

Does one Size Fit All?—Linking Parenting With Adolescent Substance Use and Adolescent Temperament

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Using longitudinal Swedish data from 1,373 early-adolescent youths, this study aims to answer the question of whether the previously established protective function of parental knowledge and its sources—adolescent disclosure, parental solicitation, and parental control—on substance use among early-adolescents is moderated by the adolescent's temperament. Adolescent temperament moderated several links between parental knowledge and its sources and adolescent substance use. The most pronounced moderating results were found for those adolescents with fearless, socially detached and thrill-seeking tendencies. For these “detached thrill-seekers”, bidirectional links between adolescent disclosure and substance use, and negative links between parental solicitation and substance use were found. We recommend, therefore, that adolescent temperament is considered when designing parenting programs.

Adolescence is the critical time for onset or intensification of substance use involvement. According to the European national survey on alcohol and drugs, at least 23% of 13-year-old adolescents have smoked cigarettes and 47% have used alcohol (The ESPAD Group, 2016). Such behavior can be harmful for adolescent psychosocial development. For example, adolescent alcohol use is associated with depressive affects, self-derogation, and conduct problems (Patrick & Schulenberg, 2014). Adolescent smoking is linked with a heightened risk for depressive symptoms (Mayfield Arnold, Greco, Desmond, & Rotheram-Borus, 2014). To reduce the risks for poor developmental outcomes, adolescents need to be protected from engagement in substance use. One preventive strategy is to focus on parent-adolescent relationships.

Despite adolescents' growing autonomy, the parent-adolescent relationship during this developmental stage still seems to matter for adolescents' psychosocial development. Based on the parenting literature, it seems possible to advise parents to act in certain ways to discourage their early-adolescent children from starting to drink alcohol. Some of the most well-known parent training programs,

including the Strengthening Families Program for Parents and Youth 10–14, recommend that parents set rules and monitor their adolescents closely to avoid the development of risk behavior (Molgaard & Spoth, 2001). The central idea is that when they have information about their early-adolescent children's activities, parents can provide the children with support and guidance and discourage them from engaging in substance use (Kapetanovic, Bohlin, Skoog, & Gerdner, 2017; Waizenhofer, Buchanan, & Jackson-Newsom, 2004). Parents can gain this knowledge through the adolescent voluntarily sharing information (voluntary disclosure) (Kerr, Stattin, & Burk, 2010) and through their own efforts to gain information by actively soliciting it (Fletcher, Steinberg, & Williams-Wheeler, 2004). Each of these sources may or may not help parents protect adolescents from involvement in substance use.

When young adolescents voluntarily share information about their whereabouts with their parents, it seems to benefit adolescents' psychosocial growth. Adolescents then engage less in various risk behaviors, such as substance use (Kapetanovic, Skoog, Bohlin, & Gerdner, 2018). The negative link between adolescent disclosure and adolescent risk behavior may equally indicate that adolescents who do not engage in risk behaviors feel they have nothing to hide and therefore have no problems sharing infor-

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mation with their parents. The cross-sectional design of earlier studies cannot rule out which of these interpretations is most valid. Longitudinal designs are therefore needed when studying developmental processes (Meeus, 2016). Studies are less consistent on the protective role of parental soliciting efforts. These efforts have been shown to be both beneficial (Fletcher et al., 2004; Laird, Marrero, & Sentse, 2010) and nonbeneficial (Kakihara, Tilton-Weaver, Kerr, & Stattin, 2010) for adolescent psychosocial development. Such inconsistency of findings may occur when there are moderators in play.

Adolescents' individual characteristics, including personality (Crocetti et al., 2016), may represent an example of a moderator that predict differences in the impact of parenting knowledge. According to personality theory (Cloninger, Svrakic, & Przybeck, 1993), personality includes both temperament (as a moderately stable entity) and character (an entity which modifies through socio-cultural learning and maturing). For example, one study showed that depending on their personality, some adolescents benefit more and others less in terms of their psychosocial development, from parental knowledge and its sources (Eaton, Krueger, Johnson, McGue, & Iacono, 2009). In that study, personality was studied without disaggregating heritable from environmentally modifiable traits. But what role does temperament, as a moderately heritable and moderately stable entity of personality, play in the associations between parenting and adolescent psychosocial outcomes? In this study, we explore whether adolescent temperament moderates the longitudinal associations between adolescent disclosure, parental knowledge, parental solicitation, parental control and adolescent substance use (see Figure 1 for a conceptual model).

Sources of Parental Knowledge

Parents obtain knowledge of their adolescents' whereabouts in several ways. One way is through parental behavioral control, conceptualized as a parental strategy to provide regulation and structure in adolescents' lives, through discipline and rules (Kerr & Stattin, 2000). Parents can also obtain knowledge by actively asking for information from their adolescents or their adolescents' peers, known in the literature as parental solicitation (Kerr et al., 2010). Unprompted/spontaneous sharing of information by adolescents about their activities, relationships and free time, known as adolescent disclosure, is another way for parents to obtain information about adolescents' whereabouts (Stattin & Kerr, 2000). The

general assumption in the literature is that parental knowledge per se discourages young adolescents from engaging in risk behavior (Racz & McMahon, 2011). Other research suggests that the source of information affects whether parents can discourage their adolescents from engaging in risk behavior (Kerr et al., 2010; Stattin & Kerr, 2000). For example, when parents obtain knowledge through adolescent voluntary disclosure, they are able to deter their adolescent children from engaging in risk behaviors (Keijsers, Branje, VanderValk, & Meeus, 2010). Adolescent disclosure is likely to occur when parents and adolescents have a trusting relationship (Kerr, Stattin, & Trost, 1999) and close bonds (Kapetanovic et al., 2018). In contrast, the impact of parents' efforts to control and solicitation is unclear. For example, providing structure in adolescents' environment by setting rules and behavioral regulations may result in parents acquiring information about their adolescents' whereabouts as well as promote adolescent adjustment (Grolnick & Pomerantz, 2009). If parents' rule setting also upholds the sense of autonomy granting in adolescents, that would have a positive impact on adolescent psychosocial development (Grolnick et al., 2014). However, undermining adolescent independence through parents' dominance or capricious discipline, thus applying psychological control, may result in inadequate opportunities for parents to guide their adolescent children's psychological well-being (Grolnick & Pomerantz, 2009). In addition, if adolescents perceive parents' rules and questions as intrusive, and as undermining their autonomy needs (Kakihara et al., 2010), they may be less inclined to acknowledge parents' guidance. In turn, adolescents are then likely to engage in more, and not fewer risk behaviors (Kapetanovic et al., 2017). Thus, promoting adolescent disclosure as a means for obtaining knowledge and protecting early-adolescent children seems desirable, whereas active monitoring efforts are not necessarily as helpful.

However, parenting is not a one-way street. What adolescents do may influence what kind of parenting practices parents use and how trusting parent-adolescent relationships are. For example, in their 4-year longitudinal study, Laird, Pettit, Bates and Dodge (2003) showed that just as parental knowledge predicted changes in adolescent behavior, higher levels of adolescent delinquency predicted lower levels of parental knowledge. Other research indicates that adolescent behavior may predict changes in parenting style, including authoritative, authoritarian, permissive and neglectful styles (Kerr, Stattin, & Özdemir, 2012) as well as changes in the

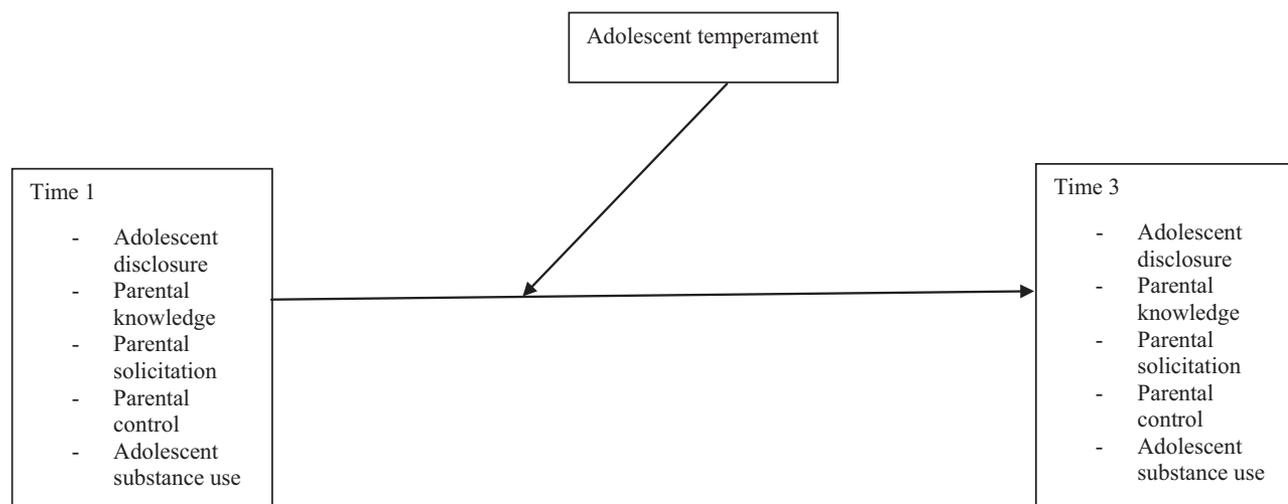


FIGURE 1 The conceptual model of associations between adolescent disclosure, parental knowledge, solicitation and control, and adolescent substance use moderated by adolescent temperament.

level of adolescents' voluntary sharing of information (Keijsers et al., 2010; Kerr et al., 2010) and parental control (Huh, Tristan, Wade, & Stice, 2006). When adolescents engage in risk behaviors, they tend to disclose less about their everyday activities, and somewhat counterintuitively, parents tend to reduce their controlling practices.

Furthermore, adolescents may react differently to, or be differently affected by, what their parents know and how they learned it. Such differences may have their basis in adolescents' temperament; they may respond to parenting practices differently depending on their temperament tendencies. In fact, the interaction between parenting and adolescent emotional reactions may account for variations in adolescent psychosocial development (see Grusec, 2011; Kiff, Lengua, & Zalewski, 2011 for reviews). For example (Kochanska, Kim, Boldt, & Yoon, 2013). However, studies on toddlers (Kochanska et al., 2013) and preadolescent children (Lengua, Wolchik, Sandler, & West, 2000) have shown that controlling parenting practices are linked to increases in adjustment problems in children who are highly impulsive and fearless. Thus, there are reasons to think that adolescent temperament may moderate the links between parental knowledge and its sources and subsequent behavioral outcomes for adolescents.

Associations Between Adolescents' Temperament and Behavior

According to the biopsychosocial model of personality (Cloninger et al., 1993), personality consists of

two domains, temperament and character. Temperament is defined as the automatic emotional response to experience; it is moderately heritable and relatively stable feature of personality manifested early in life. Character refers to self-conception, goals, values and meaning-making of one's experiences, and is influenced by sociocultural learning and matures throughout life. Thus, temperament and character are two separate but interwoven features of personality, shaped by the interaction between internal tendencies and socio-cultural forces. The temperament dimensions—novelty-seeking, harm avoidance, and reward dependence—are the focus of this study. Novelty-seeking is a tendency to seek exploratory activities, often with impulsive decision-making. Harm avoidance is a tendency to inhibit behavior to avoid problems, where fearfulness, worry and rapid fatigability are noticeable features. Reward dependence is a tendency to acquire conditioned social cues, and manifests through sentimentality, sociability and dependence on the approval of others (Cloninger et al., 1993). By early adolescence, temperament and individual traits become more interchangeable (Soto & Tackett, 2015), partly because the emotional responses are modified by the development of character (Cloninger et al., 1993), forming individuals' personality. How individuals regulate their impulses and emotional arousal is, in other words, reflected both in their personality and their behavior. For example, difficult temperament (Goldsmith et al., 1987) (characterized by for instance withdrawal of responses and high impulsiveness) at age 5 (Lerner & Vicary,

1984) is associated with alcohol abuse in adulthood. In contrast, persistent and outgoing temperament at age 4 is protective of alcohol problems during adulthood (Wennberg & Bohman, 2002). Individuals who are characterized by high novelty-seeking, low harm avoidance and low reward dependence have low inhibition of impulses and have risk-taking tendencies, which in turn are related to early alcohol use (Cloninger, Sigvardsson, & Bohman, 1988; Hartman, Hopfer, Corley, Hewitt, & Stallings, 2013). Thus, adolescents with certain temperament tendencies are more inclined to be involved in risk behaviors.

Does Adolescent Temperament Moderate the Impact of Parenting on Adolescent Behavior?

Psychosocial development is not only influenced by temperament tendencies or by external forces such as parenting, but also by the interaction between individual characteristics and contextual demands. Consequently, the effects of parenting on adolescent psychosocial development may vary depending on the temperament of the adolescent. Although temperament is a moderately stable entity of personality, parenting practices is one environmental factor that in interaction with child's temperament, may affect child's personality (De Pauw & Mervielde, 2010). In addition, parenting practices attenuate or intensify the behaviors that constitute the temperamental tendencies. For example, children with poor self-regulation (Lengua et al., 2000) and negative emotionality (Kochanska et al., 2013) have more conduct problems compared to other children. However, when met with supportive and responsive parenting practices, the risk for behavior problems decreases. In addition, the mixed results in studies linking parental knowledge and its sources with adolescent psychosocial development may be a result of the limited focus on the possibility that adolescent temperament would moderate such links. Since the year 2000, studies have presented empirical evidence for the moderating effect of child personality (including temperament) on the association between certain aspects of parenting and adolescent behavior (Crocetti et al., 2016; Eaton et al., 2009; Kochanska et al., 2013). Two studies (Crocetti et al., 2016; Eaton et al., 2009) have focused on the moderating effects of adolescent personality on links between parental knowledge and its sources and adolescent psychosocial development. However, literature in this field rarely differentiates between

temperament as heritable individual characteristics and personality characteristics obtained through sociocultural learning. Studies including the link between child temperamental tendencies and parenting have merely focused on toddlerhood and early childhood (Kochanska et al., 2013), while studies focusing on temperament and its interaction with parenting during adolescence are scarce.

To our knowledge, there are only a few studies linking adolescent temperament with parental knowledge and its sources. These studies indicate that parental controlling strategies are particularly disadvantageous for the psychosocial development of adolescents who have what is referred to as difficult temperaments (Goldsmith et al., 1987). For example, parental behavioral control appears to have an unfavorable effect on the development of externalizing behavior among adolescents with negative affectivity (Stice & Gonzales, 1998). When parental control is high, these adolescents seem to react with more and not fewer externalizing behaviors. It is likely that they react in an oppositional way because they interpret parental controlling behaviors in a hostile manner (Zeijl et al., 2007), which consequently harms their personal growth. However, when these adolescents are met with responsive and warm parenting, the likelihood of disadvantageous development declines (Belsky & Beaver, 2011; Padilla-Walker & Nelson, 2010). Based on this empirical background, one could assume that parental monitoring practices such as parental solicitation and control do not protect against the development of substance use in adolescents high on thrill-seeking or negative affect. In addition, adolescent disclosure as an indicator of close and warm parent-adolescent relationships (Kapetanovic et al., 2018) would protect against engagement in delinquent behaviors, particularly for adolescents with such temperament. Taking this into account, it seems that a match between child characteristics and parenting practices is beneficial to a child's behavioral outcomes. Furthermore, when parenting practices do not match the individual characteristics of the child, the risk of poorer psychosocial development increases (Eccles et al., 1991; Lerner & Kauffman, 1985). In other words, depending on how attuned parents are to the adolescent's individual characteristics, their practices may have different effects on adolescent psychosocial development. Thus, it is possible that parental knowledge and its sources have different associations with adolescent risk behavior, depending on the individual characteristics of the adolescent.

Current Study

The existing literature has gaps that need to be addressed. First, adolescent psychosocial development is not only bound to contextual factors such as parenting. The way parenting interacts with the temperament and needs of the adolescent may have a substantial influence on adolescent development. As shown in earlier research (Belsky & Beaver, 2011; Padilla-Walker & Nelson, 2010), adolescents with impulsive or fearless tendencies may react in a hostile manner to parental control yet benefit from warm and responsive parenting. Although some studies have investigated the moderating effect of adolescent temperament on the links between parental monitoring efforts and adolescent behavior (Crocetti et al., 2016; Stice & Gonzales, 1998), adolescent disclosure has not been included within the research parameters. To our knowledge and despite its established importance for parental knowledge and the protection of risk behaviors (Kapetanovic et al., 2018), adolescent disclosure has only been included in one cross-sectional study where personality moderation (including temperament) is studied (Eaton et al., 2009). Failure to examine adolescent disclosure may result in an overemphasis of the effect of parental monitoring efforts on adolescent behavior. Adolescent disclosure is a stronger predictor of parental knowledge and of adolescent behavioral outcomes than parental monitoring efforts (Kapetanovic et al., 2017; Keijsers et al., 2010; Stattin & Kerr, 2000), and should therefore be included in models. In addition, this will be the first study to investigate the moderating role of adolescent temperament on reciprocal associations between parental knowledge (including adolescent and parent-driven sources) and adolescent substance use. Another gap is in the approach generally taken in this area. The moderating effect of temperament on links between parenting and child behavior is typically analyzed using a variable approach to personality (Kochanska et al., 2013). Although some temperament characteristics may be more or less pronounced, human behavior is not usually affected by one trait at a time, but is rather a product of interaction between several traits that constitute one's personality (Robins & Tracy, 2003). Although studies have applied person-centered approaches to adolescent personality in interaction with parenting (De Haan, Deković, Van den Akker, Stoltz, & Prinzie, 2013), to our knowledge, no prior study in the parenting–risk behavior literature has applied a person-centered approach using the

temperament dimensions in the Junior Temperament and Character Inventory (JTCI) (Boson, Brändström, & Sigvardsson, 2017). In line with findings of earlier research, we hypothesize that adolescent temperament type moderates developmental links between parental knowledge and its sources and adolescent substance use. Additionally, few studies have investigated the moderating effect of adolescent temperament on links between parenting and adolescent behavior in young adolescents (Stice & Gonzales, 1998). Because early adolescence is the developmental period when personality substance use increases markedly (Colder, Campbell, Ruel, Richardson, & Flay, 2002) and impulsivity is at its peak (Steinberg, 2010), more focus is needed on parenting and substance use during this period, not least for the development of effective preventive interventions. The final gap is the lack of a long-term study. Although many developmental changes in parent–adolescent interactions occur during early adolescence (Larson, Richards, Moneta, Holmbeck, & Duckett, 1996), parents will continue to have an influence on their adolescent children's socialization (Grusec, 2011), which is why a longitudinal approach should be applied to studying the links between parenting and adolescent behavior.

To address these gaps in the literature, our goal was to investigate whether longitudinal associations between parental knowledge and its sources and adolescent substance use are moderated by adolescent temperament. First, we performed cluster analyses to discriminate the possible configurations of novelty-seeking, harm avoidance and reward dependence, using the temperament dimensions in the JTCI. Next, we implemented a model with reciprocal associations between parental knowledge and its sources and adolescent substance use. Finally, we tested the moderating effect of adolescent temperament configurations on associations among adolescent disclosure, parental knowledge, solicitation and control, and adolescent substance use over time.

METHOD

This study is part of an ongoing research program, Longitudinal Research on Development in Adolescence (LoRDIA), in which adolescents' health, school functioning, social networks, and substance use are studied. The program is designed to follow 1,896 adolescents in two small cities and two mid-size cities in southern Sweden from the age of 12 or 13 until they are 18 years of age. In 2013, contact

was established with all primary schools in the participating municipalities and with the parents of the pupils. Students, as well as their parents, were informed about the study, its confidentiality and the voluntary basis of participation. Parents and students had the opportunity to refuse consent for the students' participation. The students replied annually to questionnaires, which were collected in the classrooms by the research team. The study received ethical approval from the Regional Research Review Board in Gothenburg (No. 362-13; 2013-09-25; 2014-05-20; 2015-09-02).

Parenting measures and adolescent substance use were assessed in data collection Wave 1 and Wave 3 (from now on referred to as T1 and T3) of the research program, while assessment of students' personalities was carried out in Wave 2.

Participants

For this particular study, the datasets from all three waves were used. Because adolescent temperament was one of the main variables in this study, the data were processed by first including the adolescents who had completed a personality assessment during Wave 2 of the study ($n = 1,373$), thereafter adding the data from T1 and T3. In the analytical sample, the adolescent mean age at the baseline was 13.02 years (± 0.60). Girls constituted 51.6% of the sample. The majority of students were of Swedish ethnicity (84.4%) and were living with both parents (82.6%).

We compared data from adolescents in our analytical sample with data from the total population of adolescents in the LoRDIA research program. The analyses revealed that the participants, compared to those with missing data, were more frequently girls (51.6% vs. 43.7% $p < .001$), had higher merit points (211.50 [± 39.98] vs. 179.69 [± 57.80] $p < .001$) and were more seldom absent from school (% absent hours/year: 6.01 [± 6.1] vs. 7.38 [± 7.1] $p < .001$) compared with the total sample of adolescents. There were no significant differences in immigrant status (18.7% vs. 18.6%).

Measures

Adolescent substance use. The scale for adolescent substance abuse is based on questions from the annual survey by the Swedish Council for Information on Alcohol and Other Drugs (CAN) on substance use among ninth graders (Gripe, 2015). The scale contained three questions about the frequency of adolescent use of alcohol, cigarettes, and

snuff during the past 12 months, with ratings from 1 (*never*) to 3 (*many times*) (T1: $\alpha = .63$; T3: $\alpha = .75$).

Parental knowledge, solicitation and control, and adolescent disclosure. The scales, which were developed by Stattin and Kerr (2000), were used to measure parental knowledge and its potential sources. The ratings for all measures were 1 (*never*), 2 (*sometimes*), and 3 (*often/always*). Parental knowledge (T1: $\alpha = .70$; T3: $\alpha = .74$) measured how much parents knew about their children's whereabouts and associations, based on six items, such as "Do your parents know what you do during your free time?" Parental solicitation (T1: $\alpha = .74$; T3: $\alpha = .73$) assessed information on how often parents asked about the adolescents' unsupervised time based on six items, such as "How often do your parents initiate a conversation about things that happened during a normal day at school?" Parental behavioral control (T1: $\alpha = .73$; T3: $\alpha = .83$) measured ways in which parents controlled adolescents' behavior through rule-setting, based on five items, such as "Do you need to have your parents' permission to stay out late on a weekday evening?" Adolescent disclosure (T1: $\alpha = .71$; T3: $\alpha = .71$) assessed adolescents' voluntary disclosure to their parents about their activities during their free time, based on five questions, such as "If you are out at night, when you get home, do you tell your parents what you have done that evening?"

Temperament. Adolescent temperament was assessed by using the JTCI, which is a validated adolescent version, in Swedish, of the Temperament and Character Inventory (TCI) (Boson et al., 2017). The measure consists of 108 statements that adolescents rate as true or false, based on how they usually act and feel. The statements construct four temperament dimensions and three character dimensions, namely self-directedness, cooperativeness, and self-transcendence. Three of the temperament dimensions, novelty-seeking (18 items) ($\alpha = .69$), harm avoidance (20 items) ($\alpha = .82$), and reward dependence (9 items) ($\alpha = .58$), were used in this study. The fourth temperament dimension, persistence, was excluded due to poor internal consistency ($\alpha = .31$).

Mean scores, based on the condition that 75% of all items in the measure were answered, were computed for all used measures, and were then used in the analyses. For some measures (i.e., substance use, novelty-seeking and reward dependence) alphas were somewhat lower than usually accepted (.70). However, for many scales used among children,

alphas are sometimes low (e.g., .59–.68 for the Children's Depression Inventory; Kovacs, 2003), and therefore alpha $>.60$ was accepted (Lowenthal, 2001).

Data Analysis

The data analyses were conducted in four steps. First, we applied cluster analytic techniques to identify clusters of participants characterized by similar patterns of temperament. In this study, we performed the cluster analysis using ROPstat (Vargha, Torma, & Bergman, 2015), the statistical package for pattern-oriented analysis. We applied Ward's hierarchical clustering method to investigate the data and to determine the number of clusters. Subsequently, we applied the K-means clustering method to optimize the homogeneity of the chosen cluster solution. We chose the cluster solution based on the following: (1) theoretical meaning of cluster solution, (2) significantly better solution than obtained on a random data set with same size, variables and number of clusters, (3) level of homogeneity in the cluster solution ($HC = <0.1$), and (4) the degree of explained variance (EESS%), which preferably should be above 67% or at least exceed 50% (Vargha et al., 2015). To describe the scores in comparable format, we converted all index scales into z-scores.

Second, in order to confirm the internal structure of the scales used in a cross-lagged model, a series of cross-sectional confirmatory factor analyses (CFAs) were conducted. CFA fit was evaluated using goodness-of-fit statistics: chi-square ($p > .05$), the Tucker Lewis index ($TLI > .95$), comparative fit indices ($CFI > .90$) and the root-mean square error of approximation ($RMSEA < .08$). After the CFAs were completed, we needed to establish metric invariance across the time points (Van de Schoot, Lugtig, & Hox, 2012). Determining metric invariance would imply that the items used to measure constructs of interest also measure identical constructs over time. For each measure, a baseline model (Model A), with free factor loadings, was established and compared to a model with constrained factor loadings over time (Model B). If the constrained model was not significantly different from the baseline model that would imply metric invariance existed. The relative fit of the constrained model was evaluated based on the change in CFI (ΔCFI). If the decrease in CFI was $<.01$, that would indicate an equivalent fit between the models. For each tested measure, the change in CFI was $<.01$ ($\Delta CFI < .01$) (see Appendix S1). We could therefore continue with further analyses.

In the next step, we estimated the correlations between the constructs and thereafter implemented a cross-lagged model with associations between adolescent disclosure, parental knowledge, parental solicitation, parental control, and adolescent substance use. We ran the models in AMOS, using the Full Information Maximum Likelihood (FIML) approach. With FIML, it is possible to produce unbiased parameter estimates as well as bias-corrected confidence intervals (Byrne, 2010). The linear regression imputation technique was used to impute the missing values for each case with missing data, resulting in a complete dataset. Skewness and kurtosis were problematic for substance use at T1 and T3. Therefore, to obtain a bias-corrected χ^2 p -value for each model, we conducted a 200-algorithm bootstrap to obtain bias-corrected p -values and confidence intervals for the assessment of the paths in each model (Byrne 2010).

Finally, we performed multigroup analyses to test the moderating role of adolescent temperament on the links among parental knowledge, its sources, and adolescent substance use. The constrained model (where effects were set equivalent across temperament c) and the unconstrained model (where effects were freely varying) were compared using a χ^2 -difference test. A significantly better fit of the unconstrained model (indicated by significant $\Delta\chi^2$ statistics) would indicate moderation.

RESULTS

Five Temperament Types among the Adolescents

In the cluster analyses, the grouping of temperament scores for novelty-seeking, harm avoidance and reward dependence resulted in a five-cluster solution. The cluster solution was based on the following: the meaningfulness of the clusters, significantly better solution than obtained with random data (see Appendix S2), homogeneity in the clusters (0.73–0.93), and explained variance (59.93%). Figure 2 illustrates the five personality clusters. Cluster 1 ($n = 317$; 70.3% boys) consisted of adolescents who had somewhat elevated scores for novelty-seeking, low levels of harm avoidance, and low levels of reward dependence. Because of their inclination toward fearlessness, yet indifference toward and detachment from others, we called this cluster *detached and fearless*. Cluster 2 ($n = 167$; 44.2% boys) consisted of adolescents scoring high for novelty-seeking and harm avoidance and low for reward dependence. Because of the

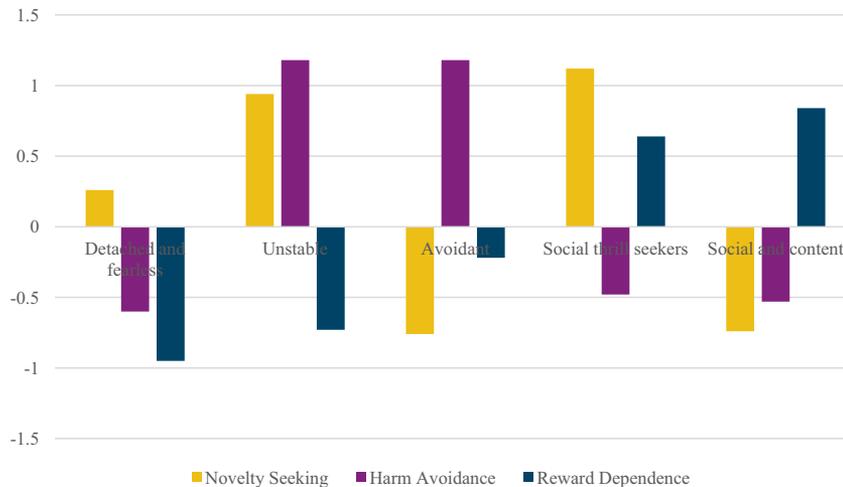


FIGURE 2 Five temperament clusters characterized by novelty-seeking, harm avoidance, and reward dependence.
 Note: Detached and fearless $n = 317$; Unstable $n = 165$; Avoidant $n = 267$; Social thrill-seekers $n = 229$; Social and content $n = 395$.

incongruous inclination toward novelty, we called this cluster *unstable*. Cluster 3 ($n = 268$; 37.5% boys) consisted of adolescents who had low levels of novelty-seeking, high levels of harm avoidance and low to average levels of reward dependence. Because of their noninterest in new excitements, their fearfulness, and some insensitivity to social cues, we called this cluster *avoidant*. Cluster 4 ($n = 229$; 47.6% boys) consisted of adolescents who had high levels of novelty-seeking, low levels of harm avoidance and high levels of reward dependence. Based on their profile, adolescents in this group were considered to be inclined to impulsive decision-making and thrill-seeking, but also to be sociable and attached to others. We called this cluster *sociable thrill-seekers*. Finally, cluster 5 ($n = 395$; 39.0% boys) consisted of adolescents who had low levels of novelty-seeking, low levels of harm avoidance and high levels of reward dependence. Adolescents in this group were socially attached, and less inclined to seek new and exciting events, although not out of fear. We therefore called this cluster *social and content*.

Does Adolescent Temperament Moderate Links between Parental Knowledge and its Sources and Adolescent Substance Use over Time?

To test moderation by temperament cluster, we implemented a model with the cross-lagged associations among adolescent disclosure, parental knowledge, parental solicitation, parental control and adolescent substance use at T1 and T3. The overall fit of the model was satisfactory, $\chi^2(13) = 14.905$, $p = .313$; TLI = .999; CFI = 1.00;

RMSEA = .010. As Figure 3 shows, there were bidirectional and negative associations between adolescent disclosure and substance use. Furthermore, adolescent disclosure at T1 was positively linked with parental knowledge, parental control and parental solicitation at T3. T1 parental knowledge was negatively related to T3 adolescent substance use, while T1 parental solicitation was positively related to T3 adolescent substance use. We could now pursue multigroup analyses where the moderation effect could be tested.

The multiple group analysis showed moderation in four paths, namely those between T1 adolescent disclosure and T3 adolescent substance use, $\Delta\chi^2(4) = 20.684$, $p = .001$, T1 parental knowledge and T3 adolescent substance use, $\Delta\chi^2(4) = 10.773$, $p = .029$, T1 parental solicitation and T3 substance use, $\Delta\chi^2(4) = 15.503$, $p = .004$, and T1 adolescent substance use and T3 adolescent disclosure, $\Delta\chi^2(4) = 13.540$, $p = .009$. T1 adolescent disclosure was negatively related to T3 substance use for adolescents in the detached and fearless cluster ($\beta = -.288$, $p = .015$) and the unstable cluster ($\beta = -.377$, $p = .005$), but nonsignificant in the avoidant, thrill-seeking and social, and content clusters. T1 parental knowledge was negatively related to T3 substance use for adolescents in the detached and fearless cluster ($\beta = -.179$, $p = .015$) but was nonsignificant in the other four clusters. T1 solicitation was positively related to T3 substance use for adolescents in the detached and fearless cluster ($\beta = .233$, $p = .008$), but nonsignificant in the other four clusters. T1 adolescent substance use was negatively related to T3 adolescent disclosure for adolescents in the detached and fearless cluster

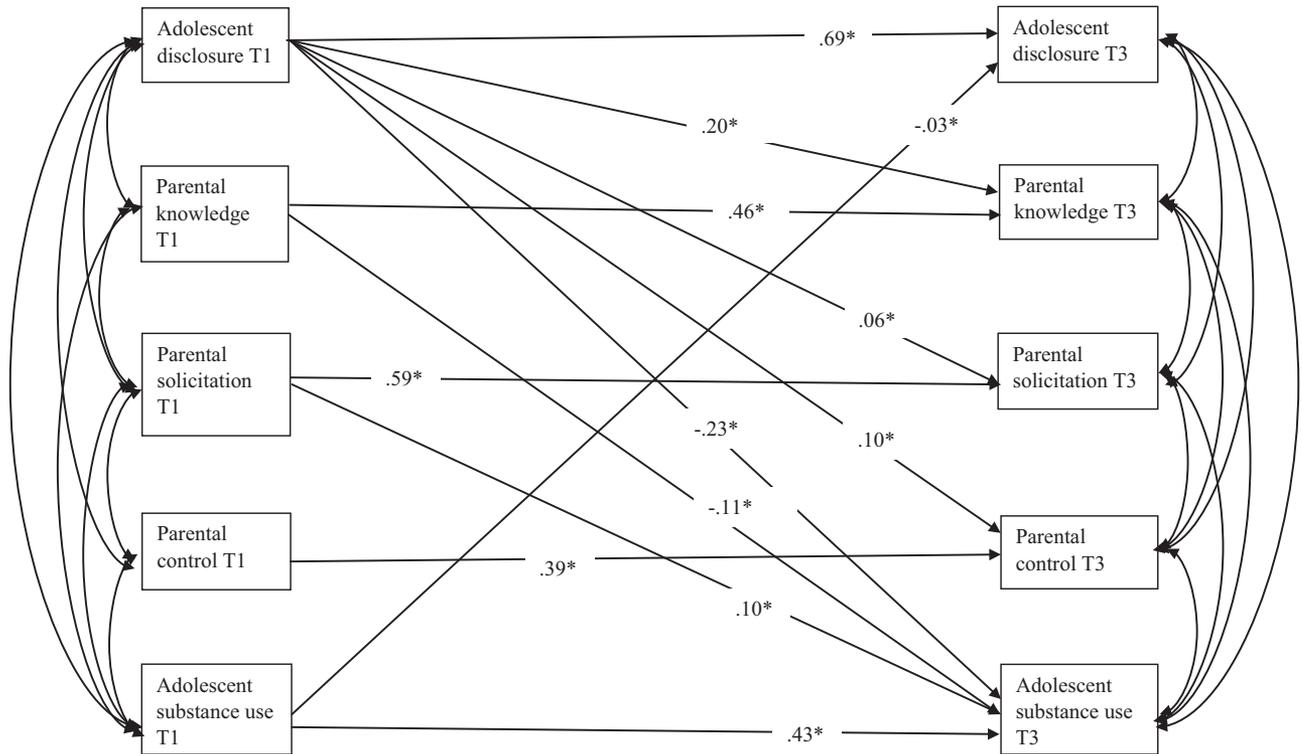


FIGURE 3 Longitudinal associations between adolescent disclosure, parental knowledge, parental solicitation, parental control, and adolescent substance use.

($\beta = -.111$, $p = .009$) and adolescents in the social and content cluster ($\beta = -.064$, $p = .026$). The link was not significant for adolescents in the unstable, avoidant, and thrill-seeking clusters.

DISCUSSION

Substance use, including alcohol drinking, is a major risk in adolescent development. One criterion for healthy development in adolescence is positive interaction between parents and their early-adolescent children. Knowing what their adolescents do and their whereabouts provides opportunities for parents to better protect their adolescents from using substances. Such knowledge is mainly a function of adolescents' voluntary disclosure (Stattin & Kerr, 2000), although parental solicitation and behavioral control (Laird et al., 2010) may be informative as well. However, parents and their adolescents together construct their relationships (Loulis & Kuczynski, 1997), which is why dynamic processes in relationships should be considered when studying development (Meeus, 2016). In addition, theoretical perspectives suggest that behavioral development occurs in a multilevel context, where the interrelation between individual characteristics and the features of the individual's context shape

individual behavior (Lerner & Kauffman, 1985). In other words, individuals and their contexts, in this case adolescents and their parents, are dynamically interactive in the process of an individual's development. Existing literature lends support to such a hypothesis, showing that adolescents who are temperamentally inclined to engage in risk behaviors (Stice & Gonzales, 1998) benefit from warm and supportive parenting (Belsky & Beaver, 2011), for their psychosocial development. To date, there are, to our knowledge, no studies focusing on the moderating role of adolescent temperament on the link among parental knowledge, its sources and adolescent substance use. To address these gaps, we performed a cluster analysis, which grouped adolescents into five distinct temperament clusters—(1) detached and fearless, (2) unstable, (3) avoidant, (4) sociable thrill-seekers, and (5) social and content. Thereafter, we investigated the moderating effects of temperament type on the longitudinal relations among adolescent disclosure, parental knowledge, solicitation and control, and adolescent substance use. Combining individual temperament with contextual demands, in this case parenting, offers new insights into the monitoring literature by identifying which parenting practices may work for which types of adolescents.

Adolescent Temperament Moderation in Links between Parenting and Adolescent Substance Use

In line with earlier research, we found bidirectional associations between adolescent disclosure and substance use (Keijsers et al., 2010). Adolescent voluntary disclosure has a protective function toward adolescent engagement in substance use, possibly because of strong emotional bonds (Kapetanovic et al., 2018) or trust (Kerr et al., 1999) between parents and their adolescents. However, what adolescents do has an impact on how much they disclose, which consequently could have an impact on the parent-adolescent relationship and parents' awareness of adolescents' whereabouts. However, the effect size in the link between adolescent substance use and disclosure is weak which is why this result should be interpreted with caution. The results also show that parental knowledge of adolescents' whereabouts (Kerr et al., 2010) was related to lower levels of adolescent engagement in substance use, while parental solicitation (Kapetanovic et al., 2018) was related to higher levels of adolescent engagement in substance use. Adolescent disclosure was related to higher levels of parental knowledge as well as parental solicitation and parental control over time. Thus, adolescent disclosure promotes parents' structuring of adolescents' everyday lives as well as communication between parents and their adolescent children.

Some of the links between parental knowledge and its sources and adolescent substance use were moderated by adolescent temperament. Parental solicitation seems to be associated with higher levels of engagement in substance use in adolescents in the detached and fearless cluster, but not in the other clusters. The detached and fearless cluster of adolescents includes individuals with a somewhat elevated level of novelty-seeking, and low levels of harm avoidance and reward dependence. Because of their unresponsiveness to danger, individuals with this type of temperament are particularly inclined to engage in risk behaviors, including substance use (Cloninger et al., 1988; Hartman et al., 2013). When parents actively seek information from their adolescents, this results in more and not less adolescent engagement in substance use over time. One explanation is that parental soliciting efforts may be perceived as intrusive because they enhance adolescents' feelings of being overly controlled (Kapetanovic et al., 2017), which in turn may provoke autonomy frustration (Van Petegem, Soenens, Vansteenkiste, & Beyers, 2015). Low levels of sociability in the

detached and fearless cluster may explain why these adolescents may be sensitive to parents' questions and queries. Less social adolescents may have difficulty in cognitively processing parental queries for information (Grusec, 2011) and may interpret parents' queries as intrusive. When adolescents perceive their parents to be intrusive, the need for autonomy may manifest in frustration and subsequent engagement in substance use (Soenens & Vansteenkiste, 2010). In other words, adolescents who have unsocial and fearless tendencies seem especially sensitive to how they are approached by parents, which may have an impact on their psychosocial development (Stice & Gonzales, 1998). Our study provides empirical support for such an idea and is in line with goodness-of-fit theory (Eccles et al., 1991). When adolescent temperament and parental practices are balanced and attuned, it is likely to benefit the psychosocial development of adolescents.

Parental knowledge was related to lower levels of substance use involvement for adolescents in the detached and fearless cluster. The bidirectional links between adolescent disclosure and substance use were also evident in the detached and fearless cluster. When adolescents of such a temperament type engaged in open communication with their parents, their level of involvement in substance use declined. As parental knowledge is most likely a result of adolescent disclosure (Stattin & Kerr, 2000), the link between parental knowledge and adolescent substance use could be a result of the effect that open communication may have on adolescent behavior. However, when involved in substance use, particularly the adolescents in the detached and fearless cluster tended to close down. In addition, adolescent disclosure was also protective against adolescent substance use for adolescents in the unstable cluster. The latter two clusters are characterized by risk-taking tendencies due to the composition of the temperament dimensions, although in different ways. Those in the detached and fearless have low harm avoidance and reward dependence, not holding back despite the risk involved in somewhat enhanced novelty-seeking. Those in the unstable cluster are characterized by high novelty-seeking combined with even higher harm avoidance, which creates a strong inner tension between wanting excitement and at the same time expecting disaster, without good possibilities for regulating this tension through interaction with others. Responsive and emotionally attuned parenting may enable adolescents with thrill-seeking tendencies or poor emotional self-regulation to learn

self-regulation (Belsky & Beaver, 2011) and effortful control (Mun, Dishion, Tein, & Otten, 2017). This goes in line with studies using the Big Five personality typology, suggesting that Undercontrollers (low scores on agreeableness and conscientiousness) tend to engage in more externalizing problems compared with Overcontrollers (low scores on Extraversion, Emotional Stability, and Imagination) and Resilients (above average scores on agreeableness, extraversion, conscientiousness, emotional stability, and imagination) (De Haan et al., 2013).

According to Cloninger's biopsychosocial theory, learning regulatory skills, for example, through positive parenting, benefits the development of personality as a whole and attenuates the risks associated with temperamental tendencies (Cloninger et al., 1993). As adolescent disclosure is indicative of strong parent-adolescent bonds and the strongest source of parental knowledge (Kapetanovic et al., 2018), strengthening open communication between adolescents and their parents would particularly help adolescents with risk-taking tendencies and poor self-regulation to handle everyday difficulties and would thus promote healthy psychosocial development.

In line with the results of our study, we suggest that parental soliciting efforts might be disadvantageous, while open communication between parents and adolescents is probably beneficial to adolescent psychosocial development, especially for adolescents who rate high in thrill-seeking (Stice & Gonzales, 1998) and fearlessness (Padilla-Walker & Nelson, 2010), and low in sociability (Grusec, 2011). More broadly, when addressing the links between parental knowledge and its sources and adolescents' behaviors, adolescent temperament tendencies should be recognized. As the results in our study indicate, adolescents' temperament plays a significant role in the longitudinal effects that adolescent disclosure and parental solicitation, in particular, have on adolescent psychosocial development.

Limitations and Strengths

This study has both limitations and strengths. The strengths of the study are the person-oriented approach using the JTCI instrument, the inclusion of two waves of parenting data, and the focus on the moderating effects of adolescent temperament on the links between parental knowledge and its sources and adolescent behavior. Applying a moderating approach to the effects of parenting on adolescents' behaviors helps to identify which

parenting practices are beneficial or detrimental to which adolescents.

One limitation is that the self-reporting questionnaires used to measure the constructs may produce rater bias. Although parenting measures and risk behavior measures do not have observer ratings, the congruence between adolescents' and their caregivers' ratings on JTCI has been found elsewhere (Boson et al., 2017). Another possible limitation is the fact that some of the alphas were below .70. Nevertheless, for many children's scales, alphas are sometimes low (e.g., .59-.68 for the Children's Depression Inventory; Kovacs, 2003). In addition, other researchers have argued against focusing solely on alpha levels for measuring the reliability of a scale (Taber, 2017). Despite somewhat low alphas for the scales and intercorrelation of scales, the adult version of TCI has been shown to work well compared to other instruments (such as NEO-P-RI Costa & McCrae, 1992) (Grucza & Goldberg, 2007). We are unaware of similar comparisons for the junior version. A third potential limitation is the use of cluster analysis to create temperament profiles. There are indications in the literature that model-based method, for example, latent profile analysis (LPA), could be a more suitable clustering technique (Magidson & Vermunt, 2002). Nevertheless, in contrast to cluster analysis, LPA comes with the assumption of local independence and normality of the data, which may result in misclassifications. Comparisons between model-based methods and cluster-analysis based methods show that applying a cluster-analysis based method is a justified method of classification (Bergman, Vargha, & Kövi, 2017; Chaturvedi, Green, & Carroll, 2001). A final limitation is that the parenting data was not included in the questionnaire from Wave 2, which had an effect on the chosen design where parental knowledge and adolescent substance use were studied between Wave 1 and Wave 3. Another design would be to measure reciprocal relations between Wave 1 and Wave 2. However, by employing a cross-lagged design we were able to determine the direction of the relations between the parenting measures and adolescent substance use and make developmental inferences with the findings, as suggested by Meeus (2016).

Conclusion and Implications

Our findings contribute to the literature by providing information on developmental processes in the parent-adolescent relationship including the role of adolescent temperament on associations between

parental knowledge and its sources and adolescent substance use over time. Adolescents can be likely to engage in substance use. When parents have information about what their adolescents do, they can protect their adolescents from substance use involvement. However, some parenting practices may be of special importance for the psychosocial development of young adolescents, depending on the adolescents' temperament. To be specific, temperamental tendencies of thrill-seeking and social detachment may make adolescents more inclined toward risk-taking. If they are also psychosocially immature and thus have trouble controlling their impulses and taking personal responsibility for their actions (Steinberg & Cauffman, 1996), that may make it difficult for them to regulate their behavior. At the same time, parents are central to healthy development in adolescents as well as to the development of adolescent personality (Bates & Pettit, 2015). They are of particular importance for the development of self-controlling strategies and mature reasoning in moral and social situations in adolescents. Considering the results in our study, we suggest that responsive and warm parenting is the most beneficial for the psychosocial development of adolescents with risk behavior tendencies. When open communication between parents and their adolescents is established, adolescents engage in less substance use over time. Parents can then also facilitate the maturation process in these adolescents. In addition, questioning and supervising of adolescents who are fearless and socially detached seems to increase oppositional behavior in these adolescents. These adolescents then engage more and not less in substance use. Individuals with this temperament type are also at risk for developing antisocial or emotionally unstable personality disorders (Cloninger et al., 1993), which is why early preventive strategies are of great importance. The practical implications of the current findings may involve tailoring parenting programs to have a greater focus on the different predispositions of adolescents in order to recognize which parenting practices would provide the most benefits for healthy psychosocial development in adolescents. More focus on the impact of warm and responsive parenting practices, through which open communication between parents and their adolescents would be promoted, is needed. Professionals working with adolescents, such as teachers and recreational workers, may need to address the question of variability in how adolescents respond to their demands and queries to improve the climate in schools and recreational organization. We

need to consider that a mismatch between adolescents' individual characteristics and contextual demands may have a disadvantageous impact on adolescent development. However, when the environment is attuned to adolescents' needs, as suggested by person-environment fit models (Eccles et al., 1991), favorable psychosocial development of adolescents may result. Finally, future research could include individual temperament in the models of parenting in order to obtain a better idea of what practices work for what adolescents. More longitudinal research is needed to fully understand what impact parents and adolescents, respectively, have on their parent-adolescent interaction and adolescent development.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1. Model fit indices and comparison between unconstrained and constrained model over time.

Appendix S2. MORI validation coefficients for the 5-cluster solution.