



Lability in Parent- and Child-Based Sources of Parental Monitoring Is Differentially Associated with Adolescent Substance Use

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Abstract

Parental knowledge about adolescents' whereabouts and activities remains one of the strongest predictors of reduced adolescent substance use. A recent study found that across middle childhood and adolescence, parental knowledge is characterized by fluctuations on a year-to-year basis, termed lability, even more-so than by linear trends, and that lability too is a predictor of adolescent substance use (Lippold et al., *Dev. Psychol.* 17, 274–283, 2016). The present study replicates Lippold et al. (*Dev. Psychol.* 17, 274–283, 2016) by quantifying developmental change and lability in parental knowledge across adolescence and examining associations with drinking, smoking, and other drug use later in adolescence, and extends the study by examining the sources of knowledge: child disclosure, parental solicitation, and parental control, separately. Using a community-based sample of 1023 youth in the Northeastern region of the USA, all three sources of knowledge were characterized by developmental change and lability. In general, higher levels and steeper developmental declines in knowledge were associated with substance use outcomes. Findings for child disclosure replicated the prior findings: increased lability of child disclosure predicted substance use. Unexpectedly, decreased lability of parental solicitation and control was associated with worse substance use outcomes. Findings suggest different mechanisms by which lability in child- and parent-driven cultivation of knowledge is associated with substance use. If replicated in studies that address causality, these mechanisms could be leveraged for prevention/intervention efforts. For example, increasing the consistency of child disclosure may help prevent substance use, but teaching parents to be more responsive to time-specific challenges with adolescents may be more effective than increasing the consistency of parents' knowledge-building parenting behaviors.

Keywords Parental knowledge · Child disclosure · Parental solicitation · Parental control · Lability · Adolescent substance use

Introduction

Parental knowledge about adolescents' whereabouts and activities remains one of the strongest predictors of reduced adolescent substance use (Lac and Crano 2009; Neiderhiser et al. 2013), and many effective prevention strategies target parental knowledge (Dishion et al. 2003; Kuntsche and Kuntsche 2016). Theoretically, the relation between parental

knowledge and adolescent behavior, including substance use, is likely bidirectional, dynamic over time, and in part child-driven (Keijsers et al. 2016). Yet, relatively little is known about how parental knowledge changes over time during middle childhood and adolescence when these strategies are most needed. Lippold et al. (2016) conducted a groundbreaking study showing that from 6th to 8th grade, parental knowledge is characterized by fluctuations on a year-to-year basis, termed lability, even more-so than by linear trends. Further, greater fluctuations in knowledge were associated with increased risk for delinquency and alcohol and tobacco use. This is true even controlling for 6th grade levels and linear developmental changes in knowledge over the course of the study. Thus, Lippold and colleagues concluded that gradual and predictable changes in monitoring practices may be particularly important for the prevention of substance use, rather than sudden or unpredictable changes in rules or freedoms/independence granted to the child. However, as with all novel findings, these findings should

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be replicated and probed in more detail before prevention or intervention scientists act on them.

The present study is aimed at replicating and extending the study by Lippold and colleagues by first quantifying the developmental change and lability in perceived parental knowledge across adolescence and then examining associations of these different forms of change in parental knowledge with drinking, smoking, and other drug use later in adolescence. We extend the original study by (1) using a different (community-based rather than prevention + control) large sample, (2) capturing a longer period of time (from middle school through the early high school years), and (3) examining specific indicators of adolescent substance use later in development when more youth are expected to have initiated and progressed to less experimental or incidental forms of use. Importantly, we also extend the original study by separately examining three sources of perceived parental knowledge: child disclosure, parental solicitation, and parental control. Given that parents' knowledge is believed to come primarily from youth disclosure (Kerr et al. 2010), we anticipate a stronger replication of the Lippold study for child disclosure than the other two sources of knowledge. Thus, the present study will have implications for the timing and course of intervention and prevention efforts to reduce adolescent substance use. It will also provide critical information regarding the target/source (e.g., parents or children) of increases in parental knowledge.

Sources of Knowledge

Parental knowledge is a specific component of parental monitoring that represents the results of parenting behaviors (and child disclosure) related to the tracking of the child's whereabouts and activities (Dishion and McMahon 1998; Kerr and Stattin 2000; Stattin and Kerr 2000). Seminal work by Stattin and Kerr (Kerr and Stattin 2000; Stattin and Kerr 2000) proposes three main sources of information. Child disclosure, where the child willingly provides information to parents, and parental solicitation, where parents gather information from the child, are both communicative sources of knowledge. The other parent-initiated effort to track the child is parental control. This is a behavioral source of knowledge where parents attempt to limit opportunities for maladaptive behavior of the child by limiting some and enforcing other opportunities to gain knowledge of the child's whereabouts and activities.

Although correlated at both the between and within-family level (Keijsers et al. 2016), these three sources of parental knowledge are sometimes differentially associated with substance use-related outcomes. For example, child disclosure was more robustly associated with adolescent-reported delinquency (Keijsers et al. 2010; Keijsers et al. 2009) and hazardous alcohol use and alcohol dependence symptoms (Stavriniades et al. 2010) than parental solicitation and control. Other studies have found that relative to parental control,

adolescents' and mothers' reports of child disclosure and parental solicitation were more highly correlated with antisocial behavior (Laird et al. 2010) and cannabis use (Delforterie et al. 2016). These findings provide evidence that communicative sources of parental knowledge may be particularly important for delaying or preventing the onset of adolescent substance use (Tobler and Komro 2010). However, other studies have shown that all three sources of parental knowledge are associated with outcomes including initiation of any substance use (Marceau et al. 2015a) and alcohol use (Delforterie et al. 2016). Taken together, adolescent disclosure is consistently and robustly associated with adolescent substance use and externalizing phenotypes, whereas the conditions under which parental solicitation and control are associated with substance use are more mixed.

Development and Lability

Parenting is not a static influence, but instead evolves and changes over time as the child (and parent) grows. These long-term changes in parenting, including knowledge, over the course of middle childhood and adolescence are termed developmental change. Investigations into developmental change in knowledge have shown that, in general, knowledge decreases into adolescence as children begin to spend more time with peers and exert their autonomy (Keijsers et al. 2016; Lippold et al. 2016; Stavriniades et al. 2010). These patterns of change may differ somewhat by source of knowledge and informant. For example, adolescent disclosure and parental control decreased from age 13 to 16, but only mother-reported (not adolescent- or father-reported) parental solicitation decreased over time (Keijsers et al. 2009).

Studies assessing trajectories of knowledge indicate strong developmental shapes of change but relatively few have discussed the role of fluctuations over time. According to the dynamic systems framework, adolescence is a time of increased ups and downs in the daily lives of parents and adolescents. Adolescence marks a developmental phase transition in the parent-child relationship: a period of increased variability that precedes a qualitative change (Lougheed 2019). Lability in parental knowledge across years is theoretically influenced by this increase in short-term (e.g., over the course of conversations, across days) fluctuations in parent-adolescent interactions. Throughout the adolescent developmental phase transition, both adolescent and parental patterns of behavior and communication are in flux. For example, everyday parent reactions to new adolescent behaviors that accompany identity formation or renegotiations of adolescent autonomy may produce lability in sources of knowledge. In turn, the new behaviors and communication styles become canalized over weeks, months, and years; a recurring pattern that accumulates into longer-term developmental changes. However, we might expect that large unpredictable or

fluctuating stressors (e.g., gain or loss of job or economic status) or yearly changes in family dynamics (e.g., due to the unique challenges of adolescence discussed above) would contribute to lability independent from developmental changes.

Prior work has shown that several parenting behaviors, including parent-child relationship quality (e.g., Marceau et al. 2015b; Lippold et al. 2018; Lippold et al. 2019; Zheng and McMahon 2019) and knowledge (Lippold et al. 2016; Keijsers 2016), are marked by both developmental change and within-person/family fluctuations. A re-analysis of the data used in Keijsers et al. (2009) showed that adolescent-reported disclosure, solicitation, and control were each marked by substantial within-person variance over time (45–54%), although neither study assessed what proportion of the within-person variance was explained by systematic change versus lability (Keijsers 2016). In general, these data suggest that more of the variance in parenting behaviors can be attributed to fluctuations at the weekly and yearly level than can be attributed to larger-scale developmental changes across middle childhood and adolescence. This finding is important because it implies that addressing lability in prevention or intervention efforts may carry more weight in the overall parenting phenotype than addressing developmental changes. That is, developmental changes are not the predominant feature of parental knowledge during middle childhood and adolescence.

In order to predict the effectiveness of intervention or prevention efforts targeting lability in knowledge, it must be established whether the associations of lability are greater or weaker than those of developmental changes. Only Lippold et al. (2016) have examined this question thus far, finding that lability of knowledge was associated with later alcohol and tobacco use for boys and girls and higher delinquency and internalizing problems for girls but not boys, even after accounting for the influence of developmental changes in knowledge. However, Lippold et al. (2016) could not investigate the different sources of knowledge. One study found that lability (although this was quantified differently than in Lippold et al. 2016 and the current study) in disclosure was associated positively with lability in parental solicitation and negatively with lability in parental control (Keijsers et al. 2016), suggesting that these phenotypes are related and yet could differentially be linked to adolescent outcomes.

Present Study

The present study had two main goals: (1) to quantify the developmental change and lability in parental knowledge across adolescence and (2) to examine associations of these different forms of change in parental knowledge with drinking, smoking, marijuana use, and a substance use composite later in adolescence. These goals were accomplished using

data from a large community-based sample of students enrolled in 6th to 8th grade and followed longitudinally over 3 years. We examined child disclosure, parental solicitation, and parental control separately. Given evidence that parental knowledge is most driven by child disclosure and parental solicitation relative to parental control (Keijsers et al. 2010), we expected our findings of child disclosure to most mirror findings from Lippold et al. (2016). Specifically, we hypothesized that a greater proportion of the variance in each source of knowledge would be attributable to lability than to developmental change, although each form would show a developmental decrease across adolescence. Second, we hypothesized that lability in child disclosure would be related to various substance use phenotypes even after controlling for developmental change, although developmental declines were also expected to uniquely predict substance use phenotypes. We tentatively expected a similar pattern of findings from parental solicitation and control, although these analyses were exploratory given the mixed findings in the most relevant literature and the lack of highly relevant findings from which to draw hypotheses. The literature on parental monitoring and substance use is mixed with regard to the presence of gender differences including with regard to associations of lability with outcomes (Lippold et al. 2016). Thus, we also explored interactions of lability with sex in our models of substance use.

Methods

Participants were drawn from a study on the progression of adolescent alcohol use (Jackson et al. 2015; Jackson et al. 2014). Relevant to the current study, adolescents ($N = 1023$, mean age 12.20 years, range = 10–15, $SD = 0.98$ years) were recruited through schools (collected in five semi-annual cohorts) and followed longitudinally six times over 3 years. The initial baseline survey was completed during a 2-h in-person orientation session at the school, and the subsequent five assessments were conducted via web-based follow-up surveys every 6 months, with the final (6th) assessment 1 year after the next-to-last (5th) assessment. (See Jackson et al. (2014, 2015) and Marceau et al. 2015a for more detail.)

Retention rates were high across all six waves (ranging from 92% at wave 2 to 83% at wave 6). Participants with substance use data by the final assessment did not differ from those who did not, except that youth who qualified for free/reduced school lunches and whose parents had lower education and income were somewhat less likely to have substance use data (see Marceau et al. 2015a). Adolescents were roughly equally divided across grades 6–8 at baseline and were 52% female with some racial/ethnic diversity (12% Hispanic, 5% Black, 3% Asian, 2% American Indian, 8% mixed race, 6%

other, 76% White) and some geographical diversity (participants were drawn from 6 middle schools: two rural, three suburban, and one urban). (See Table S1 [available online] for complete descriptive statistics.)

Measures

Perceived Parental Knowledge Perceived parental knowledge was assessed annually (four times over the course of the study, at assessments T1, T3, T5, and T6) and was assessed using youth self-report on the Parental Knowledge scale from Kerr and Stattin (2000). This measure consists of three 5-item scales corresponding to specific sources of knowledge: child disclosure (how much the adolescent tells parents of his/her activities; e.g., “Do you talk at home about how you are doing in the different subjects in school?”); parental solicitation (how much parents ask about adolescent’s activities; e.g., “In the last month, have your parents talked with the parents of your friends?”); and parental control (how much parents control adolescent’s activities; e.g., “If you have been out very late one night, do your parents make you explain what you did and whom you were with?”). Cronbach’s alphas ranged from 0.74 to 0.92 across scales and waves of assessment. Response options ranged from “No, never (0%)” (1) to “Yes, always (100%)” (5). (See Table S1 for descriptive statistics overall and by sex.)

Substance Use For overall substance use initiation (e.g., including alcohol [sip], cigarette [puff], marijuana, or other drug use) a binary variable indicated any use (1 = yes, 0 = no) by the time of the last assessment. Lifetime initiation was coded as “1” if initiation was reported at any wave to produce a binary measure of substance use initiation for the full sample of 1023 youth to maximize our sample size. For the marijuana outcome, respondents indicated whether (1) or not (0) they had ever used marijuana (pot, hash, hash oil, etc.) at each wave, scored in the same way as overall substance use initiation.

Additional information was available for alcohol and smoking to capture nuanced rates of early use. Specifically, for both smoking and alcohol use, we created a continuous ‘uptake continuum’ variable adapted from the Smoking Uptake Continuum (Choi et al. 2001). These variables are conceptually similar to the cumulative index of alcohol use initiation and past-month use utilized by Lippold et al. (2016). The Smoking Uptake Continuum is a scale of ten items designed to quantify smoking history and current smoking in a standardized manner across seven stages. We adapted it by including a measure of smoking susceptibility in order to index commitment not to smoke. We created a parallel drinking uptake continuum based on endorsement of four alcohol milestones: sip, full drink, heavy drinking (3+ drinks in one sitting), and feeling drunk in their lifetime, combined with a

measure of willingness to drink (Jackson et al. 2014) to also assess commitment not to drink. (See Appendix 1 [available online] for full scoring/item details and Table S1 for descriptive statistics overall and by sex.)

Covariates Age was assessed to two decimal points based on birth date and assessment date at the final assessment. Sex was coded 0 = female and 1 = male based on adolescent self-report at the first assessment. Race/ethnicity was assessed via self-report at the first assessment and was coded as a nominal variable (1 = White, non-Hispanic; 2 = Black, non-Hispanic, 3 = Hispanic, 4 = other, non-Hispanic). School cohort (1–5) was also included as a nominal covariate. Finally, whether the child qualified for free/reduced lunch (0 = neither, 1 = reduced, 2 = free) was assessed in a 30-min paper-and-pencil parent survey at the first assessment (86% of reporters were mothers) and included as a nominal variable.

Analytic Strategy

The analytic strategy described here directly parallels Lippold et al. (2016). Our first aim was to quantify the developmental change and lability in parental knowledge across adolescence. To do so, we used linear multilevel models of change (in SAS PROC MIXED) to decompose the variance in parental knowledge into developmental trends and lability. Specifically, separate 2-level (assessments nested in individuals) multilevel models of change were fit to repeated measures of child disclosure, parental solicitation, and parental control across four waves. We used waves of assessment (coded from 0 to 3, so that the intercept was centered on the baseline assessment) as our metric of time, since there were large between-person differences in age, and we were interested in assessing specifically within-person changes and lability over time. The complete specification of multilevel equations is provided in Appendix 1 (available online).

To calculate the proportions of variance attributable to developmental trends (change explained by time) and lability (meaningful residual fluctuations around the trends), we compared the estimates of residual variance from the multilevel models of change with those obtained from the unconditional means models (without time as a predictor). The proportion of variance attributable to developmental trends was calculated as the residual error variance from the unconditional model (without including time as a predictor) minus the residual error variance from the multilevel model of change, and divided by residual error variance from an unconditional baseline model (see Appendix 1 and/or Lippold et al. 2016 for equations and additional detail). Once we identified the percentage of total variance in parental knowledge attributable to linear developmental trends, the leftover residual variance was conceptualized as lability. It is important to note that the variance attributed

to lability is actually a combination of “real” lability, measurement error, and time-specific error.

To address our second aim, to examine associations of long-term change and lability in parental knowledge with substance use in adolescence, we conducted a series of linear (for alcohol and smoking uptake; SAS PROC GLM) and logistic (for overall substance use initiation and marijuana use; SAS PROC LOGISTIC) regression models (missing data deleted listwise). To do this, following Lippold et al. (2016), we first saved empirical Bayes estimates of initial levels (intercept), developmental change (slope), and lability (the standard deviation of the residuals) from the multilevel models of change of each of the sources of parental knowledge for each adolescent in our sample. Higher lability scores indicate greater fluctuations of child disclosure, parental solicitation, and parental control that deviate from developmental trends, whereas lower lability scores indicate more stable levels or systematic trends of parental knowledge across the study period. These three derived scores (each adolescent’s initial level, developmental change, and lability) were then used as predictors in outcome-specific regression models. Each regression model also included the following covariates: age, sex, cohort, race, and whether the participant qualified for free/reduced school lunch (see Appendix 1 for the regression equations). We also included interaction terms between lability and sex to examine whether the association between lability and each substance use outcome varied for boys and girls, following Lippold et al. (2016). Extending Lippold et al. (2016), the associations between the different sources of parental knowledge (child disclosure, parental solicitation, and parental control) and each substance use outcome were examined separately.

Results

Developmental Change and Lability in Parental Knowledge

Our first goal was to determine the amounts of variance in parental knowledge attributable to developmental trends and lability across the study period. Results from the multilevel models of change are presented in Table 1. There were significant linear decreases in child disclosure, parental solicitation, and parental control across the study period (e.g., child disclosure decreased $\gamma_{10} = -.05, p < .01$), with substantial between-person differences in the rate of change in all three sources of parental knowledge across time (e.g., random effect of time on parental control $\sigma^2_{u1} = .02, p < .01$). These developmental trends accounted for 19% of the variance in child disclosure, 7% of the variance in parental solicitation, and 17% of the variance in parental control. Therefore, substantial amounts of within-person variance in all three sources of parental knowledge were unexplained by long-term trends. This

remaining variance (e_{it}), conceptualized as lability, accounted for between 81, 93, and 83% of the variance in child disclosure, parental solicitation, and parental control. This decomposition of variance supports our first hypothesis that, despite significant developmental decreases in parental knowledge across the study period, a greater proportion of variance in each source of knowledge would be attributable to lability than to developmental change.

Associations of the derived variables for initial level, developmental change, and lability in the three sources of parental knowledge are provided in Table S4 (available online). Briefly, there were small-to-moderate associations among higher initial levels of child disclosure, steeper declines, and less lability (i.e., more consistency) in child disclosure over time (r 's between $-.07$ and $-.25, p < .05$). However, for parental solicitation, youth with parents who engaged in more solicitation initially tended to have flatter developmental declines (or even developmental increases) in solicitation ($r = .42, p < .05$). Initial levels and developmental changes in parental solicitation were unrelated to lability. For parental control, like parental solicitation, youth whose parents engaged in more control initial tended to have flatter developmental declines (or even developmental increases, $r = .56, p < .05$). Like child disclosure, both higher initial levels and less pronounced developmental decreases in parental control were associated with less lability (i.e., more consistency, r 's $< -.46, p < .05$). Measures of lability showed moderate inter-correlations across source of parental knowledge, r 's between $.28$ and $.31$.

Associations with Substance Use Outcomes

Our second goal was to examine the associations of individuals’ initial level, developmental change, and lability in parental knowledge with overall substance use initiation, marijuana initiation, and drinking and smoking uptake later in adolescence.

Child Disclosure

Overall, results indicated that lower levels of child disclosure were associated with a higher probability of overall substance use (standardized $\alpha_1 = -.37, p < .001$) and marijuana use initiation (standardized $\alpha_1 = -.32, p < .001$) by wave 6, as well as increased smoking (standardized $\alpha_1 = -.29, p < .001$) and drinking uptake (standardized $\alpha_1 = -.30, p < .001$) at wave 6. See Table 2 for unstandardized estimates and standard errors as well as covariate effects. Additionally, steeper developmental decreases in child disclosure were associated with a higher probability of overall substance use (standardized $\alpha_2 = -.30, p < .001$) and marijuana use initiation (standardized $\alpha_2 = -.23, p < .001$) and increased smoking (standardized $\alpha_2 = -.10, p = .01$) and drinking uptake (standardized $\alpha_2 = -.10,$

Table 1 Results of the multilevel models of change in sources of knowledge

Parameter	Child disclosure		Parental solicitation		Parental control	
	Est.	SE	Est.	SE	Est.	SE
Fixed effects						
Intercept, γ_{00}	3.87**	(0.03)	3.23**	(0.03)	4.34**	(.003)
Time, γ_{10}	-0.05**	(0.01)	-0.04**	(0.01)	-0.07**	(0.01)
Random effects						
Intercept, σ^2_{u0}	0.52**	(0.04)	0.61**	(0.05)	0.36**	(0.04)
Time, σ^2_{u1}	0.01**	(0.00)	0.01*	(0.00)	0.02**	(0.00)
Residual, σ^2_e	0.32**	(0.01)	0.57**	(0.02)	0.51**	(0.02)
Fit statistics						
-2LL	7709.6		9171.2		8896.3	
AIC	7717.6		9179.2		8904.3	
Variance decomposition						
Baseline residual, $\sigma^2_{e(\text{base})}$	0.39		0.61		0.61	
% long-term change	19%		7%		17%	
% lability	81%		93%		83%	

Unstandardized estimates presented with standard errors in parentheses. Time refers to assessment (wave 1 through wave 6), which were spaced approximately 6 months apart, but with wave 6 occurring 1 year following wave 5, and is centered at wave 1, or the start of the study. Baseline residual is derived from the unconditional model and is provided because it was used to calculate the % variance explained by long-term change and lability. AIC, Akaike information criterion; -2LL, -2 log likelihood, relative model fit statistics. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 2 Associations of child disclosure variables with substance use outcomes

		Overall SU		Marijuana		Smoking Uptake		Drinking uptake		
		β	(SE)	β	(SE)	β	(SE)	β	(SE)	
Model Intercept	α_0	-10.66***	(1.70)	-11.06***	(2.10)	-1.12	(0.76)	-5.06***	(1.09)	
Level	α_1	-1.08***	(0.16)	-0.94***	(0.19)	-0.56***	(0.08)	-0.89***	(0.11)	
Slope	α_2	-8.47***	(1.48)	-6.69**	(1.72)	-1.88*	(0.72)	-2.88*	(1.01)	
Lability	α_3	0.93*	(0.36)	1.07*	(0.43)	0.27	(0.24)	0.32	(0.33)	
Covariates										
Age	α_4	0.61***	(0.11)	0.59***	(0.13)	0.12*	(0.05)	0.49***	(0.07)	
Cohort										
2	α_5	-0.10	(0.19)	0.11	(0.22)	0.04	(0.14)	-0.21	(0.20)	
3		-0.12	(0.20)	-0.10	(0.23)	-0.16	(0.14)	-0.29	(0.20)	
4		0.03	(0.24)	-0.07	(0.29)	0.10	(0.17)	-0.08	(0.25)	
5		-0.06	(0.19)	-0.21	(0.25)	-0.03	(0.12)	-0.30	(0.18)	
Sex	α_6	-0.24*	(0.09)	-0.28*	(0.12)	-0.13	(0.09)	-0.43**	(0.12)	
Race/Ethnicity										
2 (Black, non-Hispanic)	α_7	0.12	(0.34)	0.19	(0.38)	-0.14	(0.24)	0.27	(0.34)	
3 (Hispanic)		-0.34	(0.25)	-0.39	(0.31)	-0.20	(0.15)	-0.11	(0.22)	
4 (other, non-Hispanic)		0.09	(0.24)	0.29	(0.27)	-0.14	(0.15)	-0.04	(0.21)	
Reduced/free school lunch										
1 (reduced)	α_8	0.00	(0.22)	0.14	(0.25)	0.13	(0.18)	-0.20	(0.25)	
2 (free)		-0.03	(0.17)	-0.09	(0.20)	0.08	(0.12)	-0.32	(0.18)	
Lability*sex interaction	α_9	0.73*	(0.36)	0.98*	(0.44)	0.44	(0.35)	0.41	(0.49)	

$N = 489$ boys; 534 girls. Unstandardized estimates presented, with standard errors in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$. Cohort (reference = cohort 1), sex (reference = female), race/ethnicity (reference = White, non-Hispanic), and reduced/free school lunch (reference = neither) were entered as nominal variables. Joint tests for α_5 , α_7 , and α_8 were not significant

$p = .004$). Confirming our second hypothesis, above and beyond the effects of developmental change, greater lability in child disclosure was associated with a higher probability of overall substance use initiation (standardized $\alpha_3 = .13$, $p = .01$) and marijuana use initiation (standardized $\alpha_3 = .15$, $p = .012$). However, contrary to our expectations, lability in child disclosure was not associated with smoking or drinking uptake. Interestingly, the effects of child disclosure lability on overall substance use and marijuana use initiation differed for boys and girls (lability \times gender interaction term for overall substance use initiation standardized $\alpha_9 = .10$, $p = .046$; marijuana use initiation standardized $\alpha_9 = 0.14$, $p = .025$). The interaction suggests that increased lability was a stronger predictor for boys than for girls, in part because low levels of lability was protective against initiation for boys but not girls (rates of initiation were similar at high lability).

Parental Solicitation

Lower levels of parental solicitation were associated with a higher probability of overall substance use (standardized $\alpha_1 = -.15$, $p = .008$) by wave 6 and increased smoking uptake (standardized $\alpha_1 = -.13$, $p = .002$) and drinking uptake (standardized $\alpha_1 = -.09$, $p = .036$) at wave 6 (see Table 3). With regard to developmental changes in parental solicitation, steeper declines were associated with a higher probability of marijuana use initiation (standardized $\alpha_2 = -.14$, $p = .041$) and increased smoking uptake (standardized $\alpha_2 = -.10$, $p = .014$), but not overall substance use initiation or drinking uptake. As hypothesized, lability in parental solicitation was associated with marijuana use initiation above and beyond the effects of developmental change; however, the direction of the association was unexpected. Greater lability in parental solicitation was linked to a lower probability of marijuana use initiation (standardized $\alpha_3 = -.14$, $p = .044$). This association was not moderated by sex. Contrary to our hypothesis, lability in parental solicitation was not associated with any of the other substance use outcomes.

Parental Control

In general, lower levels of parental control were associated with a higher probability of overall substance use (standardized $\alpha_1 = -.20$, $p = .002$) and marijuana use initiation (standardized $\alpha_1 = -.17$, $p = .022$) by wave 6 and increased smoking uptake (standardized $\alpha_1 = -.22$, $p < .001$) and drinking uptake (standardized $\alpha_1 = -.23$, $p < .001$) at wave 6 (Table 4). As expected, steeper developmental declines in parental control were associated with a higher probability of overall substance use initiation (standardized $\alpha_2 = -.24$, $p < .001$) and marijuana use initiation (standardized $\alpha_2 = -.16$, $p = .016$), as well as increased smoking (standardized $\alpha_2 = -.23$, $p < .001$) and drinking uptake (standardized $\alpha_2 =$

$-.12$, $p = .005$). Confirming our hypothesis, after controlling for the effects of developmental change, lability in parental control was associated with adolescent substance use. Similar to the parental solicitation model results, greater lability was associated with a lower probability of overall substance use initiation (standardized $\alpha_3 = -.17$, $p = .012$) and decreased smoking uptake (standardized $\alpha_3 = -.18$, $p = .003$). These associations did not differ by sex, and lability in parental control was not associated with marijuana use initiation or drinking uptake later on in adolescence.

Discussion

Prior studies suggest that changes in parental knowledge are normative during the adolescent transition, that parents' knowledge of adolescents' whereabouts and activities tend to decrease over time, and that those decreases tend to be associated with higher levels of adolescent substance use. One previous study also showed substantial unpredicted fluctuations, or lability, in parental knowledge that was associated with increased alcohol and tobacco use in high schoolers (Lippold et al. 2016). The present study sought to replicate the finding that change in parental knowledge is characterized by both developmental change and lability and extend the previous findings by examining three sources of perceived parental knowledge separately. Second, the present study sought to replicate the finding that higher lability in parental knowledge across early-mid adolescence predicts substance use outcomes above and beyond developmental change, again extending findings by distinguishing sources of knowledge.

As expected, we found that child disclosure, parental solicitation, and parental control were each characterized by developmental change and lability. We also found that, in general, steeper developmental declines were associated with substance use outcomes. However, our findings concerning lability were somewhat unexpected. Increased lability of child disclosure predicted higher rates of overall substance use and marijuana use initiation, as well as being in later stages of smoking and drinking uptake, replicating past findings that examined a broad measure of parental knowledge (Lippold et al. 2016). Unexpectedly, decreased lability of parental solicitation and control was associated with worse substance use outcomes (particularly marijuana use for parental solicitation and overall substance use initiation and smoking uptake for parental control). Whereas child disclosure captures the child's willing divulgence of information, parental solicitation and control are both driven in part by the parents' own efforts to find out what their children are doing (Stattin and Kerr 2000). These findings suggest different mechanisms by which lability in child- and parent-driven cultivation of parental knowledge is associated with substance use, which could have meaningful impacts on targets of longer-term prevention/

Table 3 Associations of parental solicitation variables with substance use outcomes

		Overall SU		Marijuana		Smoking Uptake		Drinking uptake	
		β	(SE)	β	(SE)	β	(SE)	β	(SE)
Model Intercept	α_0	-9.88***	(1.61)	-10.50***	(2.01)	-1.83*	(0.79)	-6.25***	(1.13)
Level	α_1	-0.39*	(0.15)	-0.32	(0.18)	-0.24**	(0.08)	-0.24*	(0.11)
Slope	α_2	-5.09	(2.63)	-7.15*	(3.50)	-3.40*	(1.37)	-1.71	(1.94)
Lability	α_3	-0.12	(0.25)	-0.71*	(0.35)	0.28	(0.18)	0.19	(0.25)
Covariates									
Age	α_4	0.58***	(0.10)	0.57***	(0.13)	0.16**	(0.05)	0.56***	(0.07)
Cohort	α_5								
2		-0.07	(0.19)	0.13	(0.22)	0.08	(0.14)	-0.15	(0.21)
3		0.02	(0.19)	0.03	(0.23)	-0.10	(0.15)	-0.15	(0.21)
4		0.11	(0.23)	0.05	(0.28)	0.15	(0.18)	0.02	(0.26)
5		-0.24	(0.18)	-0.38	(0.24)	-0.07	(0.13)	-0.41*	(0.19)
Sex	α_6	-0.24*	(0.09)	-0.26*	(0.11)	-0.16	(0.09)	-0.44**	(0.13)
Race/Ethnicity	α_7								
2 (Black, non-Hispanic)		0.21	(0.33)	0.24	(0.38)	-0.09	(0.25)	0.43	(0.36)
3 (Hispanic)		-0.41	(0.24)	-0.42	(0.30)	-0.22	(0.16)	-0.08	(0.23)
4 (other, non-Hispanic)		0.14	(0.23)	0.33	(0.27)	-0.06	(0.15)	0.12	(0.22)
Reduced/free school lunch	α_8								
1 (reduced)		0.13	(0.21)	0.27	(0.24)	0.24	(0.19)	0.05	(0.26)
2 (free)		-0.07	(0.17)	-0.13	(0.20)	0.12	(0.13)	-0.21	(0.19)
Lability*sex interaction	α_9	-0.13	(0.25)	-0.64	(0.35)	-0.46	(0.26)	-0.66	(0.37)

N = 489 boys; 534 girls. Unstandardized estimates presented, with standard errors in parentheses. **p* < .05, ***p* < .01, ****p* < .001. Cohort (reference = cohort 1), sex (reference = female), race/ethnicity (reference = White, non-Hispanic), and reduced/free school lunch (reference = neither) were entered as nominal variables. Joint tests for α_5 , α_7 , and α_8 were not significant

intervention efforts to reduce adolescent substance use. That is, if the associations here prove directional (and we underscore here that these results are only correlational), then increasing the consistency of child disclosure may help prevent substance use across phenotypes. However, assuming that lability in parent-driven sources of knowledge indexes responsiveness, teaching parents to be more responsive to time-specific challenges with adolescents may be more effective, thereby increasing the consistency of their knowledge-building parenting behaviors.

Understanding Lability in Parental Knowledge

Lippold et al. (2016) suggested that lability in parental knowledge is likely to reflect inconsistency in child disclosure but also child concealment and parent-driven aspects of the parent-child relationship. Our findings suggest that the relevant aspects of lability in terms of inconsistency that is related to substance use outcomes more likely encompass characteristics and actions of the child, not parents. That is, children (and potentially especially boys) who are consistently “good kids” who disclose information at a higher rate and consistently are less likely to engage in adolescent substance use. This

idea is also supported by the modest negative associations between level and lability of child disclosure, suggesting that youth who disclosed more also tended to be more consistent in their disclosure. At the same time, this correlation was relatively small and thus corroborates the interpretation that lability is a separable feature of child disclosure that, according to our findings and those of Lippold et al. (2016), is uniquely important for adolescent substance use initiation across multiple substances.

Although the associations of levels and developmental declines in parental solicitation and control with substance use outcomes mirror the findings for child disclosure, the effects of lability were opposite and more substance specific. First, developmental declines in solicitation were associated with both tobacco smoking uptake and marijuana initiation. However, low levels of lability (i.e., high consistency) in parental solicitation were associated with only marijuana initiation. In contrast to child disclosure, parents who solicited more from youth tended to decline less and even increase in their efforts over time (as supported by relatively large positive correlation between level and slope), but these efforts were wholly unrelated to the consistency in solicitation over time. Thus, children who perceive that their parents engage in more

Table 4 Associations of parental control variables with substance use outcomes

		Overall SU		Marijuana		Smoking Uptake		Drinking uptake	
		β	(SE)	β	(SE)	β	(SE)	β	(SE)
Model Intercept	$\alpha 0$	−9.06***	(1.63)	−9.40***	(2.00)	−0.95	(0.76)	−5.08***	(1.11)
Level	$\alpha 1$	−0.79**	(0.25)	−0.66*	(0.29)	−0.58***	(0.13)	−0.92***	(0.19)
Slope	$\alpha 2$	−5.27***	(1.25)	−3.46*	(1.43)	−3.31***	(0.64)	−2.48**	(0.89)
Lability	$\alpha 3$	−0.72*	(0.29)	−0.25	(0.32)	−0.52**	(0.18)	−0.26	(0.24)
Covariates									
Age	$\alpha 4$	0.52***	(0.10)	0.49***	(0.13)	0.11*	(0.05)	0.49***	(0.07)
Cohort	$\alpha 5$								
2		−0.18	(0.19)	0.02	(0.22)	0.02	(0.14)	−0.19	(0.20)
3		0.14	(0.19)	0.09	(0.23)	−0.02	(0.14)	−0.05	(0.20)
4		0.15	(0.24)	0.07	(0.28)	0.16	(0.17)	0.05	(0.25)
5		−0.29	(0.18)	−0.38	(0.24)	−0.12	(0.12)	−0.40*	(0.18)
Sex	$\alpha 6$	−0.30**	(0.09)	−0.33**	(0.12)	−0.19*	(0.09)	−0.52***	(0.13)
Race/ethnicity	$\alpha 7$								
2 (Black, non-Hispanic)		0.15	(0.34)	0.18	(0.37)	−0.15	(0.24)	0.28	(0.35)
3 (Hispanic)		−0.37	(0.25)	−0.39	(0.31)	−0.21	(0.15)	−0.12	(0.22)
4 (other, non-Hispanic)		0.13	(0.24)	0.31	(0.27)	−0.10	(0.15)	0.07	(0.22)
Reduced/free school lunch	$\alpha 8$								
1 (reduced)		0.22	(0.22)	0.32	(0.24)	0.30	(0.18)	0.01	(0.25)
2 (free)		−0.12	(0.17)	−0.17	(0.20)	0.09	(0.13)	−0.30	(0.18)
Lability*sex interaction	$\alpha 9$	−0.20	(0.22)	0.18	(0.26)	0.15	(0.21)	−0.43	(0.30)

$N = 489$ boys; 534 girls. Unstandardized estimates presented, with standard errors in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$. Cohort (reference = cohort 1), sex (reference = female), race/ethnicity (reference = White, non-Hispanic), and reduced/free school lunch (reference = neither) were entered as nominal variables. Joint tests for $\alpha 5$, $\alpha 7$, and $\alpha 8$ were not significant

solicitation and maintain their efforts over time engage less in substance use—particularly fewer smoking behaviors. Above those associations, it would appear that inconsistency, or perhaps the ability to change their solicitation behaviors in response to the adolescents' actions or risk levels at particular points across adolescence, also reduces risk, at least for marijuana use. That is, lability in parental solicitation may index parents' agility to respond to particular child behaviors or characteristics as they pop up across development, consistent with the notion that adolescent behavior evokes changes in parenting style (Kerr et al. 2012; Sameroff 2010).

Parental control had yet different features over time. Parents who exerted more control tended to maintain or increase in their efforts over time and tended to be more consistent in their efforts. Further, increases in parental control were also associated with more consistency over time. Thus, a picture emerges whereby parents who engage in control probably do so more overall, continually over time, and consistently—they are more devoted to monitoring their youth. Thus, control may be more of a parent characteristic relative to solicitation that may be more of a response to youth actions (an empirical question in need of testing). Further, these involved parents

have youth that engage less in all forms of substance use. Because of the negative direction of association with substance use, lability in parental control may similarly index parents' agility in responding to children's behaviors. Although parents who exert high levels of control also tend to be less agile (e.g., have lower levels of lability), one might speculate that what agility they do have may be protective against adolescent substance use initiation and smoking uptake in particular. Consistent, high levels of parental control may be less effective because the adolescent could perceive parents as too autonomy restricting.

While having potentially important implications and replicating Lippold et al. (2016), these results must still be considered preliminary. There are two key next steps in this line of research. First, it is critical to use experimental or quasi-experimental data to investigate whether associations of lability in parent-driven knowledge building could potentially be causally associated with substance use. Using within-family designs (e.g., a sibling comparison approach testing whether the sibling in a family who experienced less lability in parent-based sources of knowledge than his/her co-sibling also exhibited higher rates of substance use) would strengthen

interpretations and reduce the risk of introducing harm in interventions. Alternatively, such a test would show that familial confounding better explains these findings than potentially causal models. If results hold with this more stringent test, then implementing and testing randomly assigned interventions promoting agility in responses to children and reinforcement of child-elicited communication would allow for causal interpretations. Second, probing child characteristics and broader parent-child relationship quality indicators as moderators or mediators of these associations will help to better explain the mechanisms by which lability in knowledge is (or is not) protective against adolescent substance use.

Bidirectional Links and Potential for Causal Associations

Recent research that accounts for within- and between-family processes (Keijsers 2016) has found stable latent family-level factors that contribute to associations of knowledge and delinquency over time. There were also some smaller within-family associations of child disclosure (but not parental solicitation or control) and delinquency in the form of initial within-person correlations and correlated changes. However, there was no convincing evidence of potentially causal cross-lagged paths between knowledge and delinquency (Keijsers 2016). This lack of within-person cross-lagged effects suggests that between-family processes explain associations and reduce the likelihood of causal associations. However, a body of experimental/intervention work does show that manipulating knowledge can decrease substance use (Dishion et al. 2003; Stanton et al. 2000) (but not always; see Spirito et al. 2017). Although the goal of the present manuscript was to quantify lability and assess its association with later substance use outcomes, the present findings also highlight that bidirectional processes between externalizing behaviors and knowledge may be operating with lability as well as levels and developmental change in knowledge. Subjecting these data to a random-intercept cross-lag panel model design could test for within-person bidirectional links. This analysis was beyond the scope of the current paper but would answer a unique and important question of transactional processes that we intend to explore in the future.

Limitations and Conclusions

Other limitations important to consider in interpreting this work include the following. First, all of our data were child-reported. Although child perceptions of parenting are arguably more important than parent-reported behavior in predicting adolescent substance use (Abar et al. 2015; Latendresse et al. 2009), our estimates of associations are likely to be inflated because of shared rater bias. It is reassuring that

lability of child- and parent-based sources of knowledge had different effects on substance use despite both being rated by the child—bias would systematically increase all associations. In the future, the use of multiple raters will help to clarify and increase confidence in the effects reported here. Second, we had limited measurement of marijuana use and had to rely on a measure of initiation rather than uptake, which would be more meaningful. Discrepancies in findings across any drug use and marijuana use initiation versus smoking and drinking uptake may reflect substance-specific differences or may reflect differences in how parental knowledge is linked to initiation vs. severity of use. Third, missing data patterns led to misspecification of the initiation variables. By our best estimate, about 4% of the sample were likely to have initiated but were coded as non-initiators; this is a measurement error. Fourth, missing data were deleted listwise. Sensitivity checks for continuous outcome variables in *r(lavaan)* and reduced models for categorical outcomes (full models had insufficient covariance coverage for the EM algorithm to initiate) in *Mplus* suggested no differences in findings when missing data were accommodated with FIML. Fifth, we must stress here, again, that this study was correlational and that our findings cannot be interpreted causally. Similarly, we were unable to test bidirectional effects with the current analytic strategy. Sixth, our measure of lability includes error, and the discrepancy in the amount of variance explained by true meaningful lability versus measurement error over time could not be quantified. Finally, here, lability was measured over the course of years (once per year) because of our longitudinal sampling design. It is unclear whether this is the most meaningful time scale for understanding how lability may shape or be shaped by adolescent substance use. Studies harnessing repeated measures data on multiple time scales or fine-grained (e.g., daily diary or ecological momentary assessment) data will be an important future direction in this line of work.

Despite these limitations, the present study replicated the findings that parental knowledge over the course of years across adolescence exhibits a developmental decline, but within-person variation is marked by lability to a greater extent than developmental change. Further, greater lability in knowledge is associated with increased substance use above and beyond both levels and change in knowledge, as expected, but only for the child-driven measure of knowledge: disclosure. For parent-based sources of knowledge, less lability was associated with specific substance use outcomes: marijuana initiation for parental solicitation and smoking uptake (and general substance use initiation) for parental control. Findings suggest that lability is a unique feature and perhaps a novel target for adolescent substance use prevention/intervention programming, if findings persist in designs that can speak to causality. If so, intervention efforts should strive to increase consistency of child disclosure but promote agility in parents'

cultivation of knowledge depending on the needs of the child and family across development.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Research Involving Human Participants and/or Animals The data collection for this study was reviewed and approved by Brown University's IRB, and Purdue University's IRB approved data analysis of de-identified data for the current manuscript. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Written parental informed consent was obtained for all adolescent participants, and informed consent was obtained from parent participants included in the study.

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