Published in final edited form as:
Monogr Soc Res Child Dev. 2009 ; 74(3): 121–130. doi:10.1111/j.1540-5834.2009.00544.x.

Taking Substance Use and Development Seriously: Developmentally Distal and Proximal Influences on Adolescent Drug Use

John E. Schulenberg and **Julie Maslowsky**
Department of Psychology and Institute for Social Research University of Michigan

This compelling study clearly illustrates what many of us have long been saying, though not always as thoroughly or as convincingly, that adolescent drug use is a developmental phenomenon. Dodge et al. show how early influences work through different systems over time, from the individual through parenting and peer relations and back to individual drug use. That adolescent drug use is a significant national problem has not been in question for decades; that externalizing behavior, ineffective parenting, and association with deviant peers are risk factors for adolescent drug use is not new; and that carefully conducted longitudinal research is essential for advancement in the understanding of developmental processes has long been a fact in our science. What is new and important here, for both developmental scientists and addiction researchers, is the demonstration of how risk factors from different systems gather together sequentially across a 13 year period, how they interact systematically over time, and how each potentiates and directs earlier risk factors to set the stage for the high likelihood of adolescent use of illicit drugs. This clear explication of cascading effects as "the stuff of development" helps us see why we need to pay as much attention to developmentally distal influences as we do to developmentally proximal ones. In this commentary, we offer thoughts about some of the many strengths and contributions of the Dodge et al. study, as well as about future considerations building on this study.

Cascading Effects

The cascading effects conceptualization that is appropriately center-stage in this study is of critical importance. Masten and her colleagues (2005) have been instrumental in bringing forth this conceptualization to help understand how development builds on itself, for better and worse, and how pathways reflect temporal and perhaps causal flow across domains. Dodge et al. take it all further by providing an integration of dynamic relations across multiple domains across childhood and adolescence. In testing their model, the authors find that each step in the developmental sequence increases the predictive value of the preceding step. In other words, adding constructs that are increasingly proximal to the outcome makes the distal measures more informative. Each step in the developmental sequence provides unique opportunities for moving toward or away from substance use, for continuing on a risky path or moving onto a less risky one. Based on this study, the work of Masten and colleagues, and that of others, an easy prediction for us is that dynamic cascading conceptualizations and empirical efforts will continue to yield important advances about how developmentally distal and proximal influences across different domains work together to contribute to problematic and salutary outcomes.

Address correspondence to John Schulenberg, Institute for Social Research, University of Michigan, Ann Arbor, MI 48106-1248..

Compelling Framework and Meticulous Model Testing

Praise and emulation are deserved for how Dodge et al. set up and conducted their model testing. The mediated models, guided by the dynamic cascade conceptualization, include hypotheses from previous research along with coercive social learning theory, transactional model, and cumulative risk model. The use of PLS appears to have some important features for a study as comprehensive as this one. Data reduction was necessary, but the wide range of relevant variables to be included was not conducive to a typical factor analysis/structural equation modeling approach. PLS allows for the creation of composite variables that maximally relate to the outcome without assuming they all indicate a single cause. This allowed the researchers to include indicators of broad categories of developmentally relevant variables such as sociodemographic risk or early parenting risk without meeting the usual requirement of high intercorrelations among the variables within a category. The use of an index rather than a factor based construct is an important contribution of this study. Essentially, this approach is one in which the variables within the index are viewed as sufficient but not necessary for a given outcome.

Age of onset of substance use is important in terms of substance use etiology and consequences (Maggs & Schulenberg, 2005), and Dodge et al. do well by testing for variation in magnitude of the predictors as a function of age of onset. They found few significant interactions, but what they did find was quite interesting, particularly the differential effects of peer influence on substance use initiation. Several indicators of peer substance use measured in grades 6 and 7 showed greater prediction of initiating substance use by Grade 7 than of later initiation. This may reflect that peer influences are more contemporaneous and that they shift quickly across adolescence.

Another important aspect of the testing strategy was to examine potential gender moderation, whether the parameters were different for boys and girls. They found that parameters did not vary by gender, consistent with what others have found in terms of family, peer, and individual risk factors being invariance across gender and also race/ethnicity (e.g., Pilgrim et al., 2006). Particularly because many of the predictors of substance use in this model are commonly thought to predominate in boys (externalizing behavior, conduct problems), it is important to note that the results of this study indicate that such behaviors, when present in girls, represent equal risk for later substance use. Thus, although it is often the case that means vary across important subgroups, relations among variables often do not.

To pull it all together, the authors test alternative models specified a priori. The accepted final model yields an integrated and parsimonious model of the dynamic cascades across time and domains. The authors recognize that they could improve the fit of this model by adding paths, but they resist and instead remain with the a priori model. This is an infrequent but admirable approach, and avoids the dangers of over-fitting models (e.g., by capitalizing on chance, the accepted model may not generalize). On the other hand, we are curious about what paths in the accepted model could be freed to improve the model fit, for they likely would yield important information about additional mediation and direct effects.

Pattern centered approach important for recognizing, and better yet, embracing the heterogeneity of pathways. Chapter 12 is important on a practical level because, as the authors note, clinical decisions are made on a case-by-case assessment of risk factors facing a child. Such a decision process may be justified given the consistent increase in probability of substance use with each additional risk factor. Person-centered analyses also reveal that the opposite is true; children on a high-risk track can move to a lower-risk track via the absence of one or more risk factors in their developmental sequence. Such analyses

illustrate, on the level of individual trajectories, that distal risks do not determine eventual outcome. Heterogeneous pathways result from a single starting point.

Overall, this study provides an excellent “macro framework” for future studies of the development of conduct problems and substance use. Their review facilitates location of where a smaller, more in-depth study fits in the macro framework. For example, a study of a particular age group or of one or two links in the cascade model could be appropriately imbedded in the context and developmental framework provided here, enriching that study and elucidating its contribution to our understanding. Relatedly, as part of their review, the authors organized the literature to reveal those areas that have been substantially researched and those in which there is relatively little work to date. This creates a clear agenda for future research, highlighting those areas of the development of substance use in which more research is needed in order to understand the fully context of how these problems may develop. Specifically, the authors have pointed to important future directions such as the need to include more biological variables, or look for additional moderators and/or mediators in order to build upon the framework they have drawn out.

Heterotypic Continuity and Measurement Equivalence

In their dynamic developmental approach, Dodge et al. make it clear that the manifestations of underlying constructs – such as ineffective parenting, externalizing behavior, peer relation difficulties – shift over time. More generally, adaptation and maladaptation tend to be continuous across time, while many of the activities and behaviors associated with adaptation tend to be discontinuous (e.g., Allen et al., 2005; Cicchetti & Rogosch, 2002; Moffitt & Caspi, 2001; Rutter, 1996). This reflects heterotypic continuity (continuity in underlying purpose or function, but discontinuity in manifest behavior over time), which is distinguished from homotypic continuity (continuity in both) and functional discontinuity (manifest behavior remains continuous but purpose or function shifts over time) (Schulenberg et al., 2003). The particular emphasis by Dodge et al. on how ineffective parenting and peer relation difficulties shift with development of the target child is an important contribution of this study, both in terms of theoretical acknowledgement and empirical approach. And this reflects a larger and quite thorny measurement issue for developmental scientists conducting long-term longitudinal research. As a science, we are reasonably clear on the understanding of the importance of measurement equivalence, the extent to which a given construct is being measured in the same way over time (e.g., Nesselroade & Estabrook, 2009). Thus, without establishing measurement equivalence, it is difficult to know the extent to which any change we see over time relates to change in the construct versus change in the way the construct is measured. But this makes sense only when one assumes homotypic continuity, for measurement equivalence gets quite tricky for heterotypic continuity. How to handle the measurement of cross-individual and cross-time differences in manifest behavior of common constructs is receiving some attention (e.g., Nesselroade et al., 2007), but much more is needed. Thus, this study helps both in giving the matter conceptual attention and working through out empirically.

Developmental Transitions

The authors give some attention to developmental transitions, beginning their study with the transition to school, and having the outcome (initiation of illicit drug use) span the transition into and across adolescence. The point is made that transitions are useful periods to include in developmental studies because they can engender instability allowing for variation of and covariation among constructs. Indeed, developmental transitions offer needed vantage points for addressing issues of continuity and discontinuity (Cicchetti & Rogosch, 2002; Rutter, 1996; Schulenberg & Zarrett, 2006). Especially when studying developmental cascades,

which reflect to some extent continuity (e.g., bad circumstances set the stage for other bad circumstances), transitions are important to consider because they can interrupt ongoing person-context interactions and thus serve as turning points for better or worse. At the same time, transitions can contribute to continuity by serving as proving grounds that help consolidate and strengthen ongoing behavioral and adjustment trajectories for better and worse (Schulenberg & Zarrett, 2006). Thus, internal and social context transitions can potentiate or divert ongoing cascading influences, setting the stage for stronger or weaker developmentally distal effects. Greater attention to developmental transitions is needed in cascading studies.

The Measurement of Adolescent Drug Use

Dodge et al. resist a common practice of combining alcohol, tobacco, and illicit drugs into a composite measure, arguing that to do so might mask important developmental and ecological linkages to substance use onset. As they state, alcohol, cigarette, and illicit drug use show distinct patterns in terms of timing of onset, escalation, and decline across adolescence and into young adulthood; and these different substances show distinct historical trends in terms of peaks and declines (Johnston et al., 2009). Focusing only on illicit drug use (including marijuana, cocaine, heroin, inhalants, and other illicit drugs) does have advantages given the purposes of this study, and combining illicit drugs into a composite measure makes good sense, though it is noteworthy that marijuana use typically accounts for most of the illicit drug use. For example, based on the 2008 national Monitoring the Future (MTF) survey of 12th graders, the prevalence rate for lifetime use of any illicit drug (including inhalants) is 49.3%, whereas the prevalence rate for lifetime use of marijuana is 42.6% (Johnston et al., 2009). But not including tobacco and alcohol use (as distinct measures) does represent a missed opportunity. Tobacco and alcohol use typically precede illicit drug use, though many who use tobacco and alcohol do not continue on to illicit drug use. Understanding what, in terms of developmental cascades, contributes to crossing the line into illicit drug use is important for future research.

The decision to focus on lifetime use – that is, onset of illicit drugs – was partly a function of the inconsistent measurement of substance use across adolescence; thus lifetime use was a common denominator. Measurement issues aside, the first use of illicit drugs is obviously very meaningful. Most young people who try an illicit drug (which is typically marijuana) report using illicit drugs (again, typically marijuana) more than once or twice. For example, based on the 2008 national MTF survey of 12th graders, considering only the 42.6% who report any lifetime use of marijuana, less than one-fourth of them (23.9%) use it only once or twice; thus, over three-fourths move beyond the “just trying it” phase, and indeed, nearly a third (32.6%) report using it 40 or more times in their life time (Johnston et al., 2009). No doubt, initiation of illicit drugs is a problem and thus worthy of the in-depth attention it received by Dodge et al. Future analyses, however, would benefit by examining the deeper end of illicit drug use, including frequent use of marijuana and other harder drugs. Distinguishing between first use and more consistent and heavy use is important etiologically and likely has different developmentally distal and proximal risk factors.

Extending the Framework and the Research

The Dodge et al. study does well in embracing the complexity inherent in the understanding of human development, and equally well in taming the complexity, theoretically and empirically, so as to make it feasible. As we discussed above, their model justification, set up, and testing are admirable, and indeed the “macro framework” of the study can be useful for locating other studies. Of course, the framework can and should be extended in numerous ways. In particular, as the authors discuss, more attention should be given to

biological aspects of conduct problems and substance use, specifically potential genetic contributions. Genotype is increasingly viewed as an important moderator in the effects of environment on the development of psychopathology including conduct problems and substance use (Rutter, Moffitt, and Caspi, 2006). Functional polymorphisms of the COMT, MAOA, and 5HTT genes have been implicated in the development of alcoholism (for a review, see Enoch 2007). Genotype, particularly MAOA genotype, has also been implicated in the development of conduct problems (e.g. Caspi et al 2002; Foley et al 2004; Haberstick et al 2005). The research to date has indicated that genes are especially important in predicting externalizing disorders in the context of environmental adversity (Hicks et al 2009). The Dodge et al. model identifies several sources of environmental risk for the development of substance use and conduct problems, including poor parenting practices and sociodemographic risk. The contributions of these environmental factors may be further clarified with the addition of genetic information, perhaps allowing for the understanding of how specific subgroups are more or less affected by environmental influences, depending on their genotype.

The influence of parents and peers on substance use and conduct problems is indisputable, but a third important set of contextual influences involves the school (e.g., Bachman et al., 2008). School influences dovetail with parental influences and often serve to structure peer influences. Indeed, without much extension of the model, one could easily imagine how difficulties and successes in school fit into the dynamic cascading process. A related extension of the framework is to include predictors that span further into middle and high school to capture the dynamic interactions that likely escalate further into adolescence (which would correspond with more of a focus on onset and escalation of more frequent illicit drug use mentioned above).

It is a truism, though one worth pushing on, that one can either conduct a large scale study with a large representative sample and survey measurement or a smaller scale study with more intensive measurement necessary to get at developmental mechanisms. To advance developmental science and the study of addictions, doing both, or finding a way to combine both effectively (e.g., Curran & Hussong, 2009), is needed. This is especially true for the vein that Dodge et al. have struck. Dynamic cascades are likely to be moderated by not just sociodemographic characteristics, but also individual characteristics; large representative samples allow for more in-depth consideration of pattern-centered analyses to discover common and unique pathways, resilience, and multifinality (Cicchetti & Rogosch, 2002; Schulenberg & Zarrett, 2006).

Conclusions and Implications

This study joins a growing list of conceptual and empirical efforts that examine adolescent drug use as a developmental phenomenon (e.g., see Brown et al., 2008; Chassin et al., 2009; Maggs & Schulenberg, 2005; Masten et al., 2008; Zucker, 2006). As is clearly recognized, understanding the etiology and course of substance use from early on, as well as the contextual covariates and influences, is essential for designing effective interventions. Indeed, interventions that build on a developmental and contextual foundation, focusing on the social and individual mechanisms that set the stage for optimal development, can be successful in reducing adolescent drug use and related problems (e.g., Hawkins et al., 2009; Kellam et al., 2008). Dodge et al. discuss some useful implications for targeted intervention efforts, and more generally, one can see through this study the power of prediction that comes from thorough longitudinal screening; at the same time, given the unique contributions of more developmentally proximal cascade effects, early interventions alone are likely to be insufficient.

In sum, the authors present an elegant model of cascading influences, taking us from early parenting difficulties up through substance use initiation in adolescence. They highlight the major roles of early behavior problems and of parenting and peer problems that occur in early childhood and adolescence. They take their results further by demonstrating invariance in the relationships by gender and by demonstrating the informative heterogeneity of individual trajectories that underlie these results. The authors understand that not all the important components are included here and that other sequences and pathways are likely. Science will move forward to include other components and pathways to provide a fuller understanding of the complex net of influences on adolescent drug use that is very much needed. What will last from this study is the imagery of the underlying process – dynamic cascades – representing how developmentally distal and proximal influences across different domains work together to direct and potentiate each other toward a likely but not pre-determined outcome. Theoretically and practically, this is the major contribution of the Dodge et al. study. Those of us who talk with parent and community groups and policy makers have seen a common fear that adolescent drug use "comes out of nowhere," that there are lurking contemporaneous forces over which we have little control. Developmentally informed addiction researchers and developmental scientists know this to be untrue. And to help show it is untrue, we now have the Dodge et al. study, giving us a compelling illustration of how adolescent drug use comes from known developmentally ordered forces.

Acknowledgments

Authors Note: Work on this commentary was funded in part by support from the National Institute on Drug Abuse (R01 DA 01411) and the Center for Human Growth and Development at the University of Michigan. The content here is solely the responsibility of the authors and does not necessarily represent the official views of the sponsors.

References

Allen JP, Porter MR, McFarland FC, Marsh P, McElhaney KB. The two faces of adolescents' success with peers: Adolescent popularity, social adaptation, and deviant behavior. Child Development. 2005; 76:747–760. [PubMed: 15892790]

Bachman, JG.; O'Malley, PM.; Schulenberg, JE.; Johnston, LD.; Freedman-Doan, P.; Messersmith, EE. The education—drug use connection: How successes and failures in school relate to adolescent smoking, drinking, drug use, and delinquency. Lawrence Erlbaum Associates/Taylor & Francis; New York: 2008.

Brown SA, McGue M, Maggs JL, Schulenberg JE, Hingson R, Swartzwelder S, et al. A developmental perspective on alcohol and youths 16 to 20 years of age. Pediatrics. 2008; 121:S290–S310. [PubMed: 18381495]

Caspi A, McLay J, Moffitt TE, Mill J, Marin J, Craig IW, et al. Role of genotype in the cycle of violence in maltreated children. Science. 2002; 297:851–854. [PubMed: 12161658]

Chassin, L.; Hussong, A.; Beltran, I. Adolescent substance use. In: Lerner, RM.; Steinberg, L., editors. Handbook of adolescent psychology. 3rd ed. Wiley; New York: 2009. p. 723-763.

Cicchetti D, Rogosch FA. A developmental psychopathology perspective on adolescence. Journal of Consulting and Clinical Psychology. 2002; 70:1, 6–20.

Curran PJ, Hussong AM. Integrative data analysis: The simultaneous analysis of multiple data sets. Psychological Methods. 2009; 14:81–100. [PubMed: 19485623]

Enoch MA. Genetic and environmental influences on the development of alcoholism: Resilience versus risk. Annals of the New York Academy of Science. 2007; 1094:193–201.

Foley DL, Eaves LJ, Wormley B, Silberg JL, Maes HH, Kuhn J, Riley B. Childhood adversity, monoamine oxidase a genotype, and risk for conduct disorder. Archives of General Psychiatry. 2004; 61:1–7.

Haberstick B, Lessem J, Hopfer C, Smolen A, Ehringer M, Timberlake D, Hewitt J. Monoamine oxidase A (MAOA) and antisocial behaviors in the presence of childhood and adolescent

maltreatment. American Journal of Medical Genetics: Neuropsychiatric Genetics. 2005; 135:59–64.

Hawkins JD, Oesterle S, Brown EC, Arthur MW, Abbott RD, Fagain AA, Catalano RF. Results of a type 2 translational research trial to prevent adolescent drug use and delinquency. Archives of Pediatric and Adolescent Medicine. 2009; 163:789–798.

Hicks BM, South SC, Dirago AC, Iacono WG, McGue M. Environmental adversity and increasing genetic risk for externalizing disorders. Archives of General Psychiatry. 2009; 66:640–648. [PubMed: 19487629]

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national survey results on drug use, 1975-2008. Volume I: Secondary school students. National Institute on Drug Abuse; Bethesda, MD: 2009. (NIH Publication No. 09-7402)

Kellam SG, Brown CH, Poduska JM, Ialongo NS, Wang W, Toyinbo P, Petras H, Ford C, Windham A, Wilcox HC. Effects of a universal classroom behavior management program in first and second grades on young adult behavioral, psychiatric, and social outcomes. Drug and Alcohol Dependence. 2008; 95S:S5–S28. [PubMed: 18343607]

Maggs, JL.; Schulenberg, JE. Initiation and course of alcohol consumption among adolescents and young adults. In: Galanter, M., editor. Recent developments in alcoholism, vol. 17: Alcohol problems in adolescents and young adults. Kluwer Academic/Plenum Publ; New York: 2005. p. 29-47.

Masten AS, Faden VB, Zucker RA, Spear LP. Underage drinking: A developmental framework. Pediatrics. 2008; 121:S235–S251. [PubMed: 18381492]

Masten AS, Roisman GI, Long JD, Burt KB, Obradović J, Riley JR, Boelcke-Stennes K, Tellegen A. Developmental cascades: Linking academic achievement, externalizing and internalizing symptoms over 20 years. Developmental Psychology. 2005; 41:733–746. [PubMed: 16173871]

Moffitt TE, Caspi A. Childhood predictors differentiate life-course persistent and adolescence-limited antisocial pathways among males and females. Development and Psychopathology. 2001; 13:355–375. [PubMed: 11393651]

Nesselroade, JR.; Estabrook, R. Factor invariance, measurement, and studying development over the lifespan. In: Bosworth, H.; Hertzog, C., editors. Aging and cognition: Research methodologies and empirical advances. American Psychological Association; Washington DC: 2009. p. 39-52.

Nesselroade JR, Gerstorf D, Hardy SA, Ram N. Idiographic filters for psychological constructs. Measurement: Interdisciplinary Research and Perspectives. 2007; 5:217–235.

Pilgrim CC, Schulenberg JE, O'Malley PM, Bachman JG, Johnston LD. Mediators and moderators of parental involvement on substance use: A national study of adolescents. Prevention Science. 2006; 10:1–15.

Rutter M. Transitions and turning points in developmental psychopathology: As applied to the age span between childhood and mid-adulthood. International Journal of Behavioral Development. 1996; 19(3):603–626.

Rutter M, Moffitt T, Caspi A. Gene-environment interplay and psychopathology: multiple varieties but real effects. Journal of Child Psychology and Psychiatry. 2006; 47:226–261. [PubMed: 16492258]

Schulenberg, J.; Maggs, JL.; O'Malley, PM. How and why the understanding of developmental continuity and discontinuity is important: The sample case of long-term consequences of adolescent substance use. In: Mortimer, JT.; Shanahan, MJ., editors. Handbook of the Life Course. Kluwer Academic/Plenum Publishers; New York: 2003. p. 413-436.

Schulenberg, JE.; Zarrett, NR. Mental health during emerging adulthood: Continuity and discontinuity in courses, causes, and functions. In: Arnett, JJ.; Tanner, JL., editors. Emerging adults in America: Coming of age in the 21st century. American Psychological Association; Washington DC: 2006. p. 135-172.

Zucker, RA. Alcohol use and alcohol use disorders: A developmental-biopsychosocial system formulation covering the life course. In: Cicchetti, D.; Cohen, DJ., editors. Developmental psychopathology: Risk, disorder and adaptation. 2nd Ed. Wiley; New York: 2006. p. 620-656.