Dimensions of the parent-child relationship: effects on substance use in adolescence and adulthood

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Abstract

Background: Several studies have uncovered a relationship between parenting styles and the likelihood that adolescents use tobacco, alcohol or illegal drugs. **Objectives**: This paper extends existing research in two ways. First, we consider a longer time-frame, investigating the relationship between parenting in adolescence and substance use in adulthood. Second, we explore the pathways by which this relationship is expressed, in particular the extent to which the relationships in question are mediated by age at first use and depression. **Methods**: Our analysis is based on data from the National Longitudinal Study of Adolescent Health (Add Health), N=2954, and is conducted using structural equation modelling (SEM). We consider warmth and control as distinct dimensions of parenting, as well as a typology of parenting which combines the two dimensions. **Results**: Warmth is associated with reduced risks of problem substance use in adulthood, via reduced risks of early initiation and a lower risk of depression. Parental control also has a protective effect via reduced risks of early initiation, but this is offset by a detrimental effect on depression, particularly in the case of older adolescents. We also find that indulgent parenting is not associated with extra risk of any kind compared with the authoritative style, whereas authoritarian and neglectful styles are. **Conclusions/Importance**: The nexus of relationships which we uncover has implications for policy aimed at reducing substance use in the longer term, suggesting that initiatives to promote warm and responsive parenting may be most effective in reducing the risks of later substance use problems.

Keywords: Adolescent health; substance use problems; depression; parenting styles; longitudinal analysis.

1. Introduction

The social costs of alcohol, tobacco and illegal drug use are considerable; recent estimates suggest that excessive drinking costs the US almost $250 billion each year (Sacks et al., 2015), while smoking-related illness accounts for almost 9% of healthcare spending (Xu et al., 2015). Substance use also exacts heavy personal costs on the individuals involved and their families, in the form of mental and physical health problems, lost income, relationship problems, and lost years of life (Whiteford et al., 2013; U.S. Department of Health and Human Services (HHS) & Office of the Surgeon General U.S., 2016) .

There is evidence that parenting and family relationships influence the propensity for substance use in adolescence, and that interventions promoting effective parenting can reduce adolescent substance use (Schinke et al., 2011; Haggerty et al., 2013; Allen et al., 2016). However, there is also evidence that adolescent substance use is extremely widespread (Young et al., 2002), often experimental and self-limiting, and in itself generally not associated with a significant degree of contemporaneous or future harm (Baumrind, 1991; Englund et al., 2013). This is not to say that that adolescent substance use is unproblematic – indeed, it is a significant predictor of later substance use problems (McCambridge et al., 2011) – but given limited resources available for prevention programs, it is arguable that research on substance use should focus on identifying the determinants of problem usage beyond adolescence (Shedler & Block, 1990).

This paper is based on four waves of data from the *Add Health* study, a prospective longitudinal survey that follows a group of children (N=2954) from adolescence into early adulthood. We explore the effects of parenting style in adolescence (when sample members have a mean age of 15.4 years), on problem use of tobacco, alcohol, marijuana and other illegal drugs 13 years later, when sample members have a mean age of 28.2 – by which point most

people have jobs, many have families, and substance use is no longer a youthful indiscretion but may potentially have serious effects on life chances.

We use a model of parenting styles originating in the work of Baumrind (1966, 1968, 1971, 1991). It proposes two distinct dimensions of parenting: warmth/responsiveness (the degree to which the parent/child relationship is warm, close and affectionate), and control/demandingness (the degree to which parents have expectations of good behavior on the part of their children, and the extent to which they encourage or enforce compliance with those expectations). Baumrind's original schema defined three parenting styles: *authoritative* (high in both warmth and control); *authoritarian* (high in control but low in warmth); and *permissive* (low in control). This schema has formed the basis for widely-used survey instruments (Robinson et al., 1995) and for a large body of research, in areas including developmental competence (Baumrind, 1971, 1991); self-esteem (Buri et al., 1988; Chan & Koo, 2011); and educational achievement (Dornbusch, 1987; Steinberg et al., 1989); the authoritative parenting style is almost invariably associated with the best outcomes.

This threefold schema has now been largely superseded by a full orthogonal two-factor model, which divides the permissive group into an *indulgent* group, high in warmth and low in control; and a *neglectful* group, low in both warmth and control (Maccoby & Martin, 1983). This schema decouples low- and high-warmth parents among those exerting lower levels of control; many studies using this schema find that indulgent parenting is associated with outcomes as good as authoritative parenting, while outcomes for the neglectful group are poor; in other words, the major effect is via the warmth rather than the control axis. This pattern is found in several studies examining mental or psychological competence and wellbeing (Stafford et al., 2016; García & Gracia, 2009; Eun et al., 2018; Schofield et al., 2012; Martinez et al., 2017; Martinez et al., 2019). A number of studies relating specifically to substance use in adolescence also find similar results, including those of Kandel et al. (1978), Bronte-Tinkew et al. (2006), Adalbjarnardottir and

Hafsteinsson (2001), Ozer et al. (2011), Martinez et al. (2013), Calafat et al. (2014), and Valente et al. (2017).

Not all studies find warmth to be the more important dimension. Some studies find both dimensions to be of approximately equal importance, either as determinants of competence and adjustment (Lamborn et al., 1991; Steinberg et al., 1994), or as protective factors against substance use (Hill et al., 2005; Piko & Balázs, 2012). Other studies suggest that control is more important than warmth as a protective factor against adolescent substance use (Barnes et al., 2000; Kosterman et al., 2000; Aquilino & Supple, 2001; Choquet et al., 2008).

This paper seeks to extend the state of knowledge in two ways. First, we examine a time frame extending from adolescence into the late twenties. Most studies in this area have focused on adolescence, with longitudinal studies following subjects only into late adolescence or the early adult years (Steinberg et al., 1994; Barnes et al., 2000; Aquilino & Supple, 2001; Roche et al., 2008; Mogro-Wilson, 2008; Stone et al., 2012, Van Ryzin et al., 2012). Very few studies follow adolescents into adulthood. Dubow et al. (2008) consider a three-item composite of negative family interactions in adolescence, finding it weakly related to drinking behaviour in adulthood. Maggs, Patrick, and Feinstein (2008) find the quality of parent-child relationships at age 16 is associated with alcohol consumption at age 16 and 33, and harmful drinking at age 42. White et al. (2000) find that parental warmth and hostility predict trajectories of smoking behaviour, but predict drinking only weakly. Clark et al. (2015) find that authoritarian parenting is associated with a lower risk of heavy episodic drinking at age 12 across all racial groups.

The second innovation of this study is that, in addition to assessing the effects of parental warmth and control on substance use problems in adulthood, we seek to investigate the pathways via which these effects are played out. We examine two potential pathways, which are suggested by different branches of the literature.

The first pathway is via *the age at substance use initiation*. We have already mentioned research on the relationship between parenting style and substance use; several papers in this area (e.g. Garcia & Gracia, 2009; Velleman et al., 2005) note specifically a link between parenting style and early initiation. We also expect to find a link between early initiation and the risk that an individual will go on to experience substance use problems. The "critical period" hypothesis, which originated in studies of language acquisition, suggests that there is a developmental period in the early teens during which individuals are particularly sensitive to the effects of substance use; those using substances at this age may be at substantially elevated risk of substance use disorder, or substance-related harm, in later life. The studies of Guttmannova (2011) and Maimaris and McCambridge (2014) focus on alcohol misuse, with the former suggesting evidence for a sensitive period and the latter urging more caution; Jordan and Andersen (2017) consider a wider range of substances and find evidence for a sensitive period in adolescence. Several other studies, while not specifically invoking the sensitive period hypothesis, also show that early initiation is related to higher risks of later problems. Anthony and Petronis (1995), Grant and Dawson (1998), McGue et al. (2001), King and Chassin (2007) and Richmond-Rakerd et al. (2017) consider illegal drug use, while DeWit et al. (2000), Grant, Stinson and Harford (2001), Hingson et al. (2006), Dawson et al. (2008) and McCambridge et al. (2011) consider alcohol.

The second pathway we investigate is via *depression*. As noted above (Stafford et al., 2016 and others), parenting style is associated with many aspects of mental health, with parental warmth exerting a protective effect. Poor mental health may in turn increase individuals' susceptibility to substance use problems. The "self-medication" hypothesis suggests that individuals with mental health problems engage in substance use as a way of alleviating their symptoms. The hypothesis was originally formulated in relation to opiate addiction (Khantzian et al., 1974), and has given rise to research on a range of substances (Weiss et al., 1992; Lerman

et al., 1996, 1998; Bolton et al., 2009). The theory has been critiqued on the grounds that observed associations between mental health problems and substance use may not be causal in the hypothesized direction (Lembke, 2012); however, studies examining the sequencing of onset of mental health problems and substance use suggest that mental health problems are likely to precede substance use disorders (Deykin et al., 1987; Abraham et al., 1999). The self-medication hypothesis may relate to many mental health problems; we use depressive symptoms, since detailed information on other mental health problems is not collected in the data set we use.

2. Data and Methods

Analysis is based on data from the National Longitudinal Study of Adolescent Health (*Add Health*), a longitudinal study managed from the Carolina Population Center at the University of North Carolina (Harris, 2009).

The survey follows a nationally representative sample of adolescents who were in school grades 7-12 in the 1994/95 school year. Over 90,000 students completed an initial questionnaire in school; a subsample was selected for in-home interview in the same year, with parents also interviewed. Sample members were re-interviewed in 1996, 2001/02 for a third time, and 2008 for a fourth time. At the time of writing, a fifth wave of interviews is under way, but data are not yet available.

Response rates across Waves 1 to 4 are 79%, 88.6%, 77.4% and 80.3% respectively (response rates at Waves 2, 3 and 4 are calculated as percentages of the original Wave 1 participants who were eligible for subsequent waves). In a study of attrition from this survey, Brownstein et al. (2010) found that Wave 1 respondents who were male, non-white, non-native-born, or from families with lower levels of education and socioeconomic status were more likely to drop out; however, attrition bias is relatively small after sample weights are

applied. The results presented are from unweighted regressions (see Winship & Radbill, 1994; Solon et al., 2015); weighted regressions give similar results.

Our analysis uses the public use data set, which is a randomly generated subsample of the core data set. We restrict the sample to respondents aged between 13 and 18 at the time of first interview (that is, who were of the usual ages for membership of the relevant school grades); these respondents were aged between 25 and 32 at the time of the fourth interview. This gives a core sample size of 2954, which varies slightly between different specifications. Table 1 provides descriptive statistics for the variables of interest; other descriptive statistics may be found in the Appendix.

(Table 1)

2.1 Outcome variables: substance use problems in adulthood

Outcomes are measured in Wave 4. The instruments for problem use of alcohol, marijuana and other drugs are based on the criteria for the diagnosis of Substance Use Disorder in the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSIM-IV); these have been extensively validated (Van Dulmen et al., 2002; Hasin et al., 2006). The problem drinking scale is derived from 10 items (α=0.88); the scales for problem marijuana use (α=0.85) and problem use of other drugs (α=0.92) are each based on 8 items. These scales are standardized (mean=0, SD=1). Lists of items used to derive these and other latent scales are provided in the Appendix. The smoking indicator represents average daily cigarette consumption, derived from two questions: the number of days on which respondents smoked over the past month, and the average number of cigarettes smoked on each of these days. The smoking scale is top-coded at 20 and is unstandardized (mean=3.12, SD=6.12). As well as these continuous measures, we also generate binary variables indicating the 5% of heaviest smokers, and individuals scoring the highest 5% on the substance problem scales.

In certain situations, the use of multiple outcome measures may give rise to problems with statistical inference; the larger the number of outcomes, the more likely that a significant result will be found for at least one of them (Shaffer, 1995). One solution involves adjusting confidence intervals. We do not do this, since the same relationships between parenting style and later substance use are observed in relation to every outcome.

2.2 Parenting style

Parenting style is measured in *Add Health* via bespoke survey instruments which draw on several existing well-validated instruments (Udry, 2001); we use data collected at Wave 1. We generate two scales, as follows. The *warmth* scale reflects maternal responsiveness, emotional bonding, and trust. It is based on 12 items, some of which were reported by adolescents and some by mothers (α=0.75). The *control* scale is derived from 7 items (α=0.62). The measure we use is a reversed scale of the degree to which parents grant autonomy; in Section 3.1 we explore alternative conceptualisations of control, namely monitoring and demandingness. All questions relating to these scales are asked of both mothers and fathers. We use responses from mothers; the same analysis using responses from fathers gives similar results, but sample sizes are smaller.

Existing literature shows consistently that parenting styles vary according to adolescent age and gender (Belsky, 1984; Parent et al., 2014). We are primarily interested in the effects of parenting styles inasmuch as they are typical or atypical for adolescents at a particular stage in life; we therefore adjust the relevant scales for age and sex. The scales are then standardized.

We also derive an indicator of parenting style based on the fourfold schema described in the Introduction. We define a categorical variable denoting four parenting styles: *authoritative* (a score above the median for both warmth and control); *indulgent* (scores above the median in warmth and below the median in control); *authoritarian* (below the median in warmth and above the median in control); and *neglectful* (below the median in both warmth and control).

2.3 Mediators

We use several specifications for the age at first use of each substance (for drinking, marijuana and other illegal drugs, this is the age at which the substance was ever used; for smoking, it indicates the age at which the respondent first smoked regularly). Our main model is based on a binary indicator of whether first use had occurred by Wave 1. We also present models based on (a) initiation by Wave 2, for those who had not used the substance by Wave 1; (b) a continuous indicator of age at first use, derived from responses to all four waves of the survey; and (c) a binary variable indicating initiation by age 16.

Depressive symptoms are measured in the *Add Health* survey by a modified version of the Center for Epidemiologic Studies Depression Scale (CES-D), an instrument in wide use which has been validated for adolescents and young adults (Roberts et al., 1990; Radloff, 1991). This measure is available in each of the four waves; we use the measure at Wave 3 as a mediator, since it post-dates the measurement of parenting styles and precedes the measurement of the outcome. The scale is based on 12 items (α= 0.82), and is standardized, with higher scores denoting more depressed individuals.

2.4 Control variables

We control for the following variables at Wave 1: age, gender, ethnicity, parental education (in two-parent families, the higher), family composition, peers' substance use (Jackson et al., 1997; von Sydow et al., 2002), and maternal substance use (Baumrind, 1991; Bailey et al., 2016); we include maternal drinking in the alcohol use regressions and maternal smoking in all other regressions. Parental employment and neighborhood safety were found to be insignificant and were not included in the model.

We control for several variables measured at Wave 4: completed years of education, religiosity (a standardized scale based on 5 items, α=0.83), employment; marital status; and whether the individual has children.

2.5 Methods

Our analysis is based on structural equation modelling (SEM) in Stata 13. SEM treats all relationships in the model as linear; Hellevik (2009) shows that the inclusion of dichotomous mediators (here, initiation by Wave 1) does not cause problems in this context. One of our robustness checks uses a dichotomous outcome; this is estimated with generalized structural equation modelling (GSEM), described by Rabe-Hesketh et al. (2004).

We specify a system of relationships which allows parenting behavior to exercise a direct effect on the outcome variables, as well as indirect effects via initiation and depression. Of the two mediators, initiation is measured prior to depression; we therefore allow initiation to influence depression. Controls measured at Wave 1 may influence both mediators and outcomes; controls measured at Wave 4 influence only outcomes.

Four models were estimated, one relating to problem usage of each of the four substances considered. Full results are available in the Appendix; Tables 2 and 3 in the body of the paper, which present results from the two-dimension and fourfold models of parenting respectively, contain only the coefficients on the parenting style variables and the mediating pathways.

Tables 2 and 3 also contain test statistics for the significance of the mediation pathways; these are from the Sobel procedure (Sobel, 1982), which tests whether the estimated effects of the parenting variables on the outcome variables are significantly attenuated by the inclusion of the mediators. We performed two alternative tests, the Aroian and Goodman tests (MacKinnon et al., 2002); these are not reported but the results are similar.

3. Results

Figure 1 presents estimates from a model estimating the determinants of marijuana problems at Wave 4. This is based on the two-dimensional model of parenting style. Of the two dimensions, only warmth has a direct effect on the outcome. Both mediators (first use by Wave

1 and depression at Wave 3) are positively and significantly associated with marijuana problems at Wave 4. Parental warmth has a significant negative association with both mediators. Parental control is negatively associated with initiation, but is positively related to depression at Wave 3. These results suggest that warm parenting is related to a lower risk of problem marijuana use in adulthood, by three pathways: (1) directly; (2) via a lower risk of early initiation; and (3) via lower risks of depression. It also suggests that a parenting style high in control has (1) no significant direct effect on the outcome, (2) a beneficial effect via a lowered risk of early initiation; and (3) a negative effect via a higher risk of depression. We return later to a fuller discussion of these findings.

(Figure 1)

Table 2 presents results from the same model, for all four outcomes. The top panel contains estimates of the effects of parenting styles on the outcome variables: direct effects (the effects attributable to all parts of the model except the mediators); indirect effects (effects via the mediating pathways) and total effects (the sum of these). There are significant direct effects from warmth for all outcomes except smoking, and significant indirect effects from warmth for all outcomes. There are no significant effects, direct or indirect, from control.

(Table 2)

The second panel shows mediation effects. Both mediators are significantly related to all outcome variables, except that depression at W3 is not significantly related to smoking. Warmth is associated with lower risks of initiation and with lower risks of depression. Control is associated with lower risks of initiation (for drinking and marijuana), but with higher risks of depression (in all except the smoking model).

The third panel presents tests of significance for the mediating pathways. Both pathways are significant mediators of the effect of parental warmth (except depression in the smoking regression). The evidence is less compelling in relation to the effects of parental control. Initiation is a significant mediator of parental control only in the drinking equation (although in the other three equations, the test statistic is in the same direction, and is associated with a p-value of $p<0.1$). Similarly, depression is a significant mediator of parental control only in the marijuana problems equation; however, the test statistic is of the same sign in all the other three equations, and associated with a p-value of $p<0.1$ in two of them).

Results for all models demonstrate good model fit (Bartholomew et al., 2008 define a good fit as a value <0.05 for RMSEA, a value close to 1 for CFI, and a value < 0.08 for SRMR).

Table 3 presents results from models using the fourfold typology of parenting described above; the baseline group is the 'authoritative' style. Results again demonstrate good model fit (Bartholomew et al., 2008). Few direct effects of parenting style are evident, but strong indirect effects are observed for the authoritarian and neglectful types, yielding significant total effects for all outcomes except smoking. Hardly any difference is evident between the indulgent and authoritative styles.

(Table 3)

There is compelling evidence that both mediation pathways are significant. For all outcomes, both the authoritarian and neglectful parenting types are associated with (a) a higher risk of initiation by Wave 1; and (b) a higher risk of depression at Wave 3. The Sobel test statistics show that initiation is a significant mediator of the relationship between the authoritarian and neglectful parenting styles and all four outcomes; depression is a significant mediator for all outcomes except smoking.

3.1 Robustness checks

We estimated several alternative specifications as robustness checks; results are presented in Table 4. As an initial check (not shown), we tested for nonlinearities and interactions in the effects of parental warmth and control. We found no evidence that any of the estimated relationships were significantly nonlinear, and no interaction effects beyond what is evident in the fourfold typology.

Panel 1 of Table 4 shows results from a model based on binary outcomes identifying the 5% of heaviest smokers and the 5% of highest scores on the alcohol and drug problem scales. The fact that this specification yields results similar to our previous results indicates that our model successfully predicts severe substance use problems as well as variations across the full range.

(Table 4)

Panel 2 addresses the implicit assumption that adolescents' substance use is influenced by parenting, rather than parenting responding to substance use; it is plausible that effects could run in the opposite direction. We analyze the sample of adolescents who had not initiated substance use by Wave 1, with initiation by Wave 2 as a measure of first use. Parenting at Wave 1 predicts initiation by Wave 1 more strongly than initiation by Wave 2; this may indicate a degree of bidirectional causality, or simply that in the former case, parenting style is a more proximal measure. In any case, the fact that significant relationships remain in the second specification indicates that at least part of the estimated relationship operates in the assumed direction.

We then restrict the sample to those who have initiated substance use by Wave 4. Results (not reported) are substantially unchanged; this suggests that that parenting style affects

not just the probability of initiation, but also the propensity to develop problems following initiation.

We next explore alternative specifications for the indicator of initiation. Panel 3 reports results using a continuous measure of age at initiation (individuals who had never used the substance by Wave 4 are excluded). Results are once again similar: warmth is related to older age at initiation and negatively related to depression, while control is also related to older age at initiation, albeit with smaller coefficients than warmth.

In panels 4 and 5, we use a binary variable indicating whether initiation occurred by age 16. This has the advantage of being a common benchmark for all sample members, but the disadvantage that initiation and parenting are measured at different times. For those aged over 16 at Wave 1, parenting is measured after initiation has (or has not) occurred; for those under 16, parenting is measured before the cut-off point for measuring initiation. We therefore analyze 13-15-year olds and 17-18-year-olds separately. Effects differ substantially between the two age groups, with the main differences being in the determinants of depression. The effect of warmth on depression is about twice as large for the younger group as for the older group; the effect of control on depression is insignificant for the younger group, but large and significant for the older group. This suggests that parental warmth is important for all adolescents, but particularly so at younger ages, while the relationship between control and depression is most pronounced at older ages. We also investigated whether there are differences by gender: greater parental control is associated with depression at Wave 3 for both sexes, but the effect is larger in the case of boys.

Our final robustness checks explore alternative specifications for the control dimension. Our original variable indicates the control which parents exercise over several domains of their children's lives. However, some other studies have used alternative concepts: monitoring (knowing/controlling children's whereabouts), or a wider concept of "demandingness", which

involves expectations of maturity good behavior, and a degree of enforcement of these standards (Baumrind, 1991). Replacing the indicator of control with an indicator of monitoring based on whether adolescents are allowed to make their own decisions about (a) who they associate with, and (b) what time they come home on weekends yields coefficients of the same sign but reduced magnitude (Panel 6); the effect of monitoring on initiation becomes tiny and insignificant, while its relationship with depression is positive, but significant only at the 10% level. We also test an indicator of demandingness which includes adolescents' frequency of participation in housework. This was not included in our original indicator of control because it reduced the fit of the model. The housework indicator is negatively (albeit insignificantly) related to depression (Panel 7), suggesting that, to the extent that the control/demandingness dimension is negatively related to depression, this is driven by parental control. Results (not shown) using a composite indicator of demandingness which also includes housework are similar to our initial results.

4. Discussion

Prior research has demonstrated that parenting style is associated with the risk of substance use in late adolescence and/or early adulthood (e.g. Steinberg et al., 1994; Barnes et al., 2000; Aquilino & Supple, 2001; Stone et al., 2012). This paper shows that these effects persist into the longer term: warm parenting protects against problem substance use when subjects are well into adulthood. In addition, we have highlighted two pathways via which this effect can be shown to work: the age at initiation of substance use, and depression.

We used two specifications for parenting style: one which includes continuous measures of warmth and control, and a fourfold typology based on those two dimensions. In each case, the results are unequivocal: it is parental warmth, and not control, which protects against substance use problems in adulthood. In the fourfold typology, it is the authoritarian

and neglectful styles which are associated with elevated risks of later substance use; the indulgent style is not associated with extra risks of any kind.

Our analysis of mediating pathways may shed light on heterogeneity between prior studies. Virtually all studies show that warm parenting is protective, and we show the same. However, some studies (Aquilino & Supple, 2001, and others) have found parental control to be protective against substance use in adolescence, while others (Calafat et al., 2014 and others) have not. We have found that parental control *does* inhibit the initiation of substance use in adolescence (see Tables 2 and 4), but that this protective effect does not persist into adulthood; we suggest this may be due to a link between controlling parenting and depression. Thus, the effects of parental control may differ according to the age at which the outcome is measured, and may account for the range of findings in different studies.

Our study has several strengths. It is based on a nationally representative sample, with a considerably longer follow-up period than is typically used in studies in this area; its findings make a novel and useful contribution to the state of knowledge. However, our study is not without its limitations. First, our measures of substance use initiation and of parenting style were collected contemporaneously. While it is reasonable to believe that parenting affects substance use, it is also likely that parenting style is itself influenced by adolescents' prior substance use. We have addressed this problem partially in the robustness checks, but we believe there is more scope for disentangling issues of timing and directionality in this relationship. We also believe there is scope for a better understanding of the control/demandingness dimension; our robustness checks suggest that an alternative definition based on adolescents' contributions at home may yield interesting results, but data including an expanded survey instrument would be needed to test this. Finally, there is evidence that individuals self-medicate for a range of mental health conditions, notably for anxiety, which is

394 an extremely common condition (Robinson et al, 2009) but the data allowed us to test only for
395 a pathway via depression.

396 **5. Conclusions and implications for policy**

397 There is already evidence that interventions promoting effective parenting may reduce
398 substance use in adolescence (Haggerty et al., 2013). One justification for interventions in
399 adolescence is that teenage substance use predicts problems in adulthood; our results confirm this,
400 and thus indicate that parenting initiatives may be protective in the longer as well as the shorter
401 term.

402 However, our finding that over the longer term warmth is of much greater importance
403 than control may have important implications for the formulation of future parenting
404 interventions. This would be true even if substance problems in adulthood were the only
405 outcome of concern; however, if mental health is considered as locus of concern in its own
406 right, rather than solely as a forerunner of substance use problems, the relative importance of a
407 parenting style high in warmth assumes an even higher importance.

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Declaration of Interest

The authors report no conflicts of interest.

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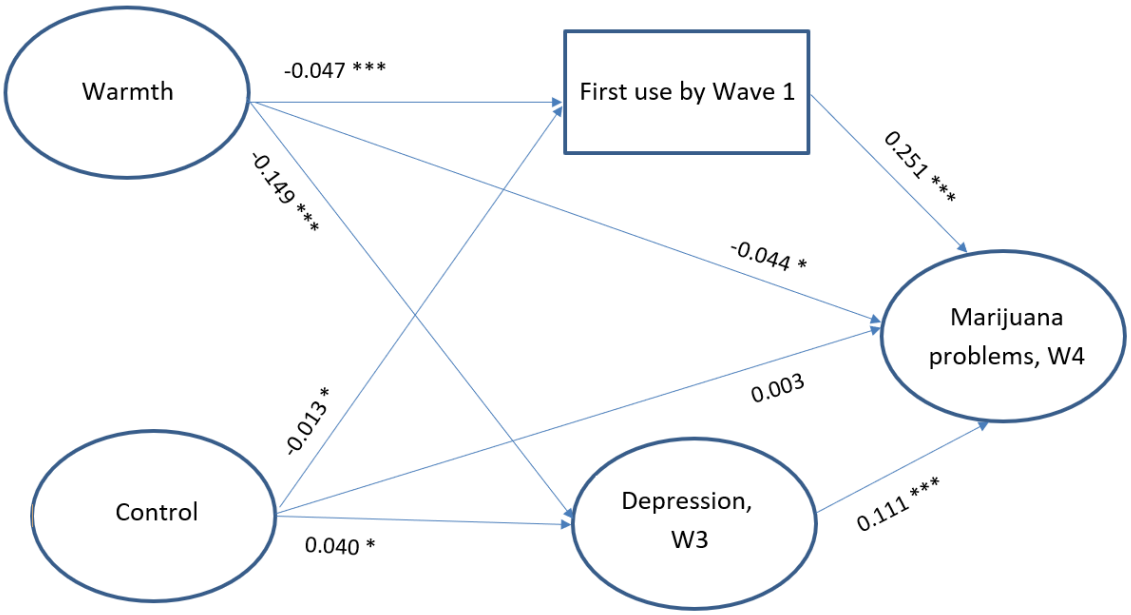
Figure 1: The relationship between parenting in adolescence and marijuana problems in Wave 4; path diagram showing results from SEM analysis.



*Note: For clarity, some relationships have been omitted from the diagram. These are: (1) the determinants of the latent constructs that are not directly observed, such as the parenting dimensions and mental health problems; (2) control variables; (3) the relationship between first use and mental health problems. Standard errors in parentheses. Statistical significance is denoted by asterisks: * sig at 5%, ** sig at 1%, *** sig at 0.1.*

Table 1 Descriptive Statistics: outcome variables, parenting style variables and mediators

Variable	Range of Values		Mean (SD)
	Min	Max	or %
Outcome Variables, W4			
Ave. number of cigarettes per day in past 30 days	0	20 or more	3.12 (6.11)
Drinking problems	-0.61	3.58	0.01 (0.99)
Marijuana problems	-0.39	5.52	0.00 (1.00)
Other illicit drug problems	-0.27	5.92	-0.01 (0.98)
Variables of Interest			
Parenting styles in dimensions			
Warmth, W1	-4.50	2.30	-0.01 (1.02)
Control, W1	-1.96	4.00	-0.01 (0.97)
Fourfold schema of parenting styles, W1			
Authoritative (Ref)	0	1	24.6
Indulgent	0	1	25.1
Authoritarian	0	1	25.4
Neglectful	0	1	25.0
Mediators			
Cigarette use by W1	0	1	0.19 (0.39)
Alcohol use by W1	0	1	0.45 (0.50)
Marijuana use by W1	0	1	0.24 (0.43)
Illegal drug use by W1	0	1	0.27 (0.44)
Age first smoked regularly (years)	10 or younger	30	16.4 (3.31)
Age first used alcohol (years)	10 or younger	30	16.2 (3.13)
Age first used marijuana (years)	10 or younger	29	16.7 (3.02)
Age first used illegal drug (years)	10 or younger	31	18.3 (4.25)
Mental health problems, W3	-1.35	4.92	-0.03 (0.96)

Source: National Longitudinal Study of Adolescent Health Waves I (1994-1995), III (2001 - 2002), and IV (2008)
N = 2954

Table 2: Relationships between parenting style in adolescence and substance use problems in adulthood; two dimensions of parenting style, coefficients from SEM analysis (N=2954)

			Smoking (cigs/day)	Drinking problems	Marijuana problems	Other illicit drug problems
Effects of parenting style on Wave 4 outcomes	**Direct effects**	*Warmth*	0.016 (0.101)	-0.038 (0.017)*	-0.044 (0.018)*	-0.046 (0.018)**
		Control	0.037 (0.104)	-0.014 (0.018)	0.003 (0.019)	0.006 (0.018)
	Indirect effects	*Warmth*	-0.201 (0.031)***	-0.023 (0.004)***	-0.029 (0.005)***	-0.024 (0.004)***
		Control	-0.031 (0.024)	-0.005 (0.003)✞	0.001 (0.003)	-0.001 (0.002)
	Total effects	*Warmth*	-0.180 (0.101)✞	-0.060 (0.017)***	-0.071 (0.018)***	-0.069 (0.018)***
		Control	0.002 (0.106)	-0.019 (0.018)	0.004 (0.019)	-0.008 (0.018)
Mediation effects	**Via initiation by Wave 1**	*Warmth → initiation*	-0.048 (0.006)***	-0.052 (0.008)***	-0.047 (0.006)***	-0.054 (0.007)***
		Control → initiation	-0.010 (0.006)	-0.025 (0.008)**	-0.013 (0.007)*	-0.014 (0.007)✞
		Initiation → outcome	3.614 (0.303)***	0.295 (0.042)***	0.251 (0.052)***	0.263 (0.048)***
	Via depression at Wave 3	*Warmth → depression*	-0.146 (0.017)***	-0.156 (0.017)***	-0.149 (0.017)***	-0.145 (0.017)***
		Control → depression	0.040 (0.018)*	0.039 (0.018)*	0.040 (0.018)*	0.041 (0.018)*
		Depression → outcome	0.175 (0.108)	0.051 (0.019)**	0.111 (0.019)***	0.068 (0.019)***
Sobel test statistics for significance of mediating pathways	**Initiation**	*Warmth*	-6.644***	-4.771***	-4.109***	-4.467***
		Control	-1.651✞	-2.855**	-1.733✞	-1.879✞
	Depression	*Warmth*	-1.592	-2.576**	-4.861***	-3.300***
		Control	1.335	1.686✞	2.077*	1.922✞
Statistics of fit		*RMSEA*	0.040	0.041	0.040	0.040
		SRMR	0.008	0.008	0.008	0.008
		CFI	0.964	0.957	0.960	0.957
		CD	0.434	0.437	0.443	0.409

Standard errors *in parentheses.*
Statistical significance *is denoted by asterisks: * sig at 5%, ** sig at 1%, *** sig at 0.1%. Insignificant results with p < 0.1 denoted by ✞.*
Post-estimation tests on differences between parental warmth and parental control:
Direct effects: *Other illicit drugs *;* ***Indirect effects:*** *all substances ***; **Total effects:** marijuana ** other illicit drugs **
Effects on initiation: *all substances ** or better.* ***Effects on depression:*** *all substances ****

Table 3: Relationships between parenting style in adolescence and substance use problems in adulthood; fourfold typology of parenting style, coefficients from SEM analysis (N=2954)

			Smoking (cigs/day)	Drinking problems	Marijuana problems	Other illicit drug problems
Effects of parenting style on Wave 4 outcomes	**Direct effects**	*Indulgent*	-0.001 (0.283)	0.017 (0.049)	0.006 (0.051)	0.006 (0.050)
		Authoritarian	0.158 (0.284)	0.062 (0.049)	0.049 (0.051)	0.079 (0.050)
		Neglectful	0.002 (0.287)	0.115 (0.050)*	0.079 (0.051)	0.072 (0.051)
	Indirect effects	*Indulgent*	0.055 (0.064)	0.020 (0.008)*	-0.008 (0.008)	-0.003 (0.007)
		Authoritarian	0.261 (0.070)***	0.045 (0.009)***	0.039 (0.009)***	0.031 (0.008)***
		Neglectful	0.295 (0.069)***	0.048 (0.009)***	0.039 (0.009)***	0.037 (0.008)***
	Total effects	*Indulgent*	0.056 (0.289)	0.036 (0.049)	-0.001 (0.051)	0.003 (0.050)
		Authoritarian	0.407 (0.289)	0.105 (0.049)*	0.085 (0.051)✞	0.108 (0.050)*
		Neglectful	0.292 (0.292)	0.160 (0.050)**	0.117 (0.052)*	0.108 (0.051)*
Mediation effects	**Via initiation by Wave 1**	*Indulgent → initiation*	0.019 (0.017)	0.082 (0.022)***	0.008 (0.018)	0.011 (0.019)
		Authoritarian → initiation	0.061 (0.017)***	0.110 (0.021)***	0.047 (0.018)**	0.054 (0.019)**
		Neglectful → initiation	0.075 (0.017)***	0.134 (0.022)***	0.087 (0.018)***	0.098 (0.019)***
		Initiation → outcome	3.599 (0.302)***	0.297 (0.042)***	0.264 (0.052)***	0.271 (0.048)***
	Via depression at Wave 3	*Indulgent → depression*	-0.083 (0.049)✞	-0.086 (0.049)✞	-0.089 (0.049)✞	-0.090 (0.049)✞
		Authoritarian → depression	0.229 (0.049)***	0.240 (0.049)***	0.230 (0.049)***	0.227 (0.049)***
		Neglectful → depression	0.140 (0.049)**	0.157 (0.050)**	0.141 (0.049)**	0.134 (0.049)**
		Depression → outcome	0.167 (0.107)	0.053 (0.018)**	0.114 (0.019)***	0.070 (0.019)***
Sobel test statistics for significance of mediating pathways	**Initiation**	*Indulgent*	1.113	3.297***	0.443	0.576
		Authoritarian	3.436***	4.209***	2.322*	2.539*
		Neglectful	4.137***	4.615***	3.501***	3.808***
	Depression	*Indulgent*	-1.148	-1.508	-1.738✞	-1.644
		Authoritarian	1.480	2.524*	3.697***	2.884**
		Neglectful	1.370	2.148*	2.595**	2.196*
Statistics of fit		*RMSEA*	0.041	0.043	0.042	0.041
		SRMR	0.008	0.009	0.008	0.008
		CFI	0.961	0.952	0.955	0.951
		CD	0.421	0.428	0.431	0.396

Standard errors *in parentheses.*

Statistical significance *is denoted by asterisks: * sig at 5%, ** sig at 1%, *** sig at 0.1%. Insignificant results with p < 0.1 denoted by ✞.*

Post-estimation tests on differences between indulgent, authoritarian and neglectful parenting styles:

Direct effects: *None sig;* ***Indirect effects:*** *Indulgent v authoritarian and indulgent v neglectful, all substances * or better;* ***Total effects:*** *none sig*

Effects on initiation: *Indulgent v neglectful, all except drinking, ** or better; other comparisons n/s;*

Effects on depression: *Indulgent v authoritarian and indulgent v neglectful, all substances ** or better; authoritarian v neglectful n/s.*

Table 4: Robustness checks; results from alternative specification

			Smoking (cigs/day)	Drinking problems	Marijuana problems	Other illicit drug problems
1. Discrete outcomes (top 5%). Logistic model using GSEM (*N = 2954*)	***Initiation***	**Warmth**	-0.400 (0.052)***	-0.302 (0.045)***	-0.369 (0.051)***	-0.368 (0.049)***
		Control	-0.094 (0.062)	-0.145 (0.047)**	-0.136 (0.060)*	-0.115 (0.055)*
	Depression	**Warmth**	-0.146 (0.017)***	-0.156 (0.017)***	-0.149 (0.017)***	-0.145 (0.017)***
		Control	0.039 (0.018)*	0.038 (0.018)*	0.040 (0.018)*	0.041 (0.018)*
2. Restrict sample to those who had not used by W1; initiation by W2 as mediator (*N = 1379-1980*)	***Initiation***	**Warmth**	-0.036 (0.011)**	-0.023 (0.013)✞	-0.023 (0.008)**	-0.019 (0.008)*
		Control	-0.013 (0.011)	-0.006 (0.012)	-0.008 (0.007)	-0.007 (0.008)
	Depression	**Warmth**	-0.159 (0.022)***	-0.153 (0.027)***	-0.146 (0.023)***	-0.138 (0.024)***
		Control	0.045 (0.021)*	0.024 (0.024)	0.051 (0.021)*	0.054 (0.021)*
3. Continuous age at initiation (restrict sample to ever used by W4) (*N = 1142-2676*)	***Initiation***	**Warmth**	0.387 (0.074)***	0.397 (0.053)***	0.263 (0.060)***	0.390 (0.116)**
		Control	0.147 (0.082)✞	0.228 (0.056)***	0.091 (0.064)	0.183 (0.126)
	Depression	**Warmth**	-0.146 (0.025)***	-0.163 (0.018)***	-0.177 (0.022)***	-0.180 (0.029)***
		Control	0.016 (0.028)	0.040 (0.019)*	0.029 (0.024)	0.065 (0.031)*
4. Initiation by age 16 (sample: those under 16 at W1) (*N = 1566*)	***Initiation***	**Warmth**	-0.039 (0.008)***	-0.059 (0.011)***	-0.030 (0.008)***	-0.048 (0.009)***
		Control	-0.005 (0.007)	-0.017 (0.010)✞	-0.012 (0.007)	-0.013 (0.008)
	Depression	**Warmth**	-0.196 (0.026)***	-0.208 (0.026)***	-0.200 (0.026)***	-0.195 (0.026)***
		Control	0.012 (0.024)	0.009 (0.024)	0.010 (0.024)	0.011 (0.024)
5. Initiation by age 16 (sample: those aged 17-18 at W1) (*N = 861*)	***Initiation***	**Warmth**	-0.056 (0.012)***	-0.051 (0.013)***	-0.050 (0.012)***	-0.040 (0.012)**
		Control	-0.001 (0.015)	-0.040 (0.017)*	-0.018 (0.016)	-0.014 (0.016)
	Depression	**Warmth**	-0.096 (0.027)***	-0.107 (0.027)***	-0.096 (0.027)***	-0.095 (0.027)***
		Control	0.114 (0.034)**	0.110 (0.035)**	0.117 (0.034)**	0.118 (0.034)**
6. Alternative definition of control: monitoring (*N = 2954*)	***Initiation***	**Warmth**	-0.048 (0.006)***	-0.051 (0.008)***	-0.046 (0.006)***	-0.052 (0.007)***
		Monitoring	-0.004 (0.006)	-0.005 (0.008)	0.002 (0.007)	0.002 (0.007)
	Depression	**Warmth**	-0.146 (0.017)***	-0.157 (0.017)***	-0.149 (0.017)***	-0.146 (0.017)***
		Monitoring	0.030 (0.018)✞	0.027 (0.018)	0.030 (0.018)✞	0.030 (0.018)✞
7. Alternative definition of demandingness: housework duties (*N = 2954*)	***Initiation***	**Warmth**	-0.052 (0.008)***	-0.052 (0.008)***	-0.048 (0.006)***	-0.054 (0.007)***
		Demandingness	-0.023 (0.008)**	-0.023 (0.008)**	-0.018 (0.007)**	-0.019 (0.007)**
	Depression	**Warmth**	-0.157 (0.017)***	-0.157 (0.017)***	-0.150 (0.017)***	-0.146 (0.017)***
		Demandingness	0.029 (0.018)	0.029 (0.018)	0.031 (0.018)✞	0.032 (0.018)✞

*Notes: Standard errors in parentheses. Statistical significance is denoted by asterisks: * sig at 5%, ** sig at 1%, *** sig at 0.1%. Insignificant results with p < 0.1 denoted by ✞.*

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