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The roles of parent temperament and parenting styles in adolescent temperament development

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Abstract

This study examined temperament development from early to middle adolescence and the roles of parenting styles and parent temperament in this development. The sample consisted of 842 adolescents ($n = 842$ in Grade 6; 54% girls) and their parents ($N = 707$). Adolescents assessed their temperament in Grades 6 and 9 and parents assessed their temperament and parenting styles when adolescents were in Grade 6. The results showed that adolescent affiliativeness increased and effortful control decreased from early to middle adolescence. High parental warmth was related to higher adolescent affiliativeness and higher effortful control, but also to a decrease in adolescent negative affectivity. High parental behavioral control, in turn, was related to adolescents' initially higher, but subsequently decreasing surgency. Further, high parental psychological control was related to lower adolescent effortful control. Parent temperament was also related to adolescent temperament, and parenting styles partially mediated several associations between parents' and adolescents' temperament. The results suggest that parents' temperament and parenting styles are related to adolescents' temperament development in a complex manner, even as adolescents seek to gain independence from parents. Understanding the roles of parental temperament and parenting in adolescent temperament development is important in order to support adolescents in their development towards a stable adulthood.

Keywords Adolescence · Temperament development · Parenting style · Parent temperament

Introduction

From early adolescence to middle adolescence, individuals go through various changes, such as physical maturation, educational transitions, and changes in social relationships (Denham, et al., 2009; Eccles, 2004). Temperament may partly affect how adolescents adjust and react to these life events and changes (Sanson et al., 2004). In addition to maturation, the manifestation of adolescent temperament is affected by socialization, including parental activities and characteristics (Bates et al., 2012; Rothbart & Bates, 2006). Temperament is partly genetically transmitted from the parent to their offsprings (Keller et al., 2005; Posner et al., 2007), but temperamental similarities between adolescents and parents can also be driven by a shared family environment (Fisak & Grills-Taquechel, 2007; Johnson et al., 2005).

Previous studies regarding the associations between offspring temperament and parenting have mainly focused on childhood or have used cross-sectional designs. Only a few longitudinal studies (as an exception, see Tiberio et al., 2016) have been conducted during adolescence, when parents continue to play an important role in their offspring's lives. Importantly, the interaction between parent and adolescent often changes in adolescence (Darling & Steinberg, 1993), which can be reflected in parenting styles and family dynamics. Developing adolescents' strive for autonomy and individuation often results to increased conflicts with parents that permit adolescents to shape more egalitarian and mature relationships with their parents (Branje, 2018). Increased knowledge of the links between adolescent temperament

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and parental activities and characteristics is of importance, as it can increase the understanding about the mechanisms of adolescents' adaptive development and help to support adolescents in their development towards balanced adulthood. Consequently, this study examined adolescents' temperament development from early to middle adolescence (stages of adolescence that are shown to comprise important window of sensitivity in terms of brain development and environmental factors; Galvan, 2013; Hare et al., 2008; Nook et al., 2018) and the roles of parenting styles and parent temperament in this development.

Development of temperament during adolescence

In the present study, we apply the developmental model of temperament by Mary Rothbart and Douglas Derryberry, (1981; see also Putnam et al., 2001; Rothbart, 2011). In this model temperament is defined as constitutionally rooted individual differences (a) in the reactivity to internal and environmental stimuli and (b) self-regulation processes modulating this reactivity. This model proposes the following broad temperament dimensions: surgency/extraversion, negative affectivity, effortful control, and affiliativeness for adolescents and orienting sensitivity for adults (Evans & Rothbart, 2007; Rothbart et al., 2001; see also Lahdelma et al., 2021).

Surgency/extraversion refers to temperamental characteristics related to positive emotions, approach behavior, and sensation seeking (Rothbart, 2011; Rothbart et al., 2004). Negative affectivity involves individual differences in the onset, intensity, and duration of negative emotions (Rothbart, 2011; Rothbart & Bates, 2006). Effortful control, in turn, refers to individual variability in the efficiency of executive attention: high effortful control enables directing and maintaining attention and to regulating and controlling one's affective and behavioral responses (Rothbart, 2011; Rothbart et al., 2004). Affiliativeness involves the desire for closeness with others independent of extraversion (Oldehinkel et al., 2004; Putnam et al., 2001) and is particularly important during adolescence (Ellis, 2002; Kiuru et al., 2019; Putnam et al., 2001). Orienting sensitivity refers to individual differences in internal and external automatic attentional processing (Evans & Rothbart, 2007). These dimensions have been found to link with Big Five personality traits (e.g. negative affectivity correlating with neuroticism) (Evans & Rothbart, 2007; Rothbart, 2007; see also Kiuru et al., 2019; Shiner & DeYoung, 2013).

Temperament is characterized by both stability and change (Putnam et al., 2001). Although it refers to relatively stable individual differences in reactivity and self-regulation (Rothbart & Bates, 2006), its manifestation is influenced by maturation and socialization, including quality of parent–child interaction and parent characteristics (see Bates et al., 2012; Ellis, 2002). In early adolescence puberty heightens emotional reactivity, sensation-seeking, and reward orientation, while middle adolescence is characterized by vulnerability to risk-taking, peer pressures, and challenges in self-regulation (Steinberg, 2005). This development occurs before the maturation of frontal lobes is complete and can also be seen as increases in emotionally reactive (i.e., negative affectivity) and decreases in regulative (i.e., effortful control) aspects of temperament from early to middle adolescence. In turn, maturation of frontal lobes toward late adolescence can be seen as facilitating self-regulatory competences (Steinberg, 2005).

In this study we examine temperament development from early to middle adolescents by considering both mean-level continuity/discontinuity and individual-order stability/instability (Bornstein et al., 2017; Caspi and Roberts, 2001). In terms of mean-level development (Damian et al., 2019), temperament is expected to change in accordance with the *maturity principle*, that is, increase or decrease in the socially desired direction during the adolescent years (Roberts et al., 2006). However, as outlined by the so called *disruption hypothesis*, it has also been proposed that temperament development from early to middle adolescence might reflect temporary dips, that is, declines in some aspects traits as reflection of disruption in personality maturity influenced by biological, social and psychological changes (Denissen et al., 2013; Luan et al., 2017; Soto & Tackett, 2015; Soto et al., 2011).

Previous results regarding mean-level temperament development during adolescence have been partly inconsistent: stability, maturity and temporary dips have been reported depending on the study (Slobodskaya, 2021). Previous studies nevertheless suggest that adolescents' traits may change on a mean level over time. Previous results are the most consistent for effortful control. Many studies have shown that conscientiousness or effortful control tend to decrease from early to middle adolescence (Allik et al., 2004; Laceulle et al., 2012; Van den Akker et al., 2014) and then again increase from late adolescence towards early adulthood (Denissen et al., 2013; Soto et al., 2011). Many studies have also shown that neuroticism or lack of emotional stability, which are related to temperamental negative affectivity, tend to increase from early to middle adolescence (especially for girls; McCrae et al., 2002; Soto et al., 2011; Soto & Tackett, 2015; Van den Akker et al., 2014). However, not all studies have found an increase in negative affectivity (Branje et al., 2007; Klimstra et al., 2009; Laceulle et al., 2012; Luan et al., 2017). Similarly, surgency/extraversion has been reported to either decrease (Borghuis

et al., 2017; Göllner et al., 2017; Soto et al., 2011; Van den Akker et al., 2014), increase (Klimstra et al., 2009; Laceulle et al., 2012; Roberts et al., 2006), or remain stable (Luan et al., 2017; McCrae et al., 2002) during adolescence. Also, only little is known about mean-level development of affiliativeness from early to middle adolescence.

Individual-order stability (i.e., a relative placement of an individual in a certain group over time) is typically assessed with stability correlations (see also Bornstein et al., 2017; Caspi & Roberts, 2001). Stability of adolescent temperament was investigated in a meta-analysis by Roberts and DelVecchio (2000) in which it was found that for 12- to 18-year-olds adolescents' individual-order stability of temperament was moderate (0.43) and increased over time. Moreover, Laceulle et al. (2012) reported moderate individual-order stability (0.48-0.56) of temperament traits for adolescents aged from 11 and 16, whereas Klimstra et al. (2009) reported individual-order stability (0.31-0.69) of temperament traits for adolescents aged from 12 to 15 (Klimstra et al., 2009). Thus, previous studies are in concert in suggesting that rank-order stability of temperament is moderate in early and middle adolescence and increases towards late adolescence.

Parenting styles and temperament development during adolescence

Parenting styles refer to relatively stable aspects of the parent–child interaction. They are reflected in parent's attitudes toward parenting practices and in an emotional climate in which the parent's behaviors are expressed (Aunola & Nurmi, 2005; Darling & Steinberg, 1993; Mikkonen et al., 2022). Parenting styles are distinct from parenting practices that refer to parental strategies to achieve goals in specific situations or contexts (Aunola & Nurmi, 2004; Pomerantz & Eaton, 2001).

In the dimensional approach the focus has been on the three dimensions of parenting styles (Aunola & Nurmi, 2005; Galambos et al., 2003; Hart et al., 2003; Zarra-Nezhad et al., 2014). The first dimension is warmth (e.g., affection, sensitivity, responsiveness; see Maccoby & Martin, 1983) that refers to parents' interactional supportiveness. The second is behavioral control (e.g., maturity demands, limit setting, monitoring; see Baumrind, 1989) that refers to regulation of the child's behavior through firm and consistent discipline. Finally, the third is psychological control (e.g., guild induction, love withdrawal; see Barber, 1996; Smetana, 2017) that refers to controlling the child's emotions and behavior through psychological means. The key difference between behavioral and psychological control relates to the focus of the attempt at control: Behavioral control is an attempt to regulate the child's behavior, whereas psychological control is an attempt to controlling over the child's psychological world (Aunola & Nurmi, 2004; Barber & Xia, 2013; Soenens & Vansteenkiste, 2010).

According to Rothbart and Bates (2006), temperament is shaped not only by the growth of the individual, but also by environmental factors, such as parental actions. Previous studies have shown that high maternal warmth is related to early adolescents' lower negative affectivity (Davenport et al., 2011) and higher effortful control (Davenport et al., 2011; Wang, 2019). Highly controlling and harsh parenting, in turn, has been associated with early adolescents' higher negative affectivity (Davenport et al., 2011) and lower effortful control (Davenport et al., 2011; Wang, 2019). Longitudinal studies on the topic among adolescents are, however, rare. As an exception, Eisenberg et al. (1999) showed that harsh parental control was linked to increased negative affectivity from middle childhood to early adolescence. In addition, Tiberio et al. (2016) found that a mother's strict and disciplined parenting predicted decreased effortful control during early adolescence. As far as we know, no previous studies have examined the role of parental psychological control in adolescent temperament development. However, a high level of parental psychological control has been shown to be associated with other various negative outcomes in offsprings, such as depressive symptoms, anxiety, and low self-esteem (for a review, see Soenens & Vansteenkiste, 2010).

Parental temperament, parenting styles and adolescent temperament development

Temperament is partly genetically transmitted (Keller et al., 2005; Posner et al., 2007). In addition, temperamental similarities between adolescents and their parents can be driven by a shared family environment (Fisak & Grills-Taquechel, 2007; Johnson et al., 2005). Previous studies in childhood have shown similarities between parents and their children in regards to their negative affectivity (Komsi et al., 2008) and effortful control (Bridgett et al., 2011). There is little research on the associations between parent and adolescent temperaments, but Kitamura et al., (2009) found that adolescents from grades 5 to 9 and their parents showed similarity in novelty seeking, harm avoidance, persistence, and reward dependence. Kiuru et al., (2019) also found a partial similarity between the temperaments of a parent and an adolescent aged 10 to 13. In particular, a parent's effortful control was linked to the adolescent's effortful control.

According to the process model of parenting (Belsky, 1984), parenting is affected by the characteristics of the parent, the characteristics of the child and the characteristics

of the social context. Hence, a parent's own characteristics, such as their temperament, may affect their parenting styles. In their meta-analysis, Prinzie et al., (2009) showed that parents who were more extroverted, agreeable, open and conscientious showed more parental warmth and used more behavioral control, while parental neuroticism was associated with higher behavioral control and lower warmth. Higher conscientiousness and emotional stability of the parent were also linked to lower psychological control (Prinzie et al., 2009). Nevertheless, the mediating role of parenting styles in the associations between parent temperament and adolescent temperament development has not been examined in previous studies. As the temperaments of parents affect their parenting styles (Prinzie et al., 2009) and the quality of parent–child interaction play a role in children's temperament (Davenport et al., 2011), it is plausible to assume that one mechanism how parent temperament is reflected on adolescent temperament might go through the parenting styles.

Research questions and hypotheses

This study addressed the following research questions (see also Fig. 1 for the schematic models):

(1) How does adolescent temperament (surgency, negative affectivity, effortful control, affiliativeness) change from early to middle adolescence? It was expected (Hypothesis 1a) that adolescents' negative affectivity (reflecting reactive aspect of temperament) would increase and effortful control (reflecting the self-regulatory aspect of temperament) would decrease from early to middle adolescence. Similarly, we hypothesized the rank-order stability from early to middle adolescence to be moderate in every adolescent temperament dimension (Hypothesis 1b).

(2) To what extent are parenting styles (parental warmth, behavioral control, psychological control) associated with adolescent temperament and its development from early to middle adolescence? It was expected (Hypothesis 2a) that high parental warmth would be associated with adolescents' lower negative affectivity and higher

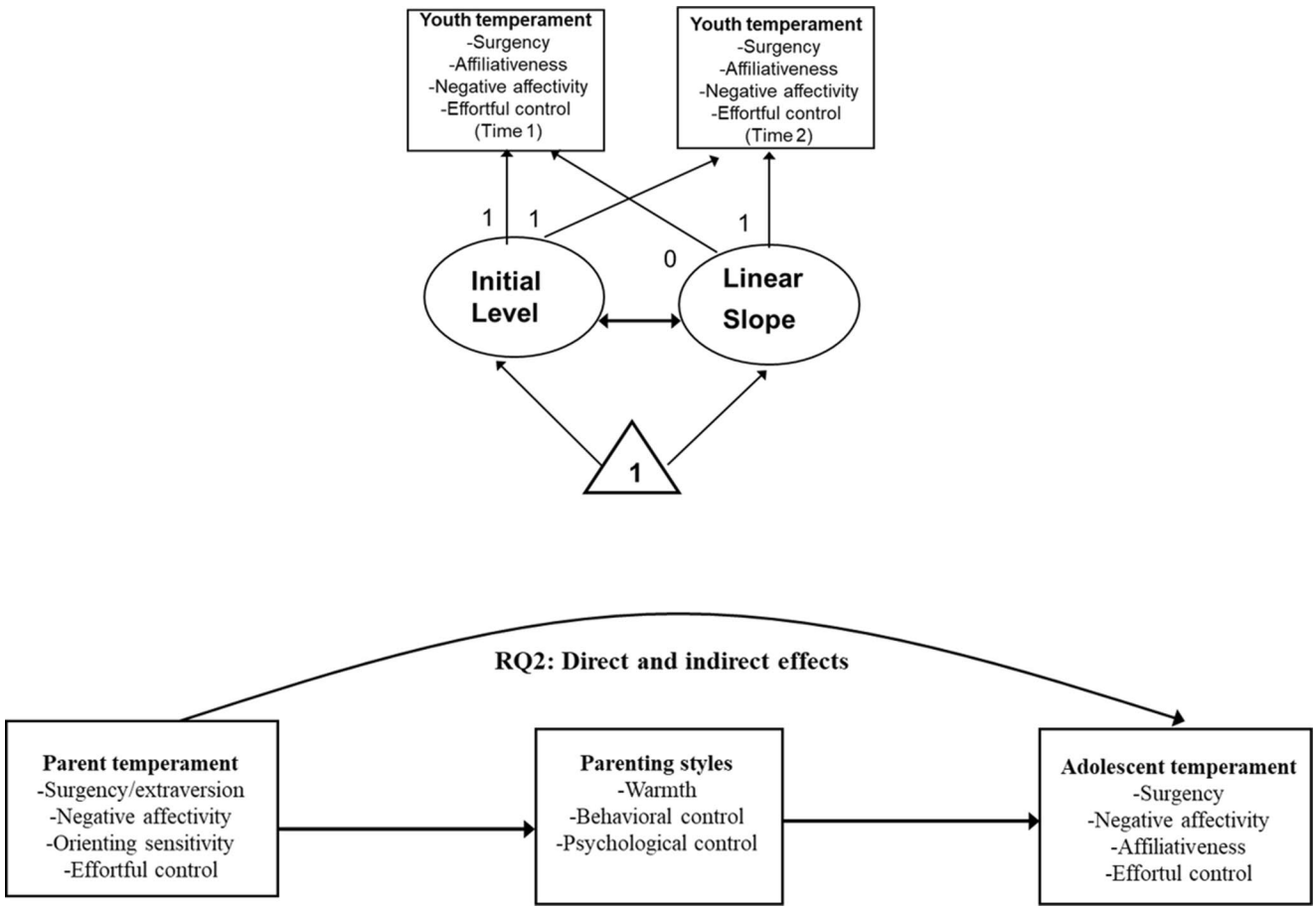

Fig. 1 Schematic models: schematic latent growth model of adolescent temperament for two time points (upper figure) and schematic model of direct and indirect associations between parent temperament, parenting styles and adolescent temperament (lower figure)

effortful control. In turn, higher levels of parental psychological control were expected (Hypothesis 2b) to be associated with adolescents' higher negative affectivity and lower effortful control.

(3) Are the associations between parent temperament and adolescent temperament development mediated by parenting styles? It was expected (Hypothesis 3a), first, that high parental warmth would mediate the positive association between parents' and adolescents' effortful control. Second, it was expected (Hypothesis 3b) that behavioral control would mediate the positive association between parents' and adolescents' surgency/extraversion.

As low family SES is associated with more controlling parenting practices (McLeod, 1998), the effect of parental education was controlled for. Also, as females tend to have slightly higher affiliativeness, higher negative affectivity and higher effortful control and males to have higher surgency (Else-Quest et al., 2006; Pulkkinen et al., 2012), the effect of adolescent biological sex was controlled for.

Method

Participants and procedure

The present study is part of a broader longitudinal study conducted in two medium-sized towns in central Finland following a community sample of adolescents through their educational transitions. The sample consisted of 842 adolescents (54% girls) who filled in paper–pencil questionnaires regarding their temperament in class on normal schooldays in Grades 6 ($n = 842$) and 9 ($n = 683$). Parents ($n = 707$) filled in electronic or postal versions of the questionnaires regarding their temperament and parenting styles when adolescents were in Grade 6. If both parents participated, responses from only one of them (primarily mothers) were included in the present sample. Of the respondents, 675 (95%) were mothers, 26 (4%) fathers, and five (1%) others (e.g., stepparents or other guardians). The parents' age range was 29 to 64 years with a mean of 42.0 years ($SD = 5.6$).

Adolescents' mean age at the outset was 12.3 years ($SD = 0.4$). Most (96%) adolescents were Finnish-speaking, 2% had some other language as their mother tongue, and 2% were bilingual (Finnish and some other language). Seventy-four percent of the families were nuclear families, 13% were single-parent families, 12% were blended families, and 1% were other types of families. Four percent of the participating mothers were not educated beyond nine years of basic education, 29% had completed upper secondary education, 40% had a bachelor or vocational college degree, and 27% had a master's degree or higher. The sample was fairly representative; however, in comparison to same-age Finnish population, the parents in the our sample were slightly more highly educated (Official Statistics of Finland, 2016a) and single-parent households underrepresented and two-parent households overrepresented (Official Statistics of Finland, 2016b).

Written consent for participation was requested from parents and adolescents. The procedures of the study are in accordance with the principles of the Helsinki Declaration on research with human subjects and the larger longitudinal study has been approved by the ethics committee of the local university.

Measures

Adolescent temperament (Grade 6 and Grade 9)

The adolescents evaluated their temperament using a short Finnish version of the Early Adolescent Temperament Questionnaire – Revised Short Form (EATQ-R; Capaldi & Rothbart, 1992; Ellis, 2002; for validity in the Finnish sample, see Kiuru et al., 2019). The questionnaire consisted of 62 statements that were assessed on a five-point Likert scale (1 = *almost never true*; 5 = *almost always true*) measuring adolescents' temperamental surgency/extraversion, negative affectivity, effortful control, and affiliativeness. The scales of surgency/extraversion (Grade 6: α =.73; Grade 9: α =.75), negative affectivity (Grade 6 α =.86; Grade 9: α =.83), effortful control (Grade 6: α =.79; Grade 9: α =.80), and affiliativeness (Grade 6:.82; Grade 9: α =.86) showed adequate to good internal consistency.

Parent temperament (Grade 6)

The parents rated their own temperament using the Adult Temperament Questionnaire—Revised Short Form (ATQ-R; Evans & Rothbart, 2007; for reliability and validity in the Finnish sample, see Kiuru et al., 2019). The questionnaire consisted of 77 statements assessed on a seven-point Likert scale (1 = *fits me very poorly*; 7 = *fits me very well*) measuring parents' temperamental surgency/extraversion, negative affectivity, effortful control, and orienting sensitivity. The scales of surgency/extraversion (α=.86; $M = 4.50$, $SD = 0.71$), negative affectivity (α =.84; $M = 3.90$, $SD = 0.69$), effortful control (α =.81; $M = 5.01$, $SD = 0.69$), and orienting sensitivity (α =.79; $M = 4.85$, $SD = 0.73$) showed adequate to good internal consistency.

Parenting style dimensions (Grade 6)

Parents rated their parenting styles using a short Finnish version (Aunola & Nurmi, 2004, 2005) of Block's Child-Rearing Practices Report (CRPR; Roberts et al., 1984), that contains 15 items on a five-point Likert scale (1 = *does not fit me at all* to 5 = *fits me very well*). The Warmth scale consists of 5 items (e.g., "I often show my child that I love him/her"), measuring parental warmth and responsiveness. The Behavioral Control scale consists of 6 items (e.g., "My child should learn that we have rules in our family") measuring limit setting and maturity demands, respectively. The Psychological Control scale consists of 4 items (e.g., "I believe a child should be aware of how much I have done for him/her) measuring parental attitudes appealing to guilt and expressing disappointment. The scales for parental warmth (α =.78; $M = 4.24$, $SD = 0.50$), behavioral control (α =.71; $M = 3.85$, $SD = 0.51$), and psychological control (α =.77; $M = 2.62$, $SD = 0.72$) showed adequate to good internal consistency.

Control variables

The controlled covariates in the statistical analyses consisted of adolescents' gender (1 = girl, 2 = boy) and the level of parental education (1 = no education beyond comprehensive education, 7 = Licentiate or Doctoral degree from university).

Statistical analyses

Our first aim was to investigate how adolescent temperament changes from early to middle adolescence. This research question was examined using latent growth modeling in which initial levels (intercept) and linear changes (slope) were estimated separately for each temperament dimension (Duncan & Duncan, 2004; see Fig. 1, for schematic latent growth model for two measurement points). This method allowed the examination of the statistical significance of both the means and variances of the growth components.

Our second research question was to investigate how parenting styles are associated with adolescent temperament and temperament development. To answer this question, separate latent growth models (LGMs) for different temperament dimensions were simultaneously estimated and parenting styles were added as predictors of both initial levels and changes of all the temperament dimensions. The effects of gender and the level of parental education were controlled for.

Our final research question was to investigate the direct and indirect effects of parent temperament on adolescent temperament and temperament development through parenting styles (see Fig. 1 for schematic models). Parent temperament variables were first added in the previous LGM to predict parenting styles and initial levels and changes of adolescent temperament dimensions. Finally, indirect effects with bootstrapped confidence intervals (see also Preacher & Hayes, 2008) from parent temperament on initial levels and linear slopes of adolescent temperament via parenting styles were examined. The effects of gender and the level of parental education were controlled for.

All the analyses were conducted using the Mplus statistical package (Version 8.4, Muthén & Muthén, 1998–2021). Missingness at Random (MAR) was assumed, which is a weaker condition for missing data than Missingness Completely at Random (MCAR). In the MAR situation, missingness is not dependent on the unmeasured variables but can depend on the values of variables included in the analyses (Little, 1988). Assuming MAR, the model parameters were estimated using full-information maximum likelihood robust estimation that allowed using all the information in the data with non-normality robust standard errors (Muthén & Muthén, 1998–2021).

Table 1 Descriptive statistics of adolescent temperament dimensions in grades 6 and 9

Variable		*n*	*M*	*SD*	Range of scale
Surgency/extraversion					
	Grade 6	839	3.36	0.66	1–5
	Grade 9	686	3.39	0.65	1–5
Negative affectivity					
	Grade 6	830	2.73	0.53	1–5
	Grade 9	683	2.70	0.56	1–5
Affiliativeness					
	Grade 6	839	3.40	0.60	1–5
	Grade 9	683	3.46	0.62	1–5
Effortful control					
	Grade 6	839	3.55	0.53	1–5
	Grade 9	683	3.28	0.51	1–5

Results

Adolescent temperament development

The descriptive statistics of adolescent temperament are shown in Table 1, whereas latent growth models for adolescent temperament development between Grade 6 and Grade 9 are shown in Table 2. The results of LGMs for the mean structure showed that, on average, adolescents' affiliativeness slightly ($d = 0.10$) increased and their effortful control moderately ($d = 0.52$) decreased from Grade 6 to Grade 9. Mean-level changes in surgency/extraversion and negative affectivity were non-significant. Furthermore, all the variances of growth components were statistically significant

Table 2 Estimation results of the latent growth models for adolescent temperament (unstandardized estimates; standard errors in parenthesis)

Growth components	Surgency/ extraversion	Negative affectivity	Affiliativeness	Effortful control
Mean structure				
Initial level	3.36(0.02)***	2.72 (0.02)***	3.40(0.03)***	3.55(0.02)***
Linear slope	0.04(0.03)	-0.04(0.03)	0.06(0.03)*	-0.28(0.02)***
Covariance structure				
Variance of initial level	0.44(0.02)***	0.28(0.02)***	0.46(0.03)***	0.28(0.01)***
Variance of linear slope	0.48(0.03)***	0.33(0.02)***	0.47(0.03)***	0.30(0.02)***
Covariance (level, slope)	-0.25(0.02)***	-0.15(0.02)***	-0.27(0.03)***	-0.16(0.02)***

*** $p < .001$; ** $p < .01$, * $p < .05$

suggesting that there was significant individual variation both in the initial levels and linear changes of temperament from Grade 6 to Grade 9. Stability correlations, describing individual order change (see also Bornstein et al., 2017; i.e., correlations of the repeated measurements of the same temperament dimensions between Grade 6 and Grade 9), in turn, ranged from 0.44 to 0.51 ($p < 0.001$), suggesting moderate individual-order stability in all the temperament dimensions from Grade 6 to Grade 9.

Parenting styles and adolescent temperament development

Figure 2 shows LGMs in which initial levels and linear changes of adolescent temperament are predicted by parenting styles. First, the results for *parental warmth* showed that high parental warmth predicted a higher initial level of adolescent affiliativeness and higher initial level of adolescent effortful control. Furthermore, parental warmth was negatively associated with linear slope of adolescent negative affectivity: the higher warmth a parent reported, the more adolescents' negative affectivity decreased from Grade 6 to Grade 9.

Second, the results for parental *behavioral control* showed that it was positively associated with the initial level, and negatively associated with the linear slope of adolescent surgency/extraversion: the higher behavioral control a parent reported, the higher was adolescents' surgency/extraversion and the more adolescent surgency/extraversion decreased from Grade 6 to Grade 9.

Third, the results for parental *psychological control* showed that it was negatively associated with the initial level of adolescent effortful control: the higher psychological control a parent reported, the lower was adolescents' effortful control in Grade 6.

Indirect effects of parent temperament on adolescent temperament through parenting styles

A full correlation matrix of observed variables is shown in Table 3. Next, parent temperament variables were added in the previous LGM to predict, on the one hand, parenting styles, and on the other hand, the initial levels and changes of adolescent temperament dimensions. The results controlling for the covariates are shown in Fig. 3.

The results indicated small and positive associations between parent surgency/extraversion and adolescent surgency/extraversion (initial level); parental negative affectivity and adolescent negative affectivity (initial level), parental orienting sensitivity and adolescent affiliativeness (initial level), and parental effortful control and adolescent effortful control (initial level). High parental effortful control was associated with adolescents' higher initial level of surgency/extraversion.

In terms of parenting styles, high parental surgency/extraversion and high parental effortful control were associated with higher parental warmth and higher parental behavioral control. In turn, high parental negative affectivity was associated with both higher behavioral and higher psychological control. Finally, high parental orienting sensitivity was associated with higher parental warmth.

Next, indirect effects from parent temperament dimensions on adolescent temperament through parenting styles were also estimated. Bias-corrected bootstrap confidence intervals of indirect effects are shown in Table 4.

For *adolescent surgency*, the results showed that high behavioral control mediated the positive association between parental surgency and the initial level of adolescent surgency. High parental negative affectivity and high parent effortful control were also associated with higher parental behavioral control which, in turn, was related to higher initial level of adolescent surgency.

For *adolescent negative affectivity*, results indicated that high parental surgency, high parental orienting sensitivity and high parental effortful control were related to higher parental warmth, which in turn, was related to a decrease in adolescent negative affectivity from early to middle adolescence.

In turn, for *adolescent affiliativeness,* high parental warmth partially mediated the associations between high parental orienting sensitivity, surgency and effortful control and a high initial level of adolescent affiliativeness.

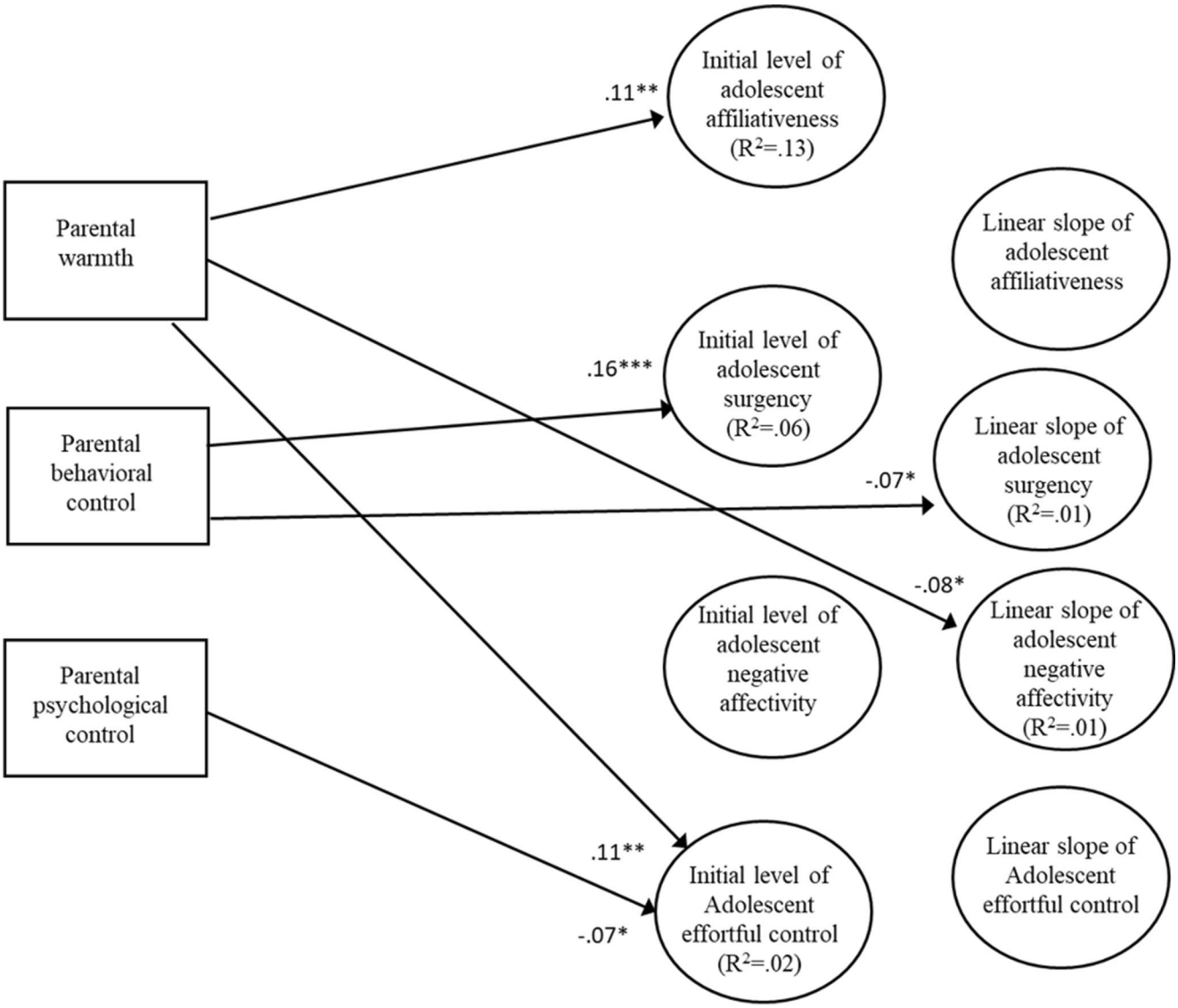

Fig. 2 The role of parenting styles in adolescent temperament. Note. Standardized estimates are presented. *** $p < .001$, ** $p < .01$, * $p < .05$. Predictors were allowed to be correlated and levels and slopes of temperament dimensions were allowed to be correlated. The effects of adolescent gender, and the level of parental education were controlled for

For *adolescent effortful control,* the results indicated that high parental warmth mediated the positive associations between parental effortful control and orienting sensitivity with the initial level of adolescent effortful control. Finally, high parental negative affectivity was related to higher parental psychological control which, in turn, was related to a lower initial level of effortful control.

Discussion

This study examined how temperament develops in adolescence and how parenting styles and parent temperament are linked to this development. First, the results showed that affiliativeness slightly increased and effortful control moderately decreased from early to middle adolescence, while mean-level changes in surgency/extraversion and negative affectivity were not significant. Individual-order stability was moderate in every temperament dimension. Second, parenting styles were associated with adolescents' temperament development. Parent temperament was also related to adolescent temperament and parenting styles mediated several associations between parents' and adolescents' temperament. These findings were mostly in line with the expected directions of change in adolescent temperament development, but they also offer new insights into the roles of parenting styles and parent temperament in adolescent temperament development.

Table 3 Correlations between observed variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Parent surgency (Gr 6)	-																
2. Parent neg.affect. (Gr 6)	-.40[a]	-															
3. Parent or. sensitivity (Gr 6)	.22[a]	.23[a]	-														
4. Parent eff. control (Gr 6)	.24[a]	-.52[a]	-.04	-													
5. Parent warmth (Gr 6)	.27[a]	-.13[a]	.23[a]	.22[a]	-												
6. Parent beh.control (Gr 6)	.12[b]	.09[c]	.01	.03	.12[b]	-											
7. Parent psych. contr. (Gr 6)	-.01	.16[a]	-.01	-.09[c]	-.08[c]	.41[a]	-										
8. Youth surgency (Gr 6)	.07	-.01	.07	.03	-.01	.17[a]	.10[b]	-									
9. Youth surgency (Gr 9)	.11[c]	-.06	.12[c]	.12[b]	.02	.08[c]	.01	.44[a]	-								
10. Youth neg. affect. (Gr 6)	.01	.04	-.04	-.08[c]	-.02	-.06	.03	-.31[a]	-.19[a]	-							
11. Youth neg. affect. (Gr 9)	-.06	.11[c]	-.06	-.06	-.10[c]	-.10[c]	.01	-.16[a]	-.29[a]	.44[a]	-						
12. Youth affiliate. (Gr 6)	.09[c]	-.08[c]	.12[b]	.10[c]	.12[b]	-.08[c]	.01	-.01	.08	.25[a]	.13[b]	-					
13. Youth affiliate. (Gr 9)	.02	.02	.09[c]	.03	.05	-.07	-.01	-.05	.10[c]	.18[a]	.25[a]	.51[a]	-				
14. Youth eff. control (Gr 6)	.09[c]	-.10[c]	.05	.17[a]	.13[b]	-.01	-.10[c]	.07	.10[c]	-.14[a]	-.12[b]	.44[a]	.21[a]	-			
15. Youth eff. control (Gr 9)	.05	-.11[c]	.00	.12[b]	.10[c]	-.01	-.04	-.03	.13[b]	-.09[a]	-.29[a]	.25[a]	.37[a]	.45[a]	-		
16. Youth gender[1]	-.04	.06	.02	-.05	-.01	.14[a]	.01	.19[a]	-.01	-.30[a]	-.30[a]	-.32[a]	-.38[a]	-.07	-.08[c]	-	
17. Parental education	-.04	-.03	.04	.11[b]	.10[b]	-.12[b]	-.13[b]	.06	.12[b]	-.04	-.03	.09[c]	.13[b]	.09[c]	.09[c]	-.03	-

[1] 1 = girl, 2 = boy, [a]$p < .001$, [b]$p < .01$, [c]$p < .05$. Gr 6 = Grade 6, Gr 9 = Grade 9

Development of temperament from early to middle adolescence

Partially in line with our Hypothesis 1a (see also Allik et al., 2004; Van den Akker et al., 2014; Laceulle et al., 2012), the results showed that effortful control decreased from early to middle adolescence. One explanation for these findings is that neural networks related to effortful control and self-regulation develop strongly during adolescence (Best & Miller, 2010). In the brain, the release of dopamine increases (Siegel, 2015) and the limbic system develops earlier than the prefrontal cortex (Casey et al., 2008), which can be seen as reduced impulse control and judgement of the adolescent, as well as an increase in a risk behavior. Pubertal maturation also intensifies emotional reactivity, sensation-seeking, and orientation toward social rewards (stages of early and middle adolescence are shown to comprise important windows of sensitivity in terms of brain development and environmental factors; Galvan, 2013; Hare et al., 2008; Nook et al., 2018; Steinberg, 2005), which together with slow maturation of self-regulatory skills can be shown as diminished effortful control during adolescence. Furthermore, youth confront changed social and personal expectations regarding more mature behavior and thinking, even though their regulation abilities are not entirely developed and therefore do not promote the fulfillment of these new expectations (Denissen et al., 2013; Steinberg, 2007). Hence, effortful control usually does not increase until late adolescence. It has been shown that only in late adolescence along maturation of frontal lobes (Steinberg, 2005) do individuals' emotional stability and self-regulation increase, while adolescents cope with the stressors of life in an increasingly adaptive way (Klimstra et al., 2009; Soto & Tackett, 2015).

Our results further showed that, on average, affiliativeness increased from early to middle adolescence. Affiliativeness involving the desire for closeness with others (independent of extraversion) has been suggested to be particularly important in adolescence (Ellis, 2002; Oldehinkel et al., 2004; Putnam et al., 2001). Adolescents are particularly sensitive to social rewards (Steinberg, 2007) and have a heightened desire to "fit in" with peers (Hamm et al., 2014), which may help to explain the increase in affiliativeness from early to middle adolescence. The development of affiliativeness has been less studied compared with other temperament traits, so our finding adds new insights to the study of temperament development and emphasizes the changing role of social motivation and processing in adolescence.

Finally, in line with some previous studies (Branje et al., 2007; Luan et al., 2017; McCrae et al., 2002) and

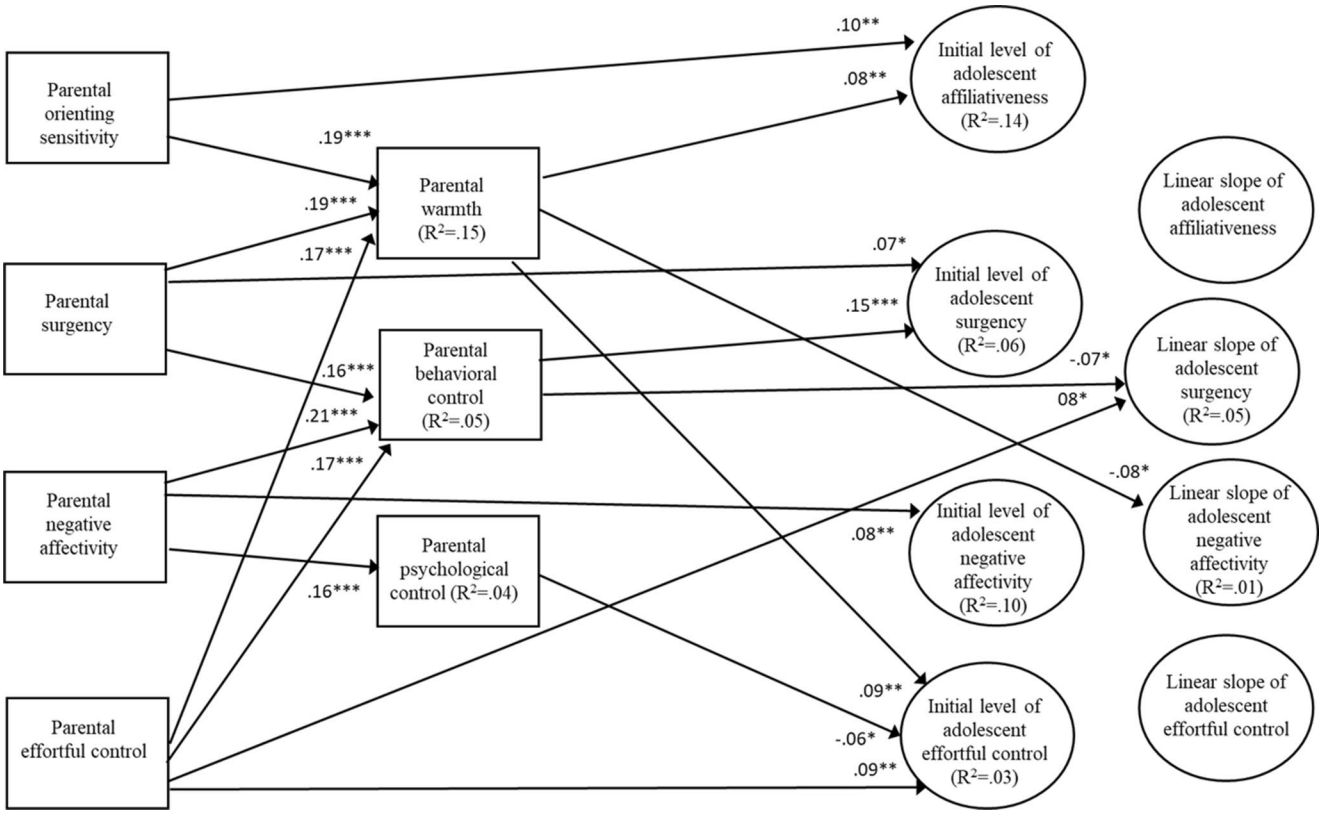

Fig. 3 Associations between parental temperament, parenting styles and adolescent temperament. *Note.* Standardized estimates are presented. *** $p < .001$, ** $p < .01$ and $p < .05$. Predictors were allowed to be correlated and levels and slopes of temperament dimensions were allowed to be correlated. The effects of adolescent gender, and the level of parental education were controlled for in all the analyses

in contrast to some other studies (Klimstra et al., 2009; Laceulle et al., 2012), our results showed no mean-level changes from early to middle adolescence in surgency/extraversion and negative affectivity. It is notable that some previous studies have shown slowly increasing trends in extraversion and emotional stability, particularly towards late adolescence. These small normative increases could be interpreted as maturation that could help adolescents commit to adult social roles and behaviors (Klimstra et al., 2009; Lodi-Smith & Roberts, 2007). Hence, one explanation for lacking mean-level changes in extraversion/surgency and negative affectivity is the fact that our follow-up consisted of only early and middle adolescence, but not late adolescence.

As hypothesized, the individual order stability was moderate in every temperament dimension (Hypothesis 1b). This is in line with previous studies (Laceulle et al., 2012; Roberts & DelVecchio, 2000) in suggesting that, on average, temperament traits remain moderately stable over adolescence. Trait consistency increases with age, being the lowest in early childhood and peaking in middle age (Roberts & DelVecchio, 2000).

Associations between parenting styles and adolescent temperament development

In line with Hypothesis 2a, our results showed that high parental warmth was not only related to higher initial level of effortful control in early adolescence (see also Davenport et al., 2011; Wang, 2019), but also to decreasing negative affectivity from early to middle adolescence (see also Bates et al., 2012; Davenport et al., 2011). Although it is suggested that parenting plays a particularly important role in the development of children's effortful control in early childhood (Kiff et al., 2011), our results suggest that high parental warmth is related to better effortful control also in adolescence. A particularly significant finding is the link between high parental warmth and a decrease in adolescent negative affectivity: The more parent showed warmth in parenting, the more the adolescent's negative affectivity decreased from early to middle adolescence. This converges with earlier findings of parental warmth being associated with a lower level of emotional symptoms (Schwartz et al., 2017; Yap & Jorm, 2015). It is possible that parents who are supportive, affectionate and loving towards the adolescent can

Table 4 Bias-corrected bootstrap confidence intervals of indirect effects: Parenting styles as mediators

Indirect effect			95% CI
Parent surgency	**Parent behavioral control**	**Initial level of youth surgency**	[0.011, 0.041]**
Parent negative affectivity	Parent behavioral control	Initial level of youth surgency	[0.014, 0.052]**
Parent effortful control	Parent behavioral control	Initial level of youth surgency	[0.006, 0.034]*
Parent surgency	Parent warmth	Linear slope of youth negative affectivity	[-0.001, -0.032]*
Parent orienting sensitivity	Parent warmth	Linear slope of youth negative affectivity	[-0.001, -0.035]*
Parent effortful control	Parent warmth	Linear slope of youth negative affectivity	[-0.001, -0.033]*
Parent orienting sensitivity	**Parent warmth**	**Initial level of youth affiliativeness**	[0.003, 0.034]*
Parent surgency	Parent warmth	Initial level of youth affiliativeness	[0.004, 0.035]*
Parent effortful control	Parent warmth	Initial level of youth affiliativeness	[0.003, 0.030]*
Parent effortful control	**Parent warmth**	**Initial level of youth effortful control**	[0.003, 0.032]*
Parent surgency	Parent warmth	Initial level of youth effortful control	[0.001, 0.034]*
Parent orienting sensitivity	Parent warmth	Initial level of youth effortful control	[0.004, 0.036]*
Parent negative affectivity	Parent psychological control	Initial level of youth effortful control	[-0.001, -0.026]*

contribute to helping the developing adolescent strengthen their capacity to deal with more frequent negative emotions that adolescents may be more susceptible to (Vijayakumar et al., 2019), and thus protect from the risks of adolescence for emotional well-being more generally. This is especially intriguing given the switch from parental-dependent emotion regulation processes to the more independent regulation typical for puberty (Gee et al., 2014). However, our finding is in line with prior research indicating that parents continue to hold a key role as regulators during adolescence regardless of the internal and external changes that drive more independent self-regulation (Suleiman & Dahl, 2019).

Furthermore, high parental warmth was found to be related to higher initial level of early adolescent affiliativeness. This novel finding emphasizes the important role of parental warmth in adolescents' relationships (Steinberg & Morris, 2001). Prior studies have linked parental warmth to prosocial skills and empathy in children and adolescents (Eisenberg et al., 2006). If a parent's interaction is considerate and accepting, thereby fulfilling adolescents' basic need for relatedness, it may be reflected in the adolescent's interest in other people, such as peers (Deci & Ryan, 2000).

Interestingly, the results showed further that high parental behavioral control was related to a higher initial level of surgency/extraversion in early adolescence but decreasing surgency from early to middle adolescence. Parents are thought to adapt their own actions to match the individual characteristics of a child (Bell, 1968; Zadeh et al., 2010). Hence, parents may set more boundaries for an outward-looking adolescent who may be very active and try new or exciting things more boldly than on average. A parent can also be frustrated if an adolescent with high surgency challenges the parent's authority, to which the parent reacts with more discipline (De Haan et al., 2012). This, in turn, may decrease adolescents' tension-seeking from early to middle adolescence.

Finally, as expected (Hypothesis 2b) high parental psychological control was related to a lower initial level of adolescent effortful control in early adolescence. Previous research has shown that a parent's high psychological control is associated with poorer emotion regulation skills of the adolescent (Cui et al., 2014) and higher distress and internalizing symptoms in children (Aunola et al., 2015). Our results converges with these studies by showing that parental manipulation, guilt induction and shame may decrease adolescents' sense of control and increase dependence on parents, which in turn, may lead to adolescents' lower abilities to regulate actions and emotions (Becker et al., 2010; Chorpita et al., 2016).

Parent temperament, parenting styles and adolescent temperament development

As our final research question, we examined the extent to which the associations between parent temperament and adolescent temperament and related changes from early to middle adolescence are mediated by parenting styles. The results revealed that aside from the small direct effects from parent temperament on adolescent temperament, parental warmth mediated several associations between the parent temperament and adolescent temperament and its development from early to middle adolescence. For instance, the more the parent reported effortful control and orienting sensitivity, the more warmth the parent showed, which was further associated with adolescents' higher levels of affiliativeness and higher effortful control in early adolescence, and a decrease in negative affectivity from early to middle adolescence (see also Hypothesis 3a). Earlier studies have found that the temperaments of parents and adolescents affect their ways of reacting, expressing and interacting with each other (Kiff et al., 2011; Davenport et al., 2011). Parental high effortful control and orienting sensitivity seem to increase parent's abilities to be affectionate and sensitive to the adolescent's needs (see also Prinzie et al., 2009). This, in turn, may help the adolescent strengthen their capacity to regulate negative emotions (Vijayakumar et al., 2019) and

increase their tools to form close relationships with others, such as peers (Eisenberg et al., 2006).

Further, parental behavioral control mediated some of the associations between parent and adolescent temperament. The more the parent reported surgency and effortful control, the more the parent used behavioral control, which was further associated with adolescents' greater surgency in early adolescence (see also Hypothesis 3b). Both extraversion, which assimilates to surgency, and effortful control, which is related to effective self-regulation, may be related to active and firm parenting in situations requiring discipline (Prinzie et al., 2009).

Finally, high parental negative affectivity was related to higher parental psychological control which was further related to early adolescents' lower effortful control. Negative affectivity, as well as its corresponding personality characteristic neuroticism, are related to the heightened frequency of experiencing negative feelings and insecurity. These characteristics may increase parental proneness to the use of control more generally to avoid situations that arouse negative feelings within the parent. Parents with high negative affectivity may be less able to be sensitive toward their adolescents as they may be more focused on their own distress (Latzman et al., 2009).

Strengths, limitations and future directions

The strengths of our study were the longitudinal design, large sample size and information collected from both adolescents and their parents. Aside of strengths our study has also its limitations. First, most of the studied parents were mothers. Future studies are needed to examine similar mechanisms among fathers. Second, although data was collected both from adolescents and their parents, it should be noted that parents reported on both their temperament and parenting styles, which could influence findings. Using both adolescents' and parents' reports of parenting styles may provide more meaningful knowledge of the adolescent-parent relationship and help to overcome bias related to social desirability (Korelitz & Garber, 2016). Moreover, future studies could complement questionnaire data with observations and interviews. Other issues for further examination include the direction of associations and reciprocal dynamics between parents' and adolescents' temperaments and parenting styles and possible moderators of these associations, such as pubertal timing. Third, although some predictions were found on temperament development (in addition to initial levels), and the results held even after controlling for adolescent gender and the level of parental education, the effect sizes were relatively small. In the future, twin studies and studies with the behavioral genetic perspective could attempt to isolate genetic and different environmental mechanisms underlying the associations between parenting styles and parents' and their adolescents' temperaments. Fourth, the results of this study can be generalized only to early and middle adolescence. Future studies are needed for examination of temperament in late adolescence. Furthermore, we cannot exclude the possibility that some shapes of changes in temperament from early to middle adolescence would be non-linear. Our study included only two measurement points which enabled us to examine only linear change (i.e., mean-level increase, mean-level stability or mean-level decrease) instead of possible other shapes of change. Future studies with more measurement points and longer timespan during adolescence could shed more light on possible nonlinearities of temperament development, as well as developmental change extending to the late adolescence/early adulthood. Finally, it would be important to investigate less privileged youths with their families, different cultures and educational systems.

Conclusions and practical implications

This research enriches the knowledge of adolescent temperament development from early to middle adolescence and how parent temperament and parental styles are related to adolescents' temperament development. The results suggest that parents' temperament and parenting styles are related to temperament development in a complex manner in adolescence, which is a period when independence from parents is actively sought. However, an adolescent's increasing independence is a window onto the quality of interactions within the family. Adolescence is also a sensitive period for development and the risk of the onset of mental health problems increases (Hermanson & Sajaniemi, 2018). Our results highlight acknowledging the role of supportive, affectionate, and loving parenting in decreasing negative affectivity in adolescence also in the setting of clinical practice when adolescent well-being and quality of social networks are evaluated. Further, the significance of both parental and adolescent temperament traits and their interactions in steering adolescent development should be identified both in research and practical settings. In summary, knowledge gained from this study can be utilized broadly in the context of supporting the well-being of both adolescents and their parents as well as improving clinical services and developing interventions in order to help families.

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Data availability The datasets generated and/or analyzed during the current study are not publicly available due to ethical restrictions but are available from the corresponding author on reasonable request.

Declarations

Ethical approval This study was conducted in compliance with APA ethical standards. The procedures were in accordance with the principles of the Helsinki Declaration on research with human subjects. The research plan of the project was approved by the Human Sciences Ethics Committee of the University of Jyväskylä.

Informed consent Informed consent was obtained from all the participants of the study.

Conflict of interest The authors declare that they have no conflict of interest.

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