & Drabick, 2017). Due to an increased

plasticity and refinement of neural development, infancy and early adolescence are considered potentially sensitive periods for differential susceptibility (Crone et al., 2020). However, it is unknown if individuals with high SPS remain susceptible throughout their lives or if the degree of susceptibility may vary across age (Rabinowitz & Drabick, 2017; Slagt et al., 2016). In a meta-analysis of longitudinal studies reporting parenting-by-temperament interactions, Slagt et al. (2016) reported that negative affectivity functions as a susceptibility marker during infancy but not in late childhood and adolescence. There is some empirical evidence for interactive effects of personality_X_parenting in predicting children's behaviour (De Haan et al., 2009; Prinzie et al., 2003; Van Leeuwen et al., 2004). Using the HiPIC, De Haan et al. (2009) found that less benevolent and more conscientious children tend to present more externalizing behaviours when exposed to overreactive parenting. Similarly, children with low levels of benevolence were found to be more likely to present externalizing behaviour when their parents are not supportive or use coercive parenting (Prinzie et al., 2003; Van Leeuwen et al., 2004). In the HiPIC, benevolence is composed by five facets of which irritability has the highest loading (Mervielde et al., 2005). In several studies in adolescents irritability has been identified as a risk factor in the aetiology and course of psychopathology (Humphreys et al., 2019; Wakschlag et al., 2015). However, evidence from adolescent studies is inconclusive, some studies found evidence supporting the diathesis-stress model (Rabinowitz & Drabick, 2017), whereas other studies supported the differential susceptibility model (Pluess & Boniwell, 2015). Most studies investigating the differential susceptibility and diathesis stress report small effect sizes (Lengua et al., 2000; Slagt et al., 2016). Further, Roisman et al. (2012) noted that false positives are extremely common in tests of differential susceptibility and diathesis stress.

The substantial heterogeneity of previous studies calls for further investigation of the generalizability of the personality_X_parenting interaction findings in adolescence (Slagt et al., 2016). This heterogeneity might relate to a number of methodological and design features, such as: (1) using independent vs non-independent informants for predictor and outcome variables; (2) whether or not correcting for multiple testing; (3) the age range of participants included; (4) using cross-sectional vs longitudinal outcomes. Overall, the quality of psychological research is hampered by fast generalization (Yarkoni, 2019). Fast generalization involves the assumption that the original findings can be directly observed in other similar situations (Yarkoni, 2019). Thus, results from two similar but independently collected samples based on analyses of the same constructs can provide more reliable findings. When an observation from one study is found by another study, it is more likely to represent a reliable finding (Committee on Reproducibility and Replicability in Science et al., 2019). Conducting one multivariate analysis instead of many univariate analyses has several advantages. Parameter estimates are obtained for all effects within a single model leading to superior parameter estimation compared to univariate analyses (Jackson et al., 2011). Further, multigroup multivariate models facilitate a more stringent comparison of results between samples (Jackson et al., 2011). Implementing a more rigorous approach in a study focusing on adolescence, a less frequently studied developmental period, has the potential to inform beyond the current state of the art of personality_X_parenting interactions.

1.3. Aims and hypothesis

The aim of the current study was to investigate the main and interactive effects of parenting (responsive and overreactive discipline) and young adolescents' negative affectivity (irritability and anxiety) and orienting sensitivity in predicting behaviour problems in adolescence. We expected the proxy measure of SPS to be a marker for differential susceptibility. We hypothesized that adolescents with high levels of negative affectivity and orienting sensitivity would exhibit more behaviour problems when exposed to overreactive and low-

responsive parenting; whereas adolescents with low levels of negative affectivity and orienting sensitivity would be less affected. Gender was included as a covariate, because several studies comparing boys and girls demonstrated that girls exhibit higher rates of internalizing behaviour and boys show more externalizing behaviour (Humphreys et al., 2019). This aim was investigated using a proxy measure of SPS and two samples from different longitudinal studies allowing to test the robustness of our findings. The proxy SPS-markers were used to test the differential susceptibility and diathesis stress models.

2. Method

This investigation was based on two studies, the Flemish study on Temperament, Personality and Development (Sample 1; De Pauw et al., 2009), and the Flemish Study on Parenting, Personality and Development (Sample 2; Prinzie et al., 2003) in which we used similar measures that cover early adolescence. Before participating, all participants provided informed consent.

2.1. Sample 1

The ethical board of the Faculty of Psychology and Educational Sciences of Ghent University approved the procedures. Data collected in waves 2016 (T1) and in 2018 (T2) were included in the current study to match the age of the participants in sample 2. A total of 222 participants were included (45.5% girls) with a mean age of 11.5 years at T1 (SD : 0.49; range 10.5–13). Most of the families participating (82.4%) constituted of two parents living together (81.1%) and most parents had a bachelor's degree (mothers 53%, fathers 43%) or master's degree (mothers 27%, fathers 24%). Families were included in the primary analyses only when data for Behaviour Problems were available at T2. Results from independent sample t -tests showed that parenting practices and personality traits were not different between families included ($n = 222$) and families not included in the analyses ($n = 20$; see Appendix Table A1). Little's MCAR test revealed that missing values for parenting and personality facets (18.9%) were missing completely at random ($X^2 = 6.26$, $DF = 9$, $p = .714$). Multiple imputations were conducted using Mersenne Twister as an active generator (Harase, 2014) and setting the default starting point (2,000,000) for initialization. Gender and age were used only as predictors in the imputation model. Predictor variables (parenting and personality facets) were imputed, the outcomes (behaviour problems) were not imputed.

2.2. Sample 2

The board of the Katholieke Universiteit Leuven approved the procedures. Data collected in waves 2009 (T1) and 2012 (T2) were included to match the age of the participants in sample 1. A total of 252 participants were included (50.4% girls) with a mean age of 10.9 years at T1 (SD : 0.57, range 10–12). Most of the families (85.5%) in sample two included two parents living together. Most parents in sample 2 had a master's degree (mothers 23.4%, fathers 31.3%) or bachelor's degree (mothers 38.1%, fathers 23.8%). The procedures applied to sample 1, were also applied to sample 2. Results from independent sample t -tests showed no significant differences between families included ($n = 252$) and families not included in the analyses ($n = 207$; see Appendix Table A1). Results from the Little's MCAR test indicated that missing values for parenting (7.6%) and personality facets (12%) were completely at random ($X^2 = 18.39$, $DF = 17$, $p = .364$). Multiple imputations were conducted for parenting and personality.

2.3. Instruments

To avoid rater bias, instruments were answered by different informants when possible. Overreactive parenting, personality facets, and behaviour problems were measured with the same set of items across

Table 1
Confirmatory factor analyses measure of orienting sensitivity.

	Item	Item reversed	Estimate	S.E.	P-value
1	Talks to people easily ^a	Reverse	0.30	0.06	< 0.001
2	Wants to know the nitty gritty things	Reverse	0.57	0.05	< 0.001
3	Can occupy him/herself for a long time	Reverse	0.33	0.06	< 0.001
4	Has difficulty making contacts		0.28	0.06	< 0.001
5	Tries to establish contacts with new class-fellows ^a	Reverse	0.25	0.05	< 0.001
6	Says little on own initiative		0.33	0.06	< 0.001
7	Withdraws into him/herself ^b		0.24	0.05	< 0.001
8	Examines the way things are made ^a	Reverse	0.67	0.05	< 0.001
9	Is quick to understand things	Reverse	0.63	0.05	< 0.001
10	Needs time to get used to peers		0.16	0.06	0.01
11	Grasps the meaning of things quickly ^a	Reverse	0.64	0.05	< 0.001
12	Notices a lot of things	Reverse	0.57	0.04	< 0.001
13	Needs time to comprehend things		0.63	0.06	< 0.001
14	Takes a wait-and-see attitude to strangers		0.08	0.06	0.17
15	Is interested in anything new	Reverse	0.56	0.05	< 0.001
16	Is quickly distracted		0.49	0.06	< 0.001

^a Items identified as the source of scalar non-invariance.

samples. More information about the instruments and example items from all instruments are available in [Appendix A \(Table A2\)](#).

2.3.1. Parenting

In both samples, mothers reported on their own parenting practices at T1.

2.3.1.1. Responsiveness. In sample 1, responsiveness was measured with the responsiveness subscale of the Louvain Adolescent Perceived Parenting Scale (LAPPS; [Delhay et al., 2012](#)). This questionnaire comprises seven items measured on a five point-Likert scale (Cronbach's alpha 0.76). In sample 2, responsiveness was measured with the Parenting Practices Questionnaire (PPQ; [Robinson et al., 1995](#)) involving 11 items measured on a five point-Likert scale (Cronbach's alpha 0.82).

2.3.1.2. Overreactivity. In both samples, overreactive parenting was assessed with the overreactive subscale of the Parenting Scale (PS; [Arnold et al., 1993](#); [Prinz et al., 2007](#)). This subscale comprises nine items formulated as hypothetical situations measured on a seven point-Likert scale (Cronbach's alpha 0.81 and 0.77, respectively). Overreactive or harsh parenting involves the implementation of punishment, it reflects displays of anger towards the child, such as raising the voice or yelling, hitting, insulting or getting into arguments ([Arnold et al., 1993](#)).

2.3.2. Personality traits

The Hierarchical Personality Inventory for Children (HiPIC; [Mervielde et al., 2005](#)) was used to assess adolescents' irritability, anxiety and orienting sensitivity T1 in both samples. In sample 1, adolescents' personality was reported by mothers and in sample 2, by fathers and by mothers. In sample 2, answers from fathers were used for the primary analyses, and answers from mothers were analysed separately for replication purposes only. Items are rated on a five point-Likert scale ([Mervielde et al., 2005](#)).

2.3.2.1. Negative affectivity. Negative affectivity was measured by the irritability facet (eight items; Cronbach's alpha 0.89 and 0.88, mother ratings sample 2 0.87, respectively) and the anxiety facet (eight items; Cronbach's alpha 0.87 and 0.85, mother ratings sample 2 0.86, respectively). Irritability refers to the tendency to experience anger, frustration and hostility, and to direct this distress towards others ([De Fruyt et al., 2006](#)).

2.3.2.2. Orienting sensitivity. To select items measuring orienting sensitivity, three reviewers (Authors 1, 3, and 5) independently

screened the HiPIC and based upon theoretical considerations. A total of 18 items was selected. From these items, two items belonged to other facets used for analyses (irritability or anxiety) and were not included in the orienting sensitivity measure to avoid overlapping constructs. Orienting sensitivity was composed by a blend of items that belonged to the shyness, curiosity, intellect and expressiveness facets (16 items). To investigate the factor structure of orienting sensitivity, a multigroup confirmatory factor analysis was conducted in Mplus 8.3 with the 16 items. Maximum likelihood with robust standard errors (MLR) estimation was used to account for nonnormality when estimating standard errors. The Comparative Fit Index (CFI; 0.467), Tucker-Lewis Index (TLI; 0.462), root mean square error of approximation (RMSEA; 0.153), standardized root-mean-square residual (SRMSR; 0.166) indicated poor model fit ([Putnick & Bornstein, 2016](#)). Based on modification indices, covariances between items were added to the model until the model fitted to the data. Fit indices of this model CFI (0.940), TLI (0.915), RMSEA (0.061), SRMSR (0.088) indicated an adequate model ([Putnick & Bornstein, 2016](#)). Next, measurement invariance was tested to investigate equivalence of orienting sensitivity across samples ([Putnick & Bornstein, 2016](#)). Five items were identified as the source of scalar non-invariance (see [Table 1](#)). After controlling for these five items, there were no statistically significant differences between the metric and configural (X^2 19.172, DF 15, $p = .206$), scalar and configural (X^2 35.834, $p = .074$), scalar and metric (X^2 17.71, DF 10, $p = .072$) models. Therefore, the pattern and item loadings (configural and metric) were equivalent in both samples, as well as most intercepts (partial scalar). A presentation of the 16 items included and their corresponding loadings can be found in [Table 1](#). Finally, Cronbach's alpha indicated good internal consistency (0.84 and 0.83, respectively).

2.3.3. Behaviour problems

For behaviour problems, adolescents rated the Brief Problem Monitor (ASEBA: BPM; sample 1) and the same set of items from the Youth Self Report (ASEBA: YSR; sample 2) on a three point-Likert scale.

2.3.3.1. Externalizing. These items comprise maladaptive behaviour that involve problems with other people, such as rule-breaking and aggressive behaviour (seven items; Cronbach's alpha 0.67 and 0.64 respectively; [Achenbach & Rescorla, 2001](#)).

2.3.3.2. Internalizing. These items comprise problems within the self, such as depression, anxiety, withdrawn from social contacts and somatic complains without known medical cause (six items; Cronbach's alpha 0.82 and 0.79 respectively; [Achenbach & Rescorla, 2001](#)).

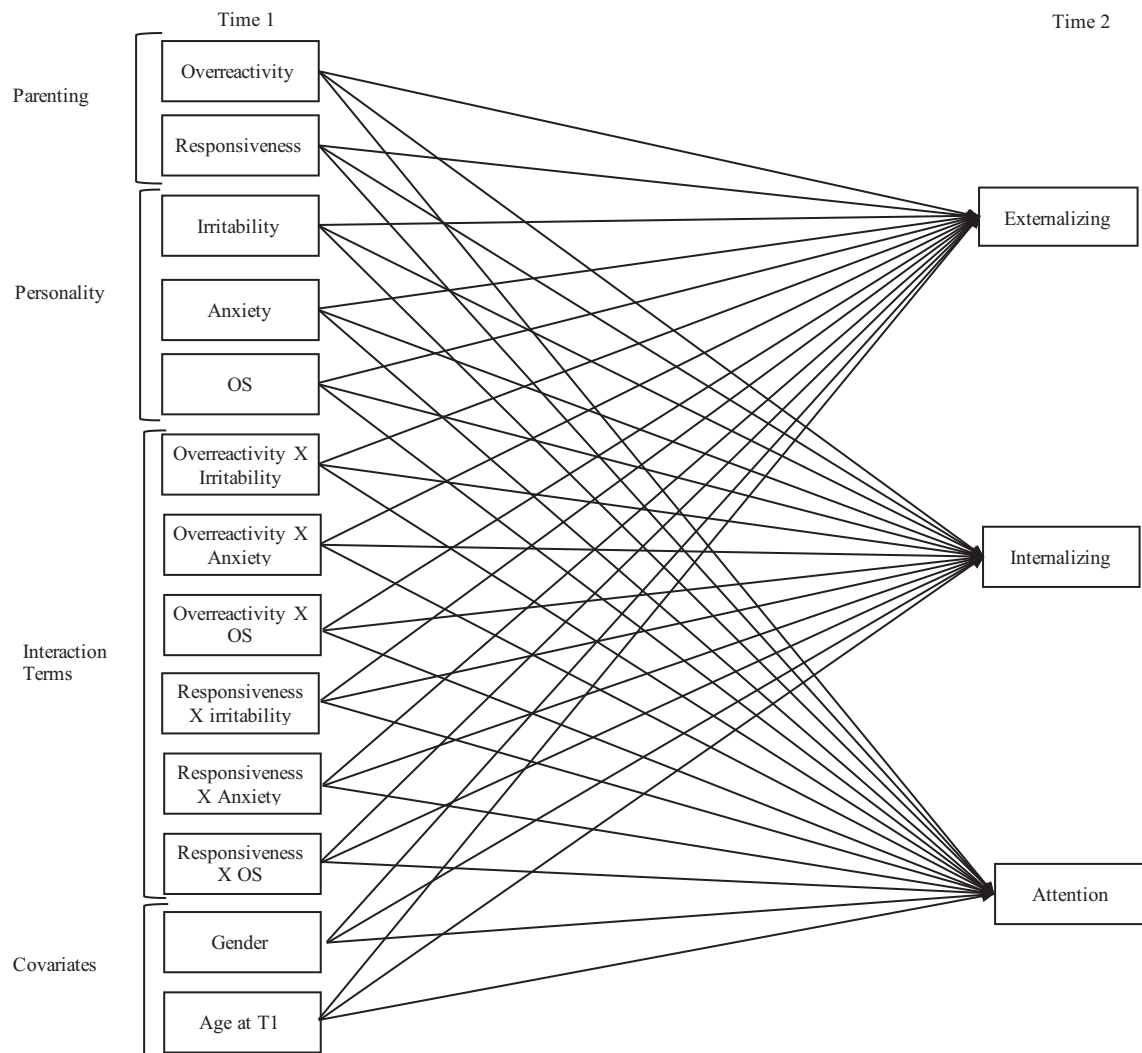


Fig. 1. Model tested.
OS: Orienting Sensitivity.

2.3.3.3. Attention problems. The BPM includes six items related to attention problems. In Sample 1, the reliability improved by deleting one item whereas in sample 2, five of the six items related to attention problems were available. Therefore, five items targeted behaviours related to attention problems (Cronbach's alpha 0.70 and 0.54 respectively; Achenbach & Rescorla, 2001). From the five items used to measure attention problems, four items were the same in both samples and one item was different across samples. These items targeted both, inattentive symptoms (e.g., I have difficulty concentrating or paying attention to something) and hyperactive symptoms (e.g., I find it difficult to sit still).

2.4. Statistical analyses

Pearson's correlation coefficients (r) and differences between participants who completed T2 vs drop-outs were computed in SPSS – 26. The multivariate model presented in Fig. 1 was tested in Mplus 8.3. This model included main and interactive effects of parenting and young adolescents' personality facets predicting behaviour problems in adolescence. Gender and age were included as covariates. MLR estimation was used to account for nonnormality when estimating standard errors. For the ease of interpretation and to reduce multicollinearity variables were converted into z scores before testing the model (Cohen et al., 2003). First, a baseline unconstrained model was established. Second, a

model in which all paths were constrained to be equal across samples was examined. Satorra-Bentler scaled chi-squared was used to compare the baseline model with the constraint model. Goodness-of-fit was assessed with the CFI, RMSEA and SRMSR (Putnick & Bornstein, 2016). Regions of Significance (RoS) were determined (at ± 2 SD) to investigate whether the difference in outcomes between participants was statistically significant rather than only visually detected (Del Giudice, 2017). Next, the effect of parenting on behaviour problems was plotted as a function of the moderator using the Johnson-Neyman technique (Clavel, 2015; Johnson & Neyman, 1936).

3. Results

3.1. Correlations

Correlations between parenting, personality facets and overreactivity are displayed in Table 2. In both samples, irritability was positively correlated with anxiety, overreactivity, externalizing behaviour and attention problems. Anxiety was positively correlated with internalizing behaviour and orienting sensitively was positively correlated with attention problems.

Table 2
List of correlations between parenting, personality facets and behaviour.

		1	2	3	4	5	6	7	8
Sample 1	1	Overreactivity							
	2	Responsiveness	-0.32						
	3	Irritability	0.40	-0.15					
	4	Anxiety	0.13	-0.05	0.45				
	5	Orienting Sensitivity	0.29	-0.34	0.19	0.15			
	6	Externalizing	0.13	-0.13	0.28	0.01	-0.02		
	7	Internalizing	0.11	-0.15	0.13	0.33	0.07	0.24	
	8	Attention	0.17	-0.1	0.21	0.08	0.19	0.38	0.20
	9	Age at time 1	0.12	-0.14	0.03	-0.12	0.07	0.01	0.01
Sample 2	1	Overreactivity							
	2	Responsiveness	-0.30						
	3	Irritability	0.31	-0.03					
	4	Anxiety	0.13	0.05	0.52				
	5	Orienting Sensitivity	0.19	-0.06	0.34	0.28			
	6	Externalizing	-0.15	-0.06	0.27	0.01	0.17		
	7	Internalizing	-0.02	0.05	0.17	0.15	0.17	0.34	
	8	Attention	0.11	-0.03	0.17	-0.03	0.22	0.43	0.28
	9	Age at time 1	0.05	0.06	-0.02	0.02	0.11	0.04	-0.08

Statistical significant correlations < 0.05 in bold.

3.2. Multivariate model with main and interaction effects

First, a multigroup baseline unconstrained model was established. This baseline model was compared to a second model in which all paths were constrained to be equal between sample 1 and sample 2. It was not possible to calculate model fit of the baseline model because it was a saturated model. The constrained model showed an adequate goodness-of-fit (CFI = 0.940, RMSEA = 0.042 [0.008–0.066], SRMSR = 0.041). The Satorra-Bentler scaled chi-squared (55.328, DF = 39, $p = .043$) indicated that the constrained model fitted the data significantly worse compared to the baseline model. Based on modification indices, the equality constraint between responsiveness_X_irritability on attention problems was released. The model fit of this model indicated an adequate model fit (CFI = 0.961, RMSEA = 0.034 [0.000–0.060], SRMSR = 0.038). The Satorra-Bentler scaled chi-squared (48.599, DF = 38, $p = .116$) revealed that the baseline model did not significantly differ from the modified model. Therefore, this model was selected as the final model. In Fig. 2 the statistically significant paths are presented. All main and interactive effects were replicated across samples, with exception of the responsiveness_X_anxiety interaction on attention problems. The effect of responsiveness_X_anxiety on attention problems was in both samples not significant (sample one: $B = 0.11$, $p = .18$; sample two: $B = -0.01$, $p = .15$).

3.2.1. Externalizing problems

Results indicated main effects of irritability and anxiety on externalizing behaviour (Table 3). More irritability was associated with more externalizing behaviour (medium effect sizes), whereas less anxiety was associated with more externalizing behaviour (small effect sizes).

3.2.2. Attention problems

Main effects of irritability and orienting sensitivity on attention problems were revealed. More irritability and orienting sensitivity were associated with more attention problems (small effect sizes).

3.2.3. Internalizing problems

Analyses revealed one main positive effect of anxiety on internalizing behaviour with a small effect size. Gender was a significant covariate with a medium effect size, indicating that girls showed higher levels of internalizing problems than boys (see Table 3). Results showed an interactive effect of overreactivity_X_irritability on internalizing behaviour.

RoS analyses showed that internalizing behaviour and irritability

were correlated at high and low levels of overreactivity bounded by two standard deviations above and below the mean (see Figs. 3 and 4). Adolescents with low levels of irritability (≤ -2.5 ; $B = 0.315$, $p = .048$) whose mothers used more overreactive parenting presented higher levels of internalizing behaviour. In contrast, adolescents with high levels of irritability (≥ 1.4 ; $B = -0.195$, $p = .048$), whose mothers reported higher overreactivity presented less internalizing behaviour. Only 0.4% ($n = 2$) of the participants in both samples presented low levels of irritability (≤ -2.5) whereas 9% ($n = 41$) scored higher than ≥ 1.4 SD on irritability.

4. Discussion

Our aim was to investigate the main and interactive effects of parenting and young adolescents' negative affectivity (irritability and anxiety) and orienting sensitivity in predicting behaviour problems during adolescence and to test replicability across two samples. Analyses revealed only one replicable interactive effect and some main effects. Overreactive parenting did not affect all adolescents to the same degree and into the same direction. Main effects showed that higher levels of irritability and lower levels of anxiety were associated with more externalizing behaviour two or three years later. Higher levels of anxiety were associated with more internalizing behaviour. Higher levels of irritability and orienting sensitivity were associated with more attention problems over time.

4.1. No evidence for differential susceptibility or diathesis stress

Contrary to our hypothesis, results show that personality facets (irritability, anxiety and orienting sensitivity) capturing SPS in young adolescence are not markers for differential susceptibility or diathesis stress. As suggested in the meta-analysis of Slagt et al. (2016) the capacity of markers to capture differential susceptibility may vary along the lifespan. The foundations of social behaviour and emotions are formed in early years of life (Tierney & Nelson, 2009). The accelerated development in infancy may explain why susceptibility to the environment is evident in that developmental window and less so in adolescence despite some fast neurobiological developments in the early stage of that period (Slagt et al., 2016).

Even though irritability is considered one of the purest facets of benevolence (Mervielde et al., 2005), it is still a narrow measure of the benevolence dimension which may have contributed to differences with previous studies. Benevolence also encompasses egocentrism, compliance, dominance, and altruism facets (Mervielde et al., 2005). Thus,

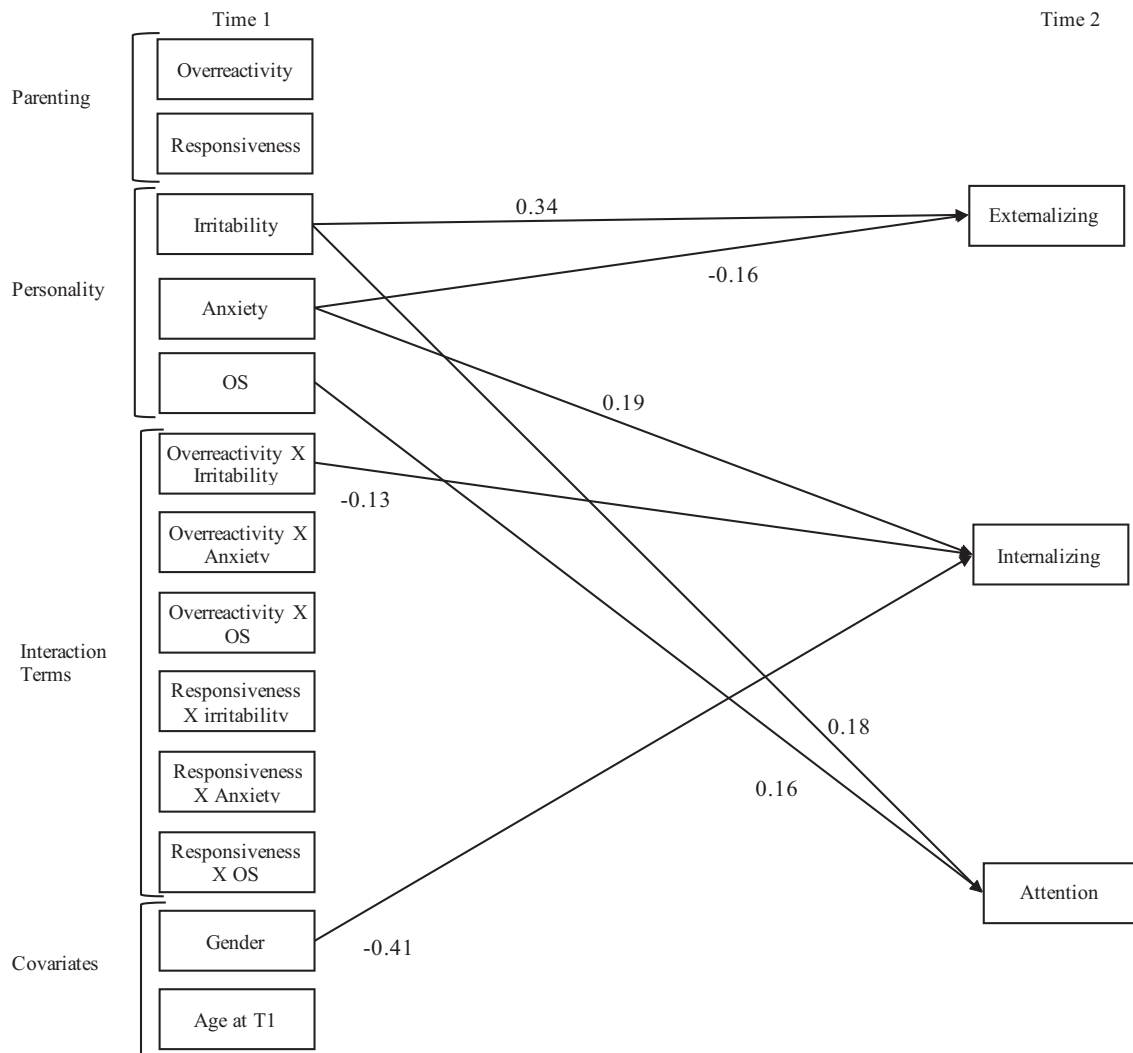


Fig. 2. Statistically significant paths ($p = < 0.05$) and corresponding estimates. OS: Orienting Sensitivity.

benevolence incorporates more traits which together relate to the “difficult temperament” construct of Thomas and Chess (1997). In addition to measuring the irritability, fear and orienting sensitivity facets rather than complete dimensions, the HiPIC was not originally designed to measure SPS and compared to most previous studies, we implemented a more rigorous approach. We used ratings from independent informants, a longitudinal design and a focus on young adolescence (a period that is less studied). Similarly, De Leeuw et al. (2010) investigated the development of smoking behaviour in early adolescence and found no significant personality by parental interactions over time. Rioux et al. (2019) found interactions of adolescent's traits by parenting in cross-sectional analyses. However, when they conducted longitudinal analyses (two years later) previous interactive effects were no longer significant (Rioux et al., 2019).

4.2. Irritability by overreactivity on internalizing behaviour

Analyses revealed only one replicable interactive effect. Overreactive parenting did not affect all adolescents to the same degree and into the same direction. The interactive effect of irritability by overreactivity on internalizing behaviour indicated that adolescents with higher levels of irritability (9% of participants, presumably the more susceptible subjects) with more overreactive mothers presented less internalizing behaviour, and when their mothers used less

overreactive parenting they showed more internalizing behaviour. Given that the current study was conducted in a non-clinical population, parents did not score particularly high on overreactive parenting. The crossover point for participants who benefited from overreactive parenting was less than half standard deviation above the mean (0.46). Thus, the beneficial effect of overreactive parenting became evident when parents implemented some overreactive parenting within the normal range. This dosage of overreactivity may involve moments of firm guidance and behavioural control rather than violence or rejection. Similarly, Bates and Pettit (2015) suggested in a study with irritable children that directive parenting prevents them from developing internalizing behaviour. Moreover, children with a difficult temperament whose mothers implemented behavioural control, are less likely to develop behaviour problems when compared to children with difficult temperament whose mothers implement low parental control (Bates et al., 1998). Further studies are needed, but it is possible that young adolescents with high levels of irritability require moments of firm guidance to prevent the development of internalizing problems over time.

4.3. Main effects of personality facets on adolescent behaviour problems

Anxiety, irritability and orienting sensitivity predicted different behaviour problems. These results are in line with previous studies

Table 3
Main and interaction effects of parenting and personality on behaviour problems.

		B	SE	p	r	Confidence Intervals	
						Lower 2.5%	Upper 2.5%
Externalizing	Overreactivity	04	0.05	0.43		-0.06	0.14
	Responsiveness	-0.07	0.05	0.16		-0.17	0.03
	Irritability	0.34	0.05	< 0.001	0.39	0.23	0.45
	Anxiety	-0.16	0.06	0.01	0.21	-0.27	-0.04
	Orienting Sensitivity	-0.01	0.05	0.86		-0.11	0.09
	Overreactivity X Irritability	0.00	0.06	0.94		-0.13	0.12
	Overreactivity X Anxiety	0.01	0.06	0.86		-0.11	0.14
	Overreactivity X Orienting Sensitivity	0.02	0.06	0.74		-0.09	0.13
	Responsiveness X Irritability	0.00	0.06	0.97		-0.11	0.11
	Responsiveness X Anxiety	-0.02	0.06	0.75		-0.15	0.10
	Responsiveness X Orienting Sensitivity	-0.06	0.05	0.27		-0.16	0.05
	Gender	-0.14	0.09	0.10		-0.32	0.03
	Age at T1	0.02	0.04	0.72		-0.07	0.10
	Internalizing	Overreactivity	-0.01	0.05	0.81		-0.11
Responsiveness		-0.05	0.05	0.31		-0.14	0.05
Irritability		0.06	0.06	0.32		-0.05	0.16
Anxiety		0.19	0.05	< 0.001	0.24	0.09	0.29
Orienting Sensitivity		0.03	0.05	0.60		-0.07	0.12
Overreactivity X Irritability		-0.13	0.06	0.03	0.18	-0.25	-0.01
Overreactivity X Anxiety		0.05	0.05	0.32		-0.05	0.16
Overreactivity X Orienting Sensitivity		-0.01	0.05	0.78		-0.11	0.09
Responsiveness X Irritability		-0.06	0.06	0.32		-0.16	0.05
Responsiveness X Anxiety		-0.05	0.06	0.35		-0.17	0.06
Responsiveness X Orienting Sensitivity		0.05	0.05	0.36		-0.05	0.14
Gender		-0.41	0.09	< 0.001	0.46	-0.58	-0.23
Age at T1		-0.04	0.04	0.33		-0.13	0.04
Attention		Overreactivity	0.04	0.05	0.39		-0.05
	Responsiveness	0.00	0.05	0.97		-0.10	0.10
	Irritability	0.16	0.05	< 0.001	0.21	0.06	0.27
	Anxiety	-0.10	0.05	0.06		-0.20	0.00
	Orienting Sensitivity	0.16	0.05	< 0.001	0.21	0.07	0.25
	Overreactivity X Irritability	-0.04	0.06	0.52		-0.14	0.07
	Overreactivity X Anxiety	-0.05	0.06	0.41		-0.16	0.07
	Overreactivity X Orienting Sensitivity	-0.05	0.04	0.23		-0.14	0.03
	Responsiveness X Irritability	0.06	0.06	0.26		-0.05	0.17
	Responsiveness X Anxiety ^a	0.11/-0.10	0.08/0.07	0.18/0.15		-0.05/-0.22	0.27/0.03
	Responsiveness X Orienting Sensitivity	-0.03	0.05	0.59		-0.13	0.07
	Gender	-0.01	0.09	0.90		-0.19	0.16
	Age at T1	0.02	0.04	0.60		-0.06	0.11

Statistical significant main and interactive effects are in bold. Interpretation effect sizes $r = 0.1-0.3$ small, $0.3-0.5$ medium.

^a Results not replicated across samples, results are presented for sample 1/sample 2.

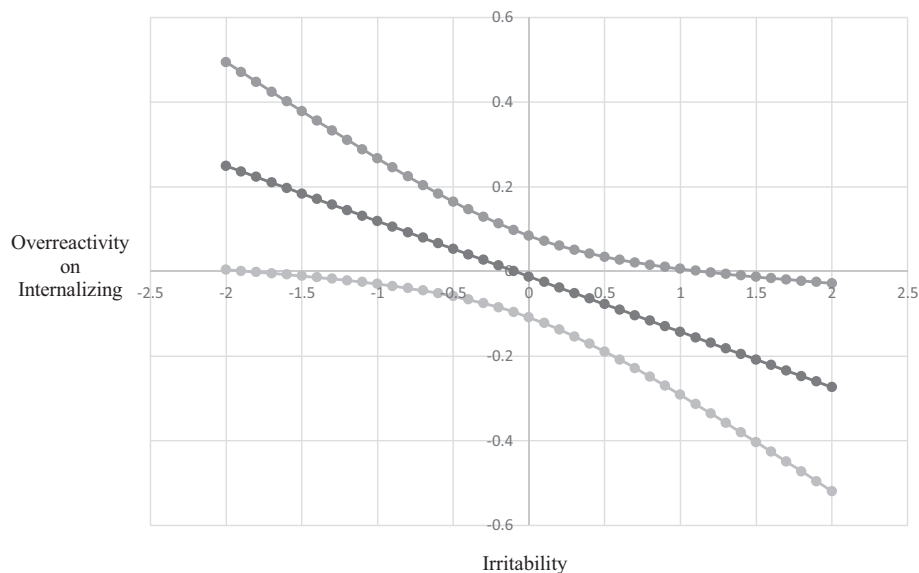


Fig. 3. The association between overreactivity and internalizing behaviour at all levels of irritability.

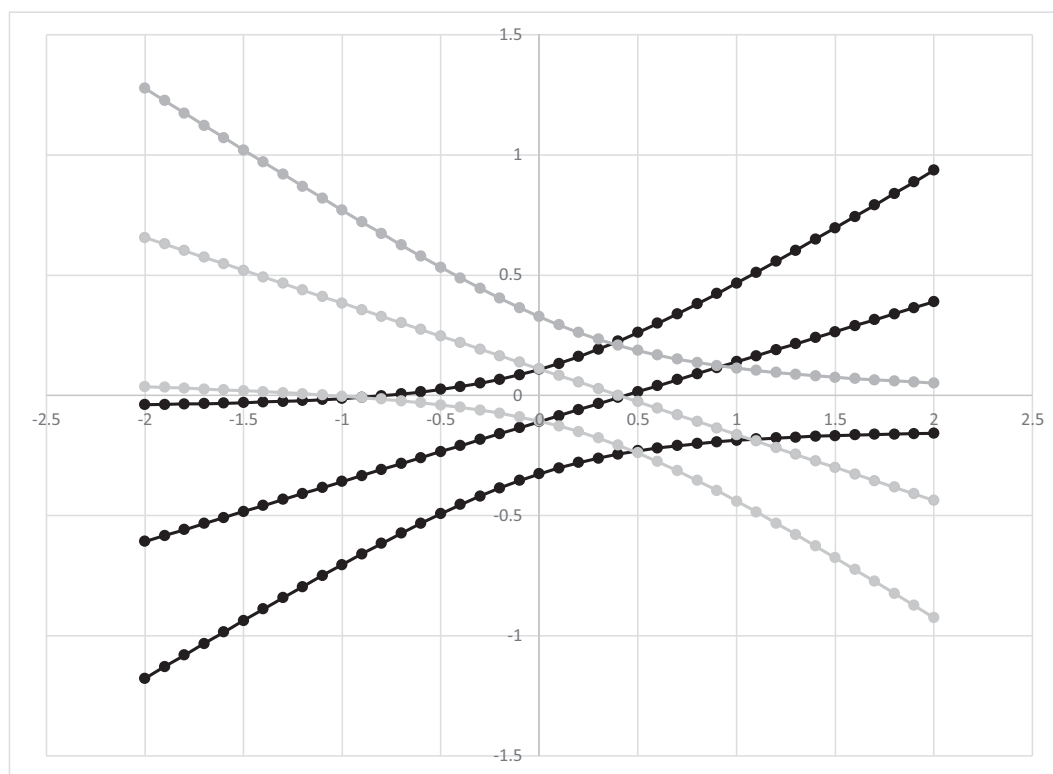


Fig. 4. The association between overreactivity and internalizing behaviour at high (< 2 SD) and low levels of irritability (> 2 SD). Adolescents low irritability (in black) whose parents implement overreactive parenting present the more internalizing behaviour. Adolescents high irritability (in grey) whose parents implement overreactive parenting present the opposite pattern.

showing that personality characteristics are a developmental precursor of behaviour problems (Nigg, 2006; Prinzie et al., 2004; Rettew & McKee, 2005; Van Leeuwen et al., 2004). Anxiety in young adolescents predicted internalizing behaviour 2–3 years later. Internalizing symptoms or symptoms of overcontrol are associated with adolescents' extreme behavioural inhibition and anxiety-trait (Ormel et al., 2005). High SPS was associated with internalizing problems in a cross-sectional study including children and adolescents (Boterberg & Warreyn, 2016). In the current longitudinal study, main effects of the proxy measure of SPS on internalizing behaviour were only seen for anxiety. Boterberg and Warreyn (2016) used the Highly Sensitive Person Scale designed by Aron (2002) to measure SPS whereas we used a proxy measure of SPS, not previously investigated.

Low levels of anxiety were associated with more externalizing behaviour. Adolescents scoring high on anxiety trait present a heightened sensitivity to punishment (Dadds & Salmon, 2003; Lengua, 2006). In contrast, adolescents with externalizing behaviour tend to present low punishment sensitivity, poor empathy and guilt together with risky and fearless behaviour (Dadds & Salmon, 2003; Frick & Morris, 2004). Irritability appears to be a personality trait predisposing the individual to externalizing behaviour. Externalizing symptoms (also known as symptoms of undercontrol) are associated with adolescents' difficulty in inhibiting prohibited behaviour, control impulses and low effortful control (Ormel et al., 2005). They may have more difficulties in self-regulation and as a consequence, exhibit higher levels of externalizing behaviour (Prinzie et al., 2004). Higher levels of irritability have been associated with several psychiatric disorders over time (Vogel et al., 2019).

Attention problems reported in adolescence were predicted by irritability and orienting sensitivity. There is evidence suggesting that ADHD combined (C) (i.e. presence of both inattention and hyperactivity/impulsivity) and ADHD predominantly inattentive (I) are distinct disorders and not variants of one disorder (Milich et al., 2006). A

recent multi-sample study identified irritability traits as a clinical marker of individuals with ADHD-C symptoms (Riglin et al., 2017). The measure of orienting sensitivity reflects withdrawn behaviour similar to what is reported in ADHD-I. Children with ADHD-I, also known as slow cognitive tempo, tend to daydream, stare, be easily confused, show more passive behaviour and are less likely to present behaviour problems (Milich et al., 2006). Future research should investigate whether orienting sensitivity is a potential marker for inattentive symptoms.

4.4. Main effects of parenting

No main effects of parenting on behaviour problems were observed. In line with our results, a longitudinal study of Prinzie et al. (2014) did not find main effects of overreactive parenting on adolescent's levels of internalizing behaviour. A possible explanation is that the effects of parenting practices exerted during preadolescence are less evident later in adolescence. In adolescence, peers have more influence than parents (Crone et al., 2020). Adolescents are increasingly interested in social relationships with peers and spend on average twice as much time with peers than with their families (Braga et al., 2012). They also establish new ways of interacting with parents (Braga et al., 2012) which may explain why no main effects were observed. An example of the major influence that peers have on adolescents' behaviour compared to parents, is reported in the investigation by De Leeuw et al. (2010). They documented that peers and siblings' smoking behaviour predicted the development of adolescents smoking behaviour, whereas parents' smoking behaviour did not (De Leeuw et al., 2010).

4.5. Limitations and future directions

This study has some limitations that should be considered when interpreting the results. Firstly, the questionnaires used to assess responsiveness were not the same across samples, although both

questionnaires measure the same parenting dimension (Delhaye et al., 2012; Robinson et al., 1995). Secondly, the outcomes studied are maladaptive outcomes, and adaptive outcomes are also relevant for investigating differential susceptibility. However, identical positive outcomes were not available in both samples. Thirdly, we adopted a variable centred approach that does not take into account combinations of personality facets within the individual. Another limitation is that the reliability of externalizing behaviour and attention problems (sample 2) was poor, and in moderation analyses the reliability of the product term is less or equal to the least reliable predictor (Aiken & West, 1991). Lastly, matching measures, informants and timepoints in both datasets was a challenge. Increasing collaboration between research groups at the conception of the research and the choice of the questionnaires is essential to facilitate replication. Future studies including positive outcomes can provide a further understanding of personality facets as potential SPS markers.

5. Conclusions

In a rigorous approach and using a proxy measure of SPS, personality facets do not operate as markers for differential susceptibility or diathesis stress. Overreactive parenting did not affect all adolescents to the same degree into the same direction. Anxiety, irritability and orienting sensitivity in early adolescence were identified as risk factors for

the development of different behaviour problems in adolescence. Considering adolescents' personality, parenting was not associated with externalizing behaviour or attention problems.

CRediT authorship contribution statement

Clara Chavez Arana: Conceptualization, Methodology, Software, Formal analysis, Writing - original draft, Project administration, Funding acquisition. **Sarah S.W. de Pauw:** Conceptualization, Methodology, Resources, Investigation, Data curation, Writing - original draft. **Marinus H. van IJzendoorn:** Conceptualization, Methodology, Writing - original draft. **Donna A. de Maat:** Investigation, Data curation, Writing - review & editing. **Rianne Kok:** Conceptualization, Funding acquisition, Writing - review & editing. **Peter Prinzie:** Conceptualization, Methodology, Software, Validation, Resources, Writing - original draft, Project administration, Funding acquisition.

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Appendix A

Table A1
Comparisons between participants included and not included.

Sample 1	Included n = 220		Not included n = 20		p	Effect size d
	Mean	SD	Mean	SD		
Responsiveness	0.01	1.00	-0.18	0.88	0.37	0.20
Overreactivity	0.01	1.02	-0.05	1.07	0.82	0.06
Irritability	0.01	1.00	0.05	1.26	0.82	0.04
Anxiety	-0.01	1.01	0.05	1.04	0.79	0.06
Orienting Sensitivity	-0.01	1.01	0.30	1.15	0.26	0.29

Sample 2	Included n = 252		Not included n = 207		p	Effect size d
	Mean	SD	Mean	SD		
Responsiveness	-0.04	0.97	-0.15	0.95	0.23	0.11
Overreactivity	0.11	1.02	-0.06	1.00	0.07	0.17
Irritability	2.52	0.69	2.73	0.74	0.11	0.30
Anxiety	2.51	0.69	2.55	0.68	0.71	0.07
Orienting Sensitivity	2.28	0.50	2.30	0.51	0.80	0.05

Table A2
Summary of instruments.

	Sample 1			Sample 2			Sample item
	Instrument (n items)	Reliability (standardized)	Informant	Instrument (n items)	Reliability (standardized)	Informant	
Responsiveness	LAPPS (7)	0.757 (0.755)	Mother	PPQ (11)	0.824 (0.829)	=	LAPPS: I give my son/daughter a lot of care and attention PPQ: I encourage my child to talk about his or her problems
Overreactivity	Parenting scale (9)	0.805 (0.806)	Mother	=	0.771 (0.778)	=	When my child misbehaves... I speak to my child calmly - I raise my voice or yell.
Irritability	HiPIC (8)	0.893(0.893)	Mother	=	0.883 (0.881)	Father	Is quick to get angry
Anxiety	HiPIC (8)	0.871 (0.872)	Mother	=	0.853 (0.854)	Father	Is readily scared
Creativity	HiPIC (8)	0.917 (0.922)	Mother	=	0.833 (0.843)	Father	Has a rich imagination
OS	HiPIC (16)	0.852 (0.856)	Mother	=	0.819 (0.824)	Father	Has difficulty making contacts

(continued on next page)

Table A2 (continued)

	Sample 1			Sample 2			Sample item
	Instrument (n items)	Reliability (standardized)	Informant	Instrument (n items)	Reliability (standardized)	Informant	
Externalizing	BPM (7)	0.673 (0.686)	Adolescent	CBCL (7)	0.640 (0.631)	=	I argue a lot
Internalizing	BPM (6)	0.819 (0.824)	Adolescent	CBCL (6)	0.793 (0.796)	=	I feel worthless or inferior
Attention Prob	BPM (5)	0.696 (0.685)	Adolescent	CBCL (5)	0.536 (0.508)	=	I am inattentive or easily distracted

= the same instrument as in Sample 1; CBCL: Child behaviour checklist; HiPIC: The Hierarchical Personality Inventory for Children; LAPPS: Louvain Adolescent Perceived Parenting Scale; PPQ: Parenting Practices Scale; Prob: Problems; OS: Orienting Sensitivity.

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