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Assessing Associations in Substance Use across Three Generations: From Grandparents to Sons and from Sons to Their Children

Deborah M. Capaldi, PhD^a, Stacey S. Tiberio, PhD^a, David C. R. Kerr, PhD^{a,b}

^aOregon Social Learning Center, 10 Shelton McMurfhey Blvd, Eugene, OR 97401, Phone 541-485-2711, FAX 541-485-7087, staceys@oslc.org

^bSchool of Psychological Science, Oregon State University, 213 Reed Lodge, Corvallis, Oregon 97331 USA, (541) 737-1364; FAX (541) 737-3547, david.kerr@oregonstate.edu

Abstract

The Three Generational Study (3GS) began in the early 90s and involves the third generation (G3) offspring of second generation (G2) fathers who were originally recruited in 1984 as part of the Oregon Youth Study (OYS) in mid childhood (ages 9–10 years) along with their first-generation (G1) parents. As boys, the G2 fathers lived in higher delinquency neighborhoods of a medium-sized Pacific Northwestern United States city. The OYS–3GS examines questions concerning socially mediated intergenerational transmission versus discontinuity (or moderation) of antisocial behavior, substance use, and related problem behaviors. Questions address influences of the grandparents, or Generation 1 (G1), on their sons in G2 and in turn of these sons and their partners on their own children in G3. In this article, we present an overview of the study design—and underlying theory—related to general and outcome-specific transmission pathways. We then summarize key issues and findings to date related to the current main focus of the study regarding intergenerational associations in substance use.

Keywords

intergenerational; fathers; longitudinal; mothers; risk; substance use

Introduction

The Oregon Youth Study (OYS) was initiated in 1984 and involved boys (aged 9–10 years) and both parents who lived in relatively risky neighborhoods (assessed by delinquency in the neighborhood). These boys were followed into adulthood, when the OYS Three Generational Study was initiated (OYS–3GS), involving the OYS young men’s partners who were mothers and their children (Capaldi, Pears, & Kerr, 2012). Taken together, the studies have run continually for 35 years. Thus, the study involves prospective data involving three generations (G1, G2, and G3)—currently grandparents, parents, and children—and involves

Corresponding Author: Deborah M. Capaldi deborahc@oslc.org.

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regular assessments that are well suited for addressing developmental questions (e.g., age of onset of risk behavior, change in risk behaviors from childhood through adolescence). A major focus of the studies has been on examining mechanisms related to associations in risk behaviors across generations, with a particular emphasis on parenting practices (Kerr, Capaldi, Pears, & Owen, 2009) and other risky parental behaviors (e.g., crime, Capaldi, Pears, Patterson, & Owen, 2003; substance use, Kerr, Tiberio, & Capaldi, 2015). Thus, the three generational approach of this study has been of examining transmission from one generation to the next, in succession, rather than on examining grand-parenting behaviors per se.

In a recent publication, we reviewed work from the OYS and OYS–3GS studies that focused on the intergenerational transmission of antisocial behavior and crime (Capaldi, Kerr, & Tiberio, in press). In the present article, we review work pertaining to intergenerational transmission of substance use, including the theoretical basis for this work and the overall study design. In the Results section, we briefly summarize the findings of studies pertaining to the transmission of substance use from G1 to G2, and then the findings of three prior publications pertaining to transmission of substance use from G2 to G3 (Capaldi, Tiberio, Kerr, & Pears, 2016; Kerr, Capaldi, Pears, and Owen, 2012; Kerr et al., 2015) are presented and summarized, with some discussion in that section of findings specific to each of those studies.

Both alcohol and drug use (including use of marijuana and other illicit drugs) are associated across generations (Bailey, Hill, Oesterle, & Hawkins, 2006; Pears, Capaldi, & Owen, 2007). To understand why this may be, we need to examine early environmental pathways to emerging substance use, particularly as genes exert prominent influences on problem use in adulthood but shared environmental influences are stronger for youth and for early stages of substance use (e.g., onset of first or patterned use) (Dick, 2011; Lynskey, Agrawal, & Heath, 2010). Although genetic influences are a part of intergenerational influences, no one progresses to substance dependence without prior substance exposures and use opportunities, which are all environmentally mediated. Intergenerational studies of transmission of substance use risk are key to understanding continuity and discontinuity in use across generations and thus etiology. Estimates of the magnitude and nature of intergenerational associations in substance use, as well as the factors that facilitate or disrupt familial transmission, have not yet been adequately addressed. Doing so requires prospective data, a developmental study design, and an integrated dynamic theoretical model.

Dynamic Developmental Systems Approach

As discussed by Capaldi, Kerr, Eddy, and Tiberio (2016), the OYS approach was based originally in a social learning model, which focused particularly on parenting practices (e.g., discipline and monitoring or tracking and supervision of the child's whereabouts and activities) and peer influences associated with the development of antisocial behavior in boys including delinquency (Patterson, 1986; Patterson, Reid, & Dishion, 1992). Substance use came to be a key focus as the boys moved into adolescence. Our current approach, a Dynamic Developmental Systems model (DDS; Capaldi, Kerr et al., 2016; Capaldi, Kim, & Pears, 2009; Washburn, Capaldi, Kim, & Feingold, 2014), is an extension of the social

learning approach to a more comprehensive model for understanding risk behaviors across the developmental span from early childhood to adulthood. The DDS approach to explaining the development of problem behaviors, including substance use, emphasizes the interplay among biologic systems (e.g., genetic), individual characteristics (e.g., temperament, Ganiban, Ulbricht, Saudino, Reiss, & Neiderhiser, 2011), contextual factors (e.g., neighborhood, socioeconomic status), and socialization experiences—which in addition to parental influences particularly include both peer (Dishion, Andrews, & Crosby, 1995; Dishion & Owen, 2002; Poulin, Kiesner, Pedersen, & Dishion, 2011) and romantic partner (Capaldi, Kim, & Owen, 2008) influences. The approach builds on a considerable body of work from a lifespan perspective and emphasizes the interaction between the individual's prior dispositions and learning and the environments in which s/he is placed or selects (Baltes, 1983; Cairns & Cairns, 1995; Capaldi, Dishion, Stoolmiller, & Yoerger, 2001; Caspi & Elder, 1988; Coie et al., 1993; Dishion, French, & Patterson, 1995; Dishion & Patterson, 1997; Elder Jr., 1985; Hetherington & Baltes, 1988; Magnusson & Torestad, 1993; Rutter, 1989).

General risk versus outcome-specific risks.—A key aspect of DDS, which is particularly applicable to the development of substance use, is the importance of both general pathway risk and outcome-specific (i.e., substance related) risk (Kendler, Gardner, & Dick, 2011; Zucker, Boyd, & Howard, 1995). Poor inhibitory control in childhood is part of the general risk pathway and an early form of externalizing behavior that predicts later conduct problems or antisocial behavior (Frick & Morris, 2004; Ormel et al., 2005). Poor parental discipline practices are also part of this risk pathway in childhood. It is well established that conduct problems in childhood are a general risk factor for early onset of alcohol, tobacco, and marijuana use (Dishion, Capaldi, & Yoerger, 1999; Zucker, 2008), and there is significant intergenerational transmission of conduct problems (Capaldi, Pears, Kerr, Owen, & Kim, 2012). Therefore, it is important to consider whether other forms of risk contribute to an additional explanation of substance emergence and growth or increase over this general risk pathway. Key outcome specific-risk factors include parental and peer use of substances of any category and use of particular substances (e.g., parental use of alcohol as a risk factor for offspring use of alcohol).

A further issue in considering intergenerational associations in substance use, as discussed by Capaldi, Tiberio et al. (2016), is that studies of effects of parental substance use on offspring alcohol use have focused on effects from parental alcohol use, rather than also examining effects of use of other substances (Chassin, Flora, & King, 2004; White, Johnson, & Buyske, 2000). Many adults who drink alcohol also use other substances, particularly tobacco and marijuana, and there are significant associations between alcohol use disorders and other substance use disorders (Stinson et al., 2006).

Role of time.—In addition to the importance of development and ongoing dynamic transactions between systems and elements of systems, a key aspect of the DDS model is time, including timing of events (e.g., Washburn & Capaldi, 2014). The model considers both the importance of developmental time, which is not always identical with age (e.g., adolescents go through puberty with varied timing), as well as the importance of real time

and more specifically the duration of situations or events. Time and duration can affect behavior in numerous ways. Age of onset of certain risk behaviors, including of substance use, is related to future outcomes. Age of onset of alcohol use predicts later problematic use in adulthood, including alcohol use disorder (DeWit, Adlaf, Offord, & Ogborne, 2000; Pitkänen, Kokko, Lyyra, & Pulkkinen, 2008; Warner, White, & Johnson, 2007). Thus, understanding age-of-onset issues is particularly critical for substance use. A limitation of most studies of age of onset, however, is that they rely on retrospective reporting of onset age. This has been shown to be subject to *forward telescoping*, such that as the adolescent ages, the reported age of onset moves to older ages (Johnson & Schultz, 2005). Retrospective reporting by adults is likely to suffer from similar biases.

Regarding duration, which has been examined less than age-of-onset issues, children may be more at risk if they are exposed to negative influences including poor parenting (which may include inconsistent and harsh discipline, lack of parental warmth and involvement, inadequate supervision) for longer durations (Patterson, 1982). Related to duration, it is also important to consider transactional effects between systems (e.g., between parents and children) that may emerge across particular developmental periods. For example, longitudinal associations between children's poorer effortful control from middle childhood to early adolescence were mediated by less positive and more negative parenting practices by mothers; whereas a similar mediated effect was not supported from early in middle childhood (Tiberio et al., 2016). Thus, it is important to conceptualize time from many perspectives, such as the timing of events (e.g., age of onset), the duration of events (e.g., length of risk exposures), and how systems may interact in dynamic ways to explain how children's risk may become exacerbated over time.

Substance Use Risk across Generations: The Roles of Parent Discipline Practices and Inhibitory Control

An early study with the OYS–3GS data examining transmission processes involved examining associations of substance use in G1 and G2 with parental disciplinary practices in G2 and child inhibitory control in G3 (Pears et al., 2007). Low inhibitory control indicates difficulty with behavioral and emotional regulation and refraining from acting on impulse (e.g., hitting another child), and is hypothesized to be a precursor to later conduct problems and substance use. It was hypothesized that substance use (alcohol and illicit drug use examined separately) would be associated across G1 and G2, and that each of these would relate to their poor discipline practices with their offspring and lower inhibitory control in G2 and G3, respectively. The study used prospective data spanning approximately 15–20 years and included all three generations, with G1 or grandparents' behavior from when G2 fathers were aged 9–10 years to G3 offspring behavior at age 3 years.

Whereas the findings for drug use (marijuana and other illicit drugs) overall supported the hypotheses, the findings for alcohol use—a relatively normative substance—did not. Parental drug use was associated across G1 and G2; was related to lower inhibitory control and poor discipline in G2; and, in turn, to lower inhibitory control in G3. Thus, as hypothesized, mediational links were found via low inhibitory control for transmission of risk for substance use from one generation to the next. Contrary to hypothesis, G2 illicit

drug use in adolescence did not contribute additional risk for G3 low inhibitory control over the pathway from G2 inhibitory control and G2 poor discipline toward G3. Findings from this study indicate that an early indication of a general pathway to risk for G3 is their low inhibitory control, found at just 3 years of age, predicted by G2's early poor discipline of G3.

Oregon Youth Study Methods

Study Design (G1 and G2)

Boys and their families were recruited into the OYS by inviting the entire fourth grade (ages 9–10 years) of boys from schools in neighborhoods with a higher-than-usual incidence of delinquency within the medium-sized Pacific Northwestern city to participate. The latter was assessed by analyzing the home addresses of youth committing delinquent acts compared with the school-boundary areas. Thus, the boys were at elevated risk for delinquency due to neighborhood characteristics (in a medium-sized city) but were not necessarily showing conduct problems at the time of recruitment (Capaldi et al., in press). Face-to-face home visits for recruitment were key to attaining strong participation rates (Capaldi, Chamberlain, Fetrow, & Wilson, 1997; Capaldi & Patterson, 1987). The OYS family recruitment rate was 74.4%, and retention rates of G2 men were 98% through high school, 97% through the mid-20s, and 93% through the mid-30s.

Data collection for OYS began in 1984 and was yearly from ages 9–10 through 31–32 years, with additional assessments at ages 35–36 and 37–38 years. These assessments involved data on the G2 boys/men, and data on the G1 parents also was collected through their son's age-17–18-year assessment.

Risk for externalizing behaviors was elevated for the OYS boys compared with a comparable national sample (NLSY–Child; Bureau of Labor Statistics, 2010) at ages 9–10 and 10–11 years (the first two waves of OYS) but not at later adolescent ages. The variance did not differ; thus, range was not restricted (Capaldi et al., in press).

The OYS–3GS was initiated in 1995 to examine the intergenerational transmission of antisocial behavior and related problem behaviors using a fully prospective design. Data collection for G3 is on a developmental schedule (e.g., an assessment at age 2 years, the next assessment at age 3 years). The study included up to two children from each of the G2 men's female partners who were mothers of his biological children (recruitment of stepchildren was dropped early in the study). First-born children show some differing characteristics from later-born children (Paulhus, Trapnell, & Chen, 1999), and men who become fathers in adolescence are more likely to lose touch with their child. Thus, there are advantages to including multiple children of each G2 target parent. Furthermore, as discussed by Capaldi et al. (in press), statistical approaches are now available to address some of the design implications for data analysis, including for addressing non-independence of data in the third generation. A second design implication is that children in OYS–3GS reach a particular age over a wide array of years, and the children born to younger OYS men complete assessments (e.g., at age 2 years) many years prior to children born to older OYS men. Thus, G3 child sample size by assessment age is larger at the

younger than older ages. Missing data at the older assessment waves can be incorporated into statistical models by including the child's age at his/her last completed assessment as a missing data correlate (e.g., by using the AUXILLARY option in Mplus versions 7.3; Muthén, & Muthén, 1998–2015). The OYS and OYS–3GS studies have now been continually underway for 35 years and could potentially extend over many years of G2 fertility.

Three Generational Study Child Participation

The OYS–3GS involves G2 mothers and fathers, even if they have separated. Of the 200 living OYS men (currently aged 41 to 43 years), 155 (78%) are biological fathers. Data have been collected on a total of $N = 307$ biological offspring of $N = 142$ G2 OYS men and $N = 196$ G2 mothers to date (27 stepchildren also were assessed prior to a decision not to include further stepchildren). Only 20 children (7%) who were eligible have not participated at all (Capaldi et al., in press). Regarding sample retention, only 22 children no longer participate. Shown in Table 1 are current G3 child sample sizes by assessment age, which are larger at the younger than older aged assessments due to the developmental design.

Oregon Youth Study–Three Generational Study Assessment and Measures

Both the OYS and OYS–3GS have involved comprehensive multimethod, multiagent data collection approaches. Each wave of OYS–3GS involves an assessment with the G2 father and mother and, in some cases, an additional assessment (e.g., with a peer). In addition to interviews and questionnaires to parents and children, the study involved teacher questionnaires and included observational data with parents through midadolescence and some tasks such as a measure of executive functioning (e.g., the GoStop Impulsivity Task; Dougherty, Mathias, & Marsh, 2003).

Ethnicity of OYS G2 fathers and mothers.

Ethnicity for G1 and for the 155 OYS men (and partners) who are biological parents of G3 children in the study/data set is shown in Table 2. Note that ethnicity is not directly comparable from parents to children as some of the G1 fathers were stepfathers; also, there was likely some change over time in willingness to acknowledge ethnic minority status. The overall proportion of non-European American participants is comparable to the United States population at the time (Sandefur, Martin, Eggerling-Boeck, Mannon, & Meier, 2001).

Results

Intergenerational Influences on Substance Use in OYS (G1 to G2)

Prediction of Alcohol Use Onset and Increases in Middle School and in High School Use—Earlier work on intergenerational associations in substance use from G1 to G2 included an examination of predictors of any alcohol use and of growth or increases in volume (frequency and amount) of alcohol use examined separately across both middle school or early adolescence (ages 11–12 to 13–14 years) and high school or mid to late adolescence (14–15 to 17–18 years) for the G2 boys (Capaldi, Stoolmiller, Kim, & Yoerger, 2009). Based on the DDS framework, it was predicted that the general risk pathway associated with the development of antisocial behaviors—namely poor parenting practices

(low monitoring – involving poor tracking of the child’s whereabouts, and poor discipline – including harsh and inconsistent discipline), depressive symptoms, and antisocial behavior/deviant peer association—would be predictive of both any use of alcohol and increases in volume used. Outcome-specific proximal social influences were also examined, namely alcohol use by parents and peers. It was expected also that increases in alcohol use by peers would predict increases in use, which was examined using change scores across the middle and high school periods, respectively.

Findings indicated that the prevalence of any use rose from 53% to 84% across these years (from ages 11–12 to 17–18 years), and volume consumed in the past year rose from just over 3 drinks to 165 drinks across the same ages. Findings for the boys in middle school indicated that alcohol use by both G1 parents and by the son’s peers were associated with any use of alcohol initially and with initial levels of volume, but increases in peer use predicted future likelihood of onset of alcohol use and also increases in volume used. Findings for the high school model indicated that the boy’s antisocial behavior/deviant peer association and peer alcohol use were associated with increases in levels of use whereas parental monitoring was protective against increases. Thus, these models supported the predictions that both general risk and outcome-specific risk factors play critical roles in adolescent substance use, with parental alcohol use being a key factor in initiation of use in middle school and parental monitoring being a protective factor for boys during high school.

Prediction of Marijuana Use Onset and Increases in High School Use—

Washburn and Capaldi (2014) used a similar approach to examine influences on G2 marijuana use in high school. The prevalence of marijuana use for the G2 boys increased from 17% to 35% across the high school years (ages 14–15 years to ages 17–18 years), and the average quantity of use tripled across this same period. Findings from the prediction models showed a similar pattern of general (antisocial behavior and deviant peer association) and specific-risk factors (parental marijuana use, peer substance use), with peer substance use being particularly related to growth in volume of marijuana use and with a protective role for parental monitoring.

Overall, implications are that positive parenting factors (e.g., positive involvement, consistent non-harsh discipline, monitoring; Dishion, French, & Patterson, 1995) related to less likelihood of their son’s development of antisocial behavior, parental desistance from substance use when children are born, and parental maintenance of monitoring during adolescence—particularly with a view to limiting associations with substance-using peers—may prevent intergenerational transmission of substance use from parents to sons.

Intergenerational Influences on Substance Use in OYS–3GS (G2 to G3)

Intergenerational Influences on Early Alcohol Use: Independence from the Problem Behavior Pathway—Kerr et al. (2012) examined prediction to the G3 child’s early use of alcohol (at age 13 years). The study focused on just the G2 to G3 generations as a number of family contextual risks (both general and alcohol specific) for the G3 child were examined as mediators of intergenerational associations. The contribution of a general intergenerational risk pathway via conduct problems, and of alcohol-specific risk pathways,

were examined. The roles of alcohol-specific contextual influences on children's early alcohol use have been little examined. The study was further extended to include risk from the G2 mother's as well as father's alcohol use.

Four areas of family contextual risks were posited as potential social learning mediators of the associations of maternal and paternal alcohol use with child use; namely, alcohol use norms, encouragement of alcohol use, exposure to intoxicated adults, and parental monitoring. Norms regarding alcohol use were assessed by the age at which parents thought their child should be allowed to try alcohol. Encouragement of child use was assessed from ratings of parental favorable references to alcohol use and intoxication from a parent-child discussion task about cigarettes, alcohol, and drugs. Exposure to intoxicated adults was rated from child reports of seeing adults drunk.

First, findings indicated an association between G2 fathers' adolescent alcohol use and G3 children's use in early adolescence that was not fully explained by concurrent indicators of fathers' and children's general problem behavior, although the latter was an additional significant predictor. In the final model tested (Figure 1), fathers' and mothers' adult alcohol use each contributed to child use, and exposure to intoxicated adults partially mediated the latter path. Whereas parental alcohol use showed correlational associations with the family contextual risk factors—which in turn showed correlational associations with child early adolescent alcohol use—in the multivariate path model (Figure 1), child exposure to intoxicated adults was the only such risk factor to show a significant mediational effect in the intergenerational transmission of substance use. Findings of the study indicate the importance of considering the role of maternal alcohol use, as well as that of paternal use, as a risk factor for offspring early use of alcohol. It should be noted that this study was only able to examine G3 alcohol use at age 13 years at the time it was conducted (2012), and mediational risk factors may have shown stronger associations to use later in adolescence. Furthermore, due to sample sizes at that time, gender differences could not be examined for G3. Overall, this study indicated the importance of examining both general risk developmental factors and outcome-specific risk factors in the intergenerational transmission of substance use. Child exposure to intoxicated adults was identified as a key early substance-related risk factor mediating such intergenerational associations.

Intergenerational Associations in Marijuana Use—Kerr et al. (2015) examined the extent to which G2 parent marijuana use in adolescence was associated with marijuana use onset in G3 offspring, and whether any such association was mediated by a number of risk factors from both family and peer contexts. In this study, both maternal and paternal use of marijuana as adolescents was included, with maternal reports of use being retrospective. Discrete-time survival or event history analysis, a method that predicts to the timing of an event of interest, was used to predict to the age of G3 offsprings' marijuana use onset through age 19 years. Mediators examined again included general and outcome-specific risk factors, including parental monitoring, child exposure to marijuana use, peer deviance, peer marijuana use, and perceptions of parent disapproval of child use, which were measured before or concurrent with onset. Analyses also controlled for the G3 child's alcohol onset (yes or no) and gender.

Bivariate correlations indicated that G2 parental marijuana use in adolescence was significantly associated with less monitoring (i.e., supervision) of the G3 child and G3 child perceptions of less parent disapproval of marijuana use, but with greater likelihood of G3 child exposure to adult marijuana use and both G3 child association with deviant peers and peer marijuana use. In the event history model (shown in Table 3) to age of onset of marijuana use for the G3 child, male gender and the two peer behaviors were positively associated with children's marijuana use onset, controlling for their onset of alcohol use. Parents' adolescent marijuana use had a significant indirect effect on child onset of marijuana use through children's deviant peer affiliations and also through a composite score of contextual risk (i.e., all the mediating risk factors combined). Findings thus again emphasized the significant association of substance use across generations and the key role of both general and outcome-specific peer risk factors in age of onset of substance use. Parenting-related factors did not show significant mediational effects in intergenerational transmission of marijuana use on their own, but did show such effects as part of a broader construct of contextual risk.

Kerr et al. (2015) concluded that parents' histories of marijuana use may contribute indirectly to children's marijuana use onset through their influence on the social environments children encounter. Environments characterized by more liberal-use norms, exposure to marijuana use and deviant and marijuana-using peers, and less adult supervision were related to an earlier age of onset of marijuana use. As alcohol use onset was controlled, findings suggest that the contextual factors identified here confer unique risk for younger child marijuana use onset beyond what can be explained by adolescent onset of alcohol use.

Associations of Parental Alcohol versus Tobacco and Marijuana Use with Early Adolescent Onset of Alcohol Use—Again, using an event history analysis approach, Capaldi et al. (2016) examined whether there was additional risk for onset of alcohol use in offspring from parental use of tobacco and marijuana, over and above parental use of alcohol. In addition to additive effects, two-way interaction effects of parental use of tobacco and marijuana, along with alcohol on child onset of alcohol use, were examined. Again, both G2 maternal and paternal substance use were examined, this time assessed in adulthood during G3's adolescence and averaged across that period. Effects of the G3 child's gender were examined.

Findings (shown in Table 4) indicated that mothers' but not fathers' alcohol use was associated with children's age of onset of alcohol use. Children's age of onset also was predicted by mothers' tobacco use and by the interaction of fathers' marijuana use and alcohol use. These effects were observed when controlling for parent education, child gender, and also child antisocial behavior—a general developmental risk factor for substance use onset in adolescence.

Therefore, mothers' substance use during their children's adolescence played a major role in child onset of alcohol use. Thus far, the role of maternal substance use as a risk factor for their children has generally received less attention than the role of paternal substance use. Findings indicate the importance of maternal use as a prevention target. They also indicate

that children of polysubstance-using parents may need to be targeted for prevention programs.

Conclusions and Future Directions

The study of intergenerational associations in use of substances is complex for a number of reasons, including that polysubstance use is relatively common (Moss, Chen, & Yi, 2011; Stinson et al., 2006), which must be considered when studying like-to-like associations (e.g., alcohol to alcohol). Findings of the intergenerational studies we have conducted regarding substance use indicate that parental substance use is implicated both directly and indirectly, via mediational effects, in their offsprings' use of substances in adolescence.

Prospective intergenerational studies that can examine associations in behaviors for parents and children during the same developmental periods (e.g., adolescence in each generation), as well as associations in mechanisms such as parenting across generations (which essentially requires three generations), are an important tool in the science of understanding the etiology of substance use. However, such studies are few and far between, given a number of factors including the lengthy commitment they require from researchers, funders, and the participating families themselves. The OYS-3GS is just now reaching the stage when there are sufficient numbers of G3 children assessed during adolescence to address adequately questions regarding intergenerational transmission of problem behaviors including substance use.

Findings from prospective intergenerational studies should provide a more accurate and realistic estimate of intergenerational associations than retrospective studies. Findings reviewed here regarding intergenerational associations in substance use indicate that, even using prospective estimates, parent and offspring use of substances is significantly associated. Parental use is particularly associated with initiation of substance use in the children, and there are cross-over effects to risk of child onset of alcohol use at least from parental use of substances other than alcohol. Intergenerational associations in substance use are partially mediated or explained by family related factors, including parenting and exposure to intoxicated adults. Parental monitoring has repeatedly been found to be a protective factor for child use of substances, both in our work and that of others (Barnes, Hoffman, Welte, Farrell, & Dintcheff, 2006). Peer risk factors, including both general (e.g., deviant peer association) and outcome specific (e.g., peer marijuana use), are strong risk factors that contribute to initiation (in addition to parental use) and particularly to increasing levels of use across adolescence (Bray, Adams, Getz, & McQueen, 2003). It should be noted that family factors, including parenting, are also involved in the development of the general risk pathway of antisocial behavior, which in turn is a major contributing factor to substance use. Thus, family factors contribute to substance use to a greater extent than just via intergenerational associations in substance use. These findings also indicate the significant role that both maternal and paternal substance use play in child use. As early initiation of substance use relates to a greater likelihood of future problems (Griffin, Bang, & Botvin, 2010), it is vital from a prevention perspective to address both prevention of parental use and reduction of child exposure to at least some aspects of parental use (e.g., overuse of alcohol, use of illegal drugs).

Overall, findings of the OYS and OYS–3GS studies examining intergenerational transmission of substance use indicate significant though modest associations across generations, the contribution of both general developmental risk pathway factors and outcome-specific risk factors (i.e., substance related factors), and some cross-over risk from parental use of one type of substance to youth use of another type. Findings indicate the importance of environmental influences on adolescent substance use, either directly (e.g., deviant peer influences) or mediating intergenerational associations (e.g., parental monitoring, exposure to intoxicated adults).

Numerous possibilities for prevention are identified by the findings—including parenting and other interventions aimed at strengthening inhibitory control and prevention of antisocial behavior in early childhood; limiting both maternal and paternal substance use and child exposure to intoxicated adults; strengthening parental monitoring, including supervision of adolescents with their peers; as well as other aspects of parenting and limiting unsupervised time with substance-using peers overall.

Despite the fact that OYS and OYS–3GS have combined results in a 35-year prospective data set, there are a number of study limitations. The OYS is a smaller community at-risk sample from the Pacific Northwestern United States, involving primarily individuals of European American descent; thus, generalizability of findings to other areas and ethnic groups may be limited. Furthermore, G2 involved only sons of G1; therefore, the prospective intergenerational findings from G2 to G3 involve only fathers. Finally, effects of G3 gender on intergenerational associations were not examined in the earliest G2 to G3 transmission studies as the G3 sample size at that stage was not yet large enough.

Future directions for the OYS–3GS are to examine intergenerational factors related to growth in volume of substance use across adolescence and to the development of symptoms of substance abuse and dependence. An important future direction is to strengthen our understanding of the generalizability of findings to samples with other characteristics (e.g., ethnic makeup, region of the United States, or other countries) by replicating findings of prediction models with other prospective three generational studies, which is an approach we have used successfully in the past in studying the intergenerational transmission of antisocial behavior (Thornberry, Hops, Conger, & Capaldi, 2003). This is particularly important as these intensive longitudinal studies do not have large sample sizes, but rather gain statistical power by including repeated assessments from the same individuals across time. A number of prospective three generational studies, including the OYS–3GS, have now reached the stage when they can make major contributions regarding understanding of transmission of risk behaviors as well as aspects of positive adjustment (Kerr et al., 2009). It is exciting to see these studies achieving their potential.

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Biography

Dr. Deborah M. Capaldi has expertise in the development of psychopathology, including family and peer factors related to substance use and to associated risk behaviors such as conduct problems, depression, sexual risk behavior, and intimate partner violence. Originally from England, she obtained her Ph.D. from the University of Oregon and is currently a Senior Scientist at the Oregon Social Learning Center. Dr. Capaldi is a fellow of APA Division 43 (Family). Her research currently centers on understanding intergenerational transmission of substance use and related behaviors within a dynamic developmental systems framework. To this end, she and colleagues are conducting a prospective three-generational study that has been underway for over 30 years.

Dr. David C. R. Kerr is a clinical psychologist with research interests in developmental psychopathology and the prevention of substance abuse and suicide. He completed his doctoral and post-doctoral studies at the University of Michigan and is currently a Research Scientist at the Oregon Social Learning Center and an Associate Professor at the School of Psychological Science at Oregon State University. His current work focuses on intergenerational transmission of risks for substance abuse and other problem behaviors and the effects of marijuana legalization on adolescents and young adults.

Dr. Stacey S. Tiberio earned her Ph.D. in Quantitative Psychology from the University of Notre Dame and is currently a Research Scientist at the Oregon Social Learning Center. Methodologically, her primary research interests include longitudinal data analysis — or the modeling of how processes change over time. In particular, she is interested in time-dynamic transactional models, which apply concepts of self- and co-regulation to understand the uni- and bi-directional relationships within and between processes. Her substantive research interests predominantly focus on understanding how individuals' physical and mental health may be influenced by their own behaviors, the behaviors of those around them, and their social contexts.

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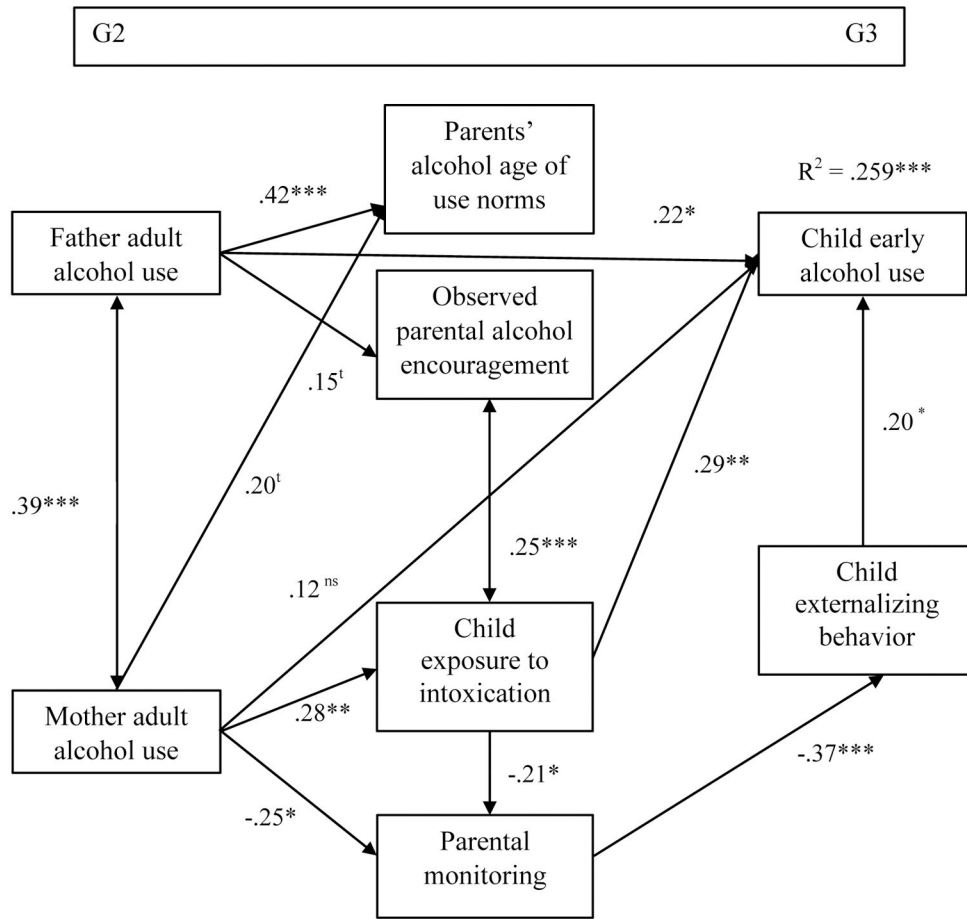
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Model χ^2 13.506 ($df = 23$), $p = 0.9401$
 TLI = 1.113, RMSEA = 0.000 (90% C.I. = 0.000-0.016)
 N = 125 3GS, 83 OYS
^t $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Note: Total indirect association between mothers' and children's alcohol use, $\beta = .11$, $p < .01$; specific indirect effect via exposure to intoxicated adults, $\beta = .08$, $p < .05$.

Figure 1.
 Path model of associations among parent alcohol use, proposed family context mediators, and children's early alcohol use.

Table 1

Projected Completion Rates by Age (to 2017) for G3

	T1*	T2	T3	T4	T5*	T6	T7	T8	T9	T10
Years of Age	2	3	5	7	9	11–12	13–14	15–16	17–18	19
	231	300	300	268	114	205	181	148	111	73

*These assessments were dropped, thus yielding smaller sample sizes.

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Table 2

Ethnicity for G1 and G2 parents

G1 Ethnicity	G1 Father	G1 Mother	G2 Father	G2 Mother
European American	91.6%	94.9%	85.4%	73.3%
African American	2.8%	0.5%	5.1%	7.1%
Latino	1.4%	0.5%	4.5%	5.3%
Native American	2.8%	2.0%	3.8%	10.7%
Asian or Pacific Islander	--	0.5%	1.2%	3.6%
"Other"	1.4%	1.5%	--	--
<i>N</i>	143	196	155	155

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Table 3

Model Results: Child Marijuana Use Onset given Parent Adolescent Marijuana Use (Antecedent) and Mediating Contextual Risk Factors Controlling for Child Gender and Alcohol Use Onset

	Models with mediation by						
	I. Parent use	II. Monitoring	III. Parental disapproval	IV. Child exposure	V. Peer use [†]	VI. Deviant peer	VII. Contextual risk
Child marijuana use onset predicted by: (OR)							
Antecedent:							
Parent adolescent marijuana use	1.34	1.31	1.29	1.33	1.34	1.13	1.19
Mediators:							
1. Parental monitoring	--	0.87	--	--	--	--	--
2. Parental disapproval	--	--	0.82	--	--	--	--
3. Child exposure to	--	--	--	1.30	--	--	--
4. Peer use	--	--	--	--	3.10 ^{***}	--	--
5. Deviant peer	--	--	--	--	--	2.47 ^{***}	--
6. Contextual risk	--	--	--	--	--	--	2.42 ^{***}
Controls:							
Child gender (male = 1)	2.14 [*]	1.97 <i>M</i>	2.16 [*]	2.30 [*]	3.33 ^{**}	1.78	2.64 ^{**}
Child alcohol onset	1.68	1.67	1.55	1.48	0.76	1.51	0.93
Indirect effect of parent use on child onset via mediator	--	1.02	1.04	1.05	1.22	1.23 [*]	1.29 ^{**}
Mediator predicted by: (standardized beta)							
Parent use	--	-0.17 <i>M</i>	-0.18	0.18 [*]	0.18 <i>M</i>	0.23 [*]	0.29 ^{***}

Note: OR = Odds ratio.

[†] An alternative model that also controlled for child deviant peer association was fit to the data; results indicated that child deviant peer association marginally predicted child marijuana use onset (OR = 1.74, *p* = .054) but did not attenuate the effect of child peer marijuana use on child marijuana use onset (OR = 2.54, *p* = .001).

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M $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

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Table 4

Predicted Probability of Child Alcohol Use Onset Given the Predictor Variables and Percent of Overall Variance Explained from the Survival Analyses

	Model				
Child alcohol use onset predicted by:	Parent tobacco use	Parent alcohol use	Parent marijuana use	Parent tobacco, alcohol, and marijuana use	Parent tobacco, alcohol, and marijuana use with controls
Child gender (male = 1, female = 0)	2.10 *	1.73 *	1.92 *	2.08 *	1.74 ^M
Mothers' tobacco use	1.88 ***	--	--	2.20 ***	2.13 ***
Fathers' tobacco use	0.77	--	--	0.72 ^M	0.78
Mothers' alcohol use	--	1.54 *	--	1.61 *	1.58 *
Fathers' alcohol use	--	1.02	--	1.14	1.27
Mothers' marijuana use	--	--	1.32 *	1.11	1.12
Fathers' marijuana use	--	--	1.06	0.82	0.83
Fathers' alcohol X marijuana use	--	--	--	1.52 *	1.49 *
Parents' education	--	--	--	--	1.14
Child antisocial behavior	--	--	--	--	1.63 *
% variance explained (R^2)	15.5 **	7.4	5.4 ^M	27.0 ***	30.6 ***

Note:

*** $p < .001$.

** $p < .01$.

* $p < .05$.

^M $p < .10$.

All parent substance use predictor variables and control variables of child antisocial behavior and parental education were standardized across all children (i.e., means of 0 and variances of 1).

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