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Longitudinal Studies of Drug Use and Abuse

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1. LONGITUDINAL STUDIES OF DRUG USE AND ABUSE

In this chapter we discuss longitudinal studies investigating variables related to substance use and abuse. The emphasis is on research with general-population samples that has assessed participants at relatively early ages and followed them over time to examine how predictor variables are related to outcomes at later ages. Excluded are studies of persons already showing drug abuse (see Chapter 3), research with clinical samples of adolescents, and studies that started in late adolescence, when most persons who are going to use substances have already done so. The outcomes include intensity of tobacco, alcohol, and marijuana use; continuous measures of substance-related problems; or diagnostic assessments such as alcohol abuse. Such studies clarify questions about predictive relations through establishing variables that are true antecedents of drug use. They also help clarify the understanding of drug abuse through indicating risk factors and protective factors, conceptualized as distinct domains because risk and protection indices are not highly correlated (Newcomb and Felix-Ortiz, 1992).

Data on how the prevalence of substance use varies with age in general populations are available from several sources including Monitoring the Future and the National Household Survey on Drug Abuse (e.g., Johnston et al., 2000). Such studies show that substance use before the age of 11 years is infrequent but between the ages of 12 and 18 years, rates of substance use increase to a level where a substantial part of the population has used cigarettes or alcohol, and a smaller but not insignificant proportion shows problem use (e.g., Harrison et al., 1998). This makes longitudinal research during this period useful for helping to inform theory about the origins of substance abuse.

A general model of liability to substance abuse is presented in Figure 1. Factors operating in childhood may predispose to early onset of drug use, around 12 years of age. For a subgroup of teens, substance use onset is followed by escalation in the frequency and intensity of use (Wills et al., 1996). A high level of use can then lead to development of abuse or dependence for some persons, either in adolescence or at later ages (e.g., Wills et al., 2002). Risk factors increase liability for substance abuse through promoting early and/or escalated use, while protective factors reduce the likelihood of onset and escalation. Other factors may operate as direct effects (not through level of use), so individuals could be more or less vulnerable to problem use at a given level of substance use. This model, recognizing both indirect effects of predictors through promoting higher levels of use, and direct effects to abuse, underlies much of the research discussed in this chapter.

2. STUDIES WITH BROAD-BASED MODELS

Here we discuss early studies that continue to influence current research. Sample sizes were in the range from 1,000 to 2,000 participants. These studies

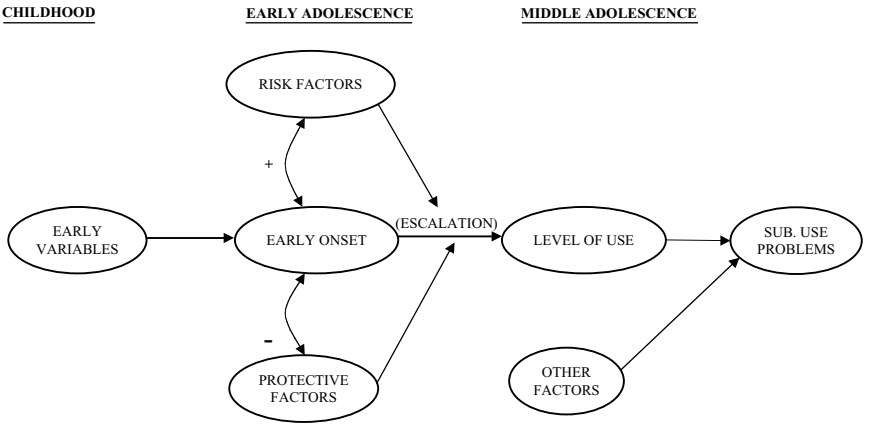

Figure 1. Model for Longitudinal Prediction of Substance Use from Variables in Childhood, Early Adolescence, Middle Adolescence and Late Adolescence/Early Adulthood. (Curved double-headed arrows indicate concurrent effects; straight single-headed arrows indicate cross-time effects. Paths are assumed to have positive coefficient unless otherwise noted;—indicates inverse coefficient.)

tested broad-based models assuming that drug abuse is linked to some combination of individual, family, and peer factors.

2.1. Social Adaptation Approach

In the Woodlawn Project, a large sample of mostly African-American children was assessed at 6 years of age; teacher and maternal reports were obtained about children's symptomatology and academic readiness. The sample was followed into adolescence (16 years of age) and adulthood (32 years of age). In adolescence, substance use was found to be elevated among males who had been rated in first grade as aggressive, while ratings of shyness were inversely related to substance use; among females, only ratings of psychological distress in first grade predicted adolescent substance use (Kellam et al., 1982). In adulthood, shyness in childhood and school bonding during adolescence predicted less marijuana use among women; among men, the combination of aggression and shyness in childhood predicted current marijuana and cocaine use (Ensminger et al., 2002). Early ratings of underachievement were related to alcohol abuse and dependence in adulthood, while adolescent data indicating that parents helped with homework and set clear rules for school behavior were indicated as protective factors.

2.2. Epidemiologic Approach

Epidemiologic research by Kandel and colleagues (1978) was based on a large sample of high school students in New York State and emphasized social predictors

of substance use. Transitions to illicit drug use were predicted by factors such as parental substance use and lack of closeness to parents; delinquency; availability of drugs; and peer substance use. Follow-ups through age 34–35 years have delineated the natural history of drug use (e.g., Kandel et al., 1992); for example, alcohol use tended to peak around age 18 whereas cocaine use peaked in the mid-20s (Chen and Kandel, 1995). Several papers from this study have noted the adverse consequences of drug involvement in adolescence (e.g., Kandel et al., 1986).

2.3. Problem Behavior Approach

Problem behavior theory (Jessor and Jessor, 1977) locates the predisposing factors for substance use in rejection of conventional values and adoption of a deviance-prone attitudinal structure (e.g., tolerance for deviant behaviors such as stealing and fighting). School-based studies following middle-school students and college students showed prevalence (and onset) of problem drinking and marijuana use related to variables such as attending church infrequently, having low grades, being loosely attached to parents, having relative tolerance for deviance, and affiliating with deviant peers such as drinkers and marijuana users; correlations were also found among indices of heavy drinking, marijuana use, and sexual behavior (e.g., Donovan and Jessor, 1985). There was a decline in rates of substance use after adolescence, but a subgroup of persons showed sustained high levels of use from late adolescence to young adulthood (Donovan et al., 1991; Bachman et al., 2002). Recently problem behavior theory has been extended to prediction of other health behaviors (e.g., Jessor et al., 1998).

2.4. Personality Approach

In a 6-wave study by Newcomb, Bentler, and colleagues, participants were surveyed in middle schools (7th–9th grades) and then followed through high school and into young adulthood. This project tested a model emphasizing personality and attitudinal unconventionality as predictors and considering various consequences of use including academic and vocational adjustment (Newcomb and Bentler, 1988a). Problematic drug use (e.g., daily marijuana use) showed an almost linear relation to a 10-item risk-factor composite including variables such as social nonconformity, early alcohol use, low self-esteem, and poor relationship with parents (Newcomb et al., 1986). The investigators considered ethnic differences, finding African-American adolescents to have the lowest rates of substance use, and used structural equation modeling to determine predictors and consequences of substance use involvement. Analyses showed substance use positively related to factors such as life stress (Newcomb and Harlow, 1986) and inversely related to parental emotional support (Newcomb and Bentler, 1988b); problem outcomes (e.g., drunk driving) were related to coping motives for drug use (Newcomb

et al., 1988). This study found many adverse consequences of adolescent substance use, with control for initial use; these included mental health problems, physical health problems, and relationship problems in adulthood (Newcomb and Bentler, 1988a,b).

2.5. Psychopathology Approach

Research by Brook and colleagues (1995) was based on a community sample of families in upstate New York, originally assessed when child participants were 1–10 years of age (mean age 5.6 years) and followed with assessments in early adolescence, late adolescence, and early adulthood (mean ages 22 and 27 years). This research used a model focused on individual psychopathology and family factors as predictors of drug abuse. Analyses for drug use in young adulthood showed childhood measures of aggression and temper tantrums to be significant predictors over a 20-year time span; adolescent measures of impulsivity and sensation seeking were risk factors for subsequent drug use, while adolescent measures of good self-control and moral beliefs were protective. This study also found heavy drug use in adolescence was related to adverse outcomes at later ages (e.g., Brook et al., 1999, 2002).

3. RECENT THEORY-TESTING STUDIES

During the past 10 years, studies with various designs have tested focused theoretical models about the origins of liability to substance abuse. Here we discuss representative studies that have tested questions such as the role of temperament and self-control factors, social influences, and family history of substance abuse.

3.1. Temperament and Self-Control Models

Studies influenced by temperament theory (Rothbart and Ahadi, 1994) have tested early-developing dispositional characteristics as predictors of substance use. An investigation with a sample of Finnish children initially assessed at 8–9 years of age (Pulkkinen and Pitkänen, 1994) found problem drinking in adulthood predicted by early ratings of poor concentration ability, high aggressiveness and low prosociality, and poor school performance. Mâsse and Tremblay (1997) used teacher ratings of children assessed at ages 6 and 10 years, subsequently coded for dimensions from Cloninger's (1987) personality theory, and found that the characteristics of novelty seeking and harm avoidance were significant predictors for drunkenness, cigarette smoking, and other drug use during adolescence. A study of a birth cohort in New Zealand (Caspi et al., 1996) obtained temperament assessments at 3 years of age and followed participants with periodic assessments including

diagnostic interviews at age 21 years. A group characterized as "Undercontrolled" in childhood had elevated rates of alcohol dependence and alcohol problems in young adulthood. A group classified as "Inhibited" also had elevated scores for alcohol problems; this was true for boys but not for girls.

Studies with multiethnic samples of adolescents from the New York metropolitan area by Wills and colleagues (1996) have used closely spaced assessments to test a theoretical model of early onset and escalation based on temperament and self-control (e.g., planning ahead, waiting for rewards). Studies of escalation have shown that around 12 years of age, future escalators had a much higher overall risk loading compared with experimenters or abstainers, being elevated on variables such as life stress, maladaptive coping, and peer substance use, and lower on variables such as parental support and academic competence. Structural modeling analyses for early onset show temperament characteristics of activity level and negative emotionality are related to poor self-control, while (with relative independence) positive mood and attentional focusing are related to good self-control (e.g., Wills et al., 2001). Poor self-control influences substance use involvement and escalation of use through exposing adolescents to more life stress and deviant peer affiliations, whereas good self-control has protective effects through promoting better academic competence (e.g., Wills et al., 2001; Wills and Stoolmiller, 2002; Novak and Clayton, 2001). In later adolescence, self-control and coping motives for use moderate the transition from substance use to substance abuse; for example, impulsive persons show more substance-related problems at a given level of substance use (Wills et al., 2002). Similar findings with outcomes including early substance use and sexual behavior have been obtained in studies with samples of minority adolescents in the Southern US (e.g., Brody and Ge, 2001; Wills et al., 2003).

Pandina and Johnson (1999) and colleagues have used an elaborated stress-coping model with a large regional sample of adolescents, initially assessed when participants were 12, 15, or 18 years of age, and followed with 3-year intervals into young or middle adulthood. Personality variables of disinhibition and hostility in adolescence predicted alcohol problems in young adulthood (Curran et al., 1997). Adolescent indices of chronic stress, negative coping styles (e.g., dealing with problems through anger), and perceiving alcohol use as a coping mechanism predicted alcohol dependence in young adulthood (Johnson and Pandina, 2000). Persons with persistent problem drinking were initially elevated on disinhibition and other problem behaviors (e.g., destroying property), and this group showed much poorer functioning in adulthood (Bennett et al., 1999).

3.2. Social Learning Models

The Oregon Youth Study, initiated by Gerald Patterson and colleagues, used a sample of boys from high-risk neighborhoods, initially assessed in 4th grade and followed over time with periodic assessments. Results showed that association

with deviant peers often occurred by 12 years of age and was predictable from early measures of poor parental discipline and monitoring practices, poor academic performance, and poor social skills in childhood (Dishion et al., 1991). Deviant peer associations in early adolescence were found to mediate the relation between family and peer factors in childhood and substance use at 18 years of age (Dishion et al., 1995), and peer associations accounted for growth over time in substance use, sexual risk taking, and criminal behavior (Patterson et al., 2000). Another study in Oregon, with youth initially assessed at 11–15 years of age, also found peer substance use and variables such as family conflict contributed to escalation of problem behavior, and peers' use in late adolescence was a predictor of participants' use in young adulthood (e.g., Andrews et al., 2002). Adolescent's early experimentation (particularly with cigarette smoking) influenced subsequent growth in substance use involvement (Duncan et al., 1998) and chronicity of alcohol use in adolescence was a predictor of a range of problems in young adulthood (Duncan et al., 1997).

Ellickson and colleagues have analyzed data from a large prevention study initiated with 7th graders in schools in California and Oregon; the participants were followed through high school and at age 23 years. Tucker, Ellickson, and Klein (2002) studied predictors of transitions to regular smoking in 12th grade; early substance experimentation and low grades were risk factors, while protective factors included parental support and living in a two-parent nuclear family. Growth mixture modeling (Tucker et al., 2003) found four trajectories of binge drinking over the period from early adolescence to young adulthood; drinking increasers were characterized from early ages as having more deviant behaviors (e.g., skipped school, stole from a store) and lower resistance efficacy for drug offers.

A study in Seattle by Hawkins and colleagues used a social development model (Catalano and Hawkins, 1996) and was based on a sample of participants initially assessed in 5th grade and followed with periodic assessments into young adulthood. Early onset of alcohol use was related to alcohol problems in late adolescence (Hawkins et al., 1997) and transition analyses indicated that eventual problem drinkers began to diverge from other individuals in alcohol use between elementary school and middle school (Guo et al., 2000). Risk factors for alcohol abuse/dependence in young adulthood included parental alcohol abuse, youth's externalizing and internalizing problems, living in a neighborhood with more trouble-making youth, more bonding to antisocial friends, more perceived rewards from alcohol, and relatively high levels of use in middle and high school (Guo et al., 2001). Protective factors included clear family rules, strong bonding to school, social skills for refusing alcohol offers, and moral beliefs.

3.3. High-Risk Samples

Several studies have tested theoretical models with children of substance-abusing parents, in view of the elevated risk attributable to family history (e.g., Windle, 1990). Chassin and colleagues (1993) have used a stress-coping model.

This research was based on two groups of adolescents who were 10.5–15.5 years of age at baseline; one group had a biological parent who was alcoholic, the other group was demographically-matched controls with no parental alcoholism. Structural modeling analyses of early use showed vulnerability pathways, with parental alcoholism related to more life stress and negative emotionality among children, which in turn were related to more affiliation with drug-using peers; there was a protective pathway through parents' monitoring of children's behavior. For alcohol abuse/dependence in young adulthood there were pathways from parental alcoholism to externalizing (but not internalizing) symptomatology and alcohol use in adolescence; parental antisocial personality had a direct effect to drug abuse/dependence (Chassin et al., 1999; Chassin et al., 2002). A study of similar design that began when children were 3–5 years of age was based on a multifactorial model of pathways to substance abuse (Zucker, 1994). This research finds the high-risk group scoring lower at young ages on cognitive indices such as abstract planning and attentional focusing (Puttler et al., 1998) and scoring higher on measures of undercontrol and behavior problems (Loukas et al., 2003).

Tarter and colleagues have utilized temperament and self-control constructs (Tarter et al., 1999) in a study being conducted in Pittsburgh with a group of children from families having a parent with a substance abuse disorder, and demographically-matched controls with no parental substance abuse. Participants were initially assessed at 10–12 years of age (Wave 1) and were followed at 2-year intervals. A series of reports from this project has related temperament and executive cognitive functioning (ECF) to intermediate variables such as peer interaction and negative affectivity (e.g., Shoal and Giancola, 2003). Giancola and Parker (2001) found that baseline scores for ECF and difficult temperament independently (in opposite directions) predicted aggression and deviant peer affiliations at Wave 2, which in turn both predicted drug use at Wave 3 (ages 14–16 years). Tarter et al. (2003) reported data from Wave 4 (17–19 years of age), utilizing a composite dysregulation score derived from earlier assessments based on difficult temperament, ECF, externalizing symptomatology, and disruptive classroom behavior. Dysregulation from Wave 1 predicted substance use disorder at Wave 3, and Wave 3 dysregulation discriminated substance abusers from nonabusers at Wave 4.

3.4. Minority Samples

The research previously discussed was typically based on predominantly Caucasian populations. In recent years, investigators have conducted longitudinal studies with samples of ethnic minorities. These have extended the generality of previous findings and have identified new variables, such as ethnic identity and racial discrimination, that have a significant role in substance use or nonuse (e.g., Gibbons et al., 2004).

Friedman and Glassman (2000) studied a sample drawn from the rolls of the National Collaborative Perinatal Project. The analytic sample was persons who were African-American and had data at ages 16 years, 24 years, and 26 years. For predicting duration/intensity of substance use at age 26, adolescent risk factors were mostly indices of the amount of time the participant or his/her friends spent in deviant or illegal activity. Protective factors were peers' involvement in conventional pursuits (e.g., Boy/Girl Scouts, studying to get good grades) and amount of leisure time spent alone rather than with friends. Family risk factors included parents having drug problems and being angry, unreliable or unavailable; a protective factor was that mother had helped the participant with school work during adolescence.

Zimmerman and Schmeelk-Cone (2003) studied a sample of African-American adolescents from urban schools. The participants were initially assessed in 9th grade (mean age 14.6 years) and were followed at yearly intervals, with a fifth wave conducted two years after high school. Baseline data showed school motivation was lower among those who were already using alcohol and marijuana. Results from multiwave analyses showed that low school motivation contributed to continued drug use. The reciprocal path was not found, but heavy alcohol and marijuana use in adolescence reduced the likelihood of school graduation.

Bryant et al. (2003) examined academic variables with a multiethnic national sample of public school students assessed at ages 14 years and 20 years. Predisposing factors for increase in substance (tobacco, alcohol, or marijuana) use included negative attitudes toward school, placing little value on education, having friends with corresponding attitudes, and having less support from parents for academics. Tests showed that effects of some risk factors on substance use (e.g., school misbehavior) were stronger among Caucasians, but in general the effects of academic involvement were similar for majority and minority students.

Research being conducted in rural North Carolina has participants who are predominantly Caucasian but the study includes a sizable group of American Indian participants. A sample screened for elevated risk was initially assessed at 9, 11, or 13 years of age and is being followed over time with yearly assessments. A report based on three waves of data showed cross-sectional associations of behavioral undercontrol disorders with substance use for both ethnic groups and both genders; associations for emotional disorders (anxiety and depression) were significant only among Caucasian girls. Having a disorder increased the likelihood of substance use, but some tests showed initial substance use (particularly tobacco) related to subsequent disorder; both types of effects were prominent among American Indians though some effects were also found among Caucasians (Federman et al., 1997). Boys with abuse/dependence at age 16 showed earlier onset of substance use whereas girls with abuse/dependence showed later onset, implying that they progressed to abuse more rapidly (Costello et al., 1999).

4. SUMMARY AND DISCUSSION

This chapter has discussed longitudinal studies conducted with a variety of populations and utilizing different approaches to recruitment of subjects and assessment of predictors. Each study had some limitations (though different ones across studies) along with strengths accruing from the population studied and the methods utilized. A number of findings are consistent across studies, despite variations in populations and methods. Thus longitudinal research provides a rich resource, providing knowledge that can be used to help shape the content of prevention programs aimed at deterring the onset or persistence of substance use problems.

A summary of predictors is presented in Table 1. The results were observed over intervals from 4–5 years to 25–30 years and were obtained across different indices of substance use. We emphasize that extensive involvement in substance use in adolescence is a risk factor for drug abuse and adverse consequences in work, health, and social domains at later ages.

4.1. Risk Factors

Family risk factors are familial history of substance abuse (or current parental or other adult abuse), parental psychological problems and antisociality, and low

Table 1. Summary of Risk and Protective Factors for Drug Abuse

Risk factors	Protective factors
• Parental substance use, abuse • Parental anger, mental health problems, antisocial personality • Low family attachment, family conflict • Early onset of use • Temperament: activity level, negative emotionality • Poor self-control (e.g., impulsiveness, disinhibition) • Risk taking, sensation seeking • Deviance-prone, unconventional attitudes (e.g., tolerance for deviance) • Life stress, racial discrimination • Externalizing symptomatology • Deviant peer affiliations • Motives for use • Availability of drugs • Neighborhood disorganization • Genetic factors	• Emotional, instrumental family support, family rules and organization • discipline and monitoring • Temperament: attentional focusing, positive emotionality • Good self-control (e.g., planfulness, executive functioning) • Conventional attitudes (e.g., value on achievement) • Perceived harmfulness of drugs • Moral beliefs • Resistance efficacy • Academic involvement • Perceived control, self-esteem, ethnic identity

attachment plus frequent conflict with parents. Individual factors include poor self-control, a tendency to seek out risks, and deviance-prone attitudes (e.g., rebelliousness, tolerance for deviance). Temperament dimensions such as activity and negative emotionality are risk factors for early onset, and early onset and high-intensity use during adolescence predict substance use problems in adulthood. Other factors are life stress, affiliating with deviant peers, having coping motives for drug use, and externalizing-type symptomatology. Environmental factors include neighborhood disorganization and availability of drugs. Genetic factors have been suggested recently but are not well understood (McGue, 1999; Tarter et al., 1999).

4.2. Protective Factors

Protective family factors are supportive relationships with parents together with consistent discipline and monitoring by them. Protective temperament characteristics (attentional focusing, positive emotionality) and good self-control reduce onset and reduce the impact of risk factors. Academic orientation is protective, including positive attitudes toward school, valuing achievement as a goal, and getting good grades. Having moral beliefs and viewing religion as important are inversely related to drug abuse, as are social skills that enable persons to resist pressures for substance use and other risky behaviors.

4.3. Models of Predictive Effects

It is evident that drug abuse has many predictors. How, then, do these factors interrelate so as to place individuals on trajectories toward or away from drug abuse? This question has not really been addressed in most of the studies, because the analyses typically tested only whether variables at one point predicted drug abuse outcomes at a subsequent point. Few studies have tested the flow of processes over time, determining how variables operate so as to "push" individual trajectories toward or away from adverse outcomes (Tarter and Vanyukov, 1994; Zucker, 1994). For example, it is likely that parental substance abuse has effects on family relationships and on children's affect and coping, which in turn have implications for their performance in school and the kinds of peers they hang out with. It is these intermediate processes that can lead to escalated use, but at present there is still relatively little understanding of mediation processes in liability for drug abuse (Wills and Yaeger, 2003). Several models have outlined how to conceptualize the flow of influences from earlier to later factors (Catalano and Hawkins, 1996; Rothbart and Ahadi, 1994; Tarter and Vanyukov, 1994; Wills and Dishion, 2004; Zucker, 1994), and these may be useful to persons who are designing further research or analyzing longitudinal data.

4.4. Where Can Research Go from Here?

A number of variables have been identified that predict substance abuse over considerable time periods. Yet some issues are not well resolved in current studies and we think will likely be the focus in further research. One issue is that although a number of predictors have been identified, it is not always clear how the flow of effects from one level to another occurs (e.g., family history to family interaction, self-control to peer affiliations) and how downstream effects from one time to another operate (e.g., early adolescence to middle adolescence). Research is needed to help clarify how effects of distal factors are translated into impact on proximal factors so as to influence specific manifestations of substance use or abuse. Analyses testing both direct effects and indirect effects (Figure 1) would help to clarify the nature of predictive processes. Another aspect is that the unfolding of temporal relations between predictors and outcomes over time is sometimes unclear, so research using techniques such as growth modeling and trajectory analysis would be useful to clarify how variables affect each other over time (e.g., Chassin et al., 2002; White et al., 2001; Wills and Stoolmiller, 2002). Person-centered analytic approaches may help to integrate data on predictive effects, as it is likely that persons with persistent problem use differ systematically from both abstainers and moderate users on a number of variables (Schulenberg et al., 1996; Wills et al., 1996).

We think that research will increasingly be influenced by behavior genetic approaches, given the sizable genetic contributions noted for many aspects of substance use and abuse (e.g., Iacono et al., 1999; Rutter, 2002). It is likely that longitudinal studies will be advised to obtain genetic samples, and research will include analytic approaches to help understand how variation at the level of genes is translated into effects on patterns of behavior (i.e., mediation, McGue, 1999), and how expression of genetic effects is shaped by the environment in which development occurs (i.e., moderation, Dick et al., 2001). Where feasible, incorporation of physiological assessments such as stress reactivity, and physiological measures such as cortisol and other stress-related hormones, may help to provide a broadened perspective on risk and protective processes. This aspect of longitudinal research can be guided by theoretical models that help to understand how multiple levels of variables influence each other over time (Wills and Dishion, 2004).

Disclaimer. This work was supported by a Research Scientist Development Award K02 DA00252 from the National Institute on Drug Abuse (TAW), a Minority Supplement Award DA12623-S1, from the National Institute on Drug Abuse (CW), and grant R01 DA12623 from the National Institute on Drug Abuse (JAR).

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