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Differences in Polysubstance Use among Youth in the Child Welfare System: Toward a Better Understanding of the Highest-Risk Teens

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Abstract

The current study extended limited prior work on polysubstance use among youth in the child welfare system (CWS) by addressing their potentially greater risk of engaging in polysubstance use, the causes of interpersonal variation in use, and changes in use over time, particularly at later points of involvement in the CWS. Using longitudinal data from the National Survey of Child and Adolescent Well-Being (n = 1,178), a series of time-invariant and time-varying demographic and contextual factors were explored to assess their role both overall and at unique points of involvement in the CWS. A series of unconditional and conditional curve-of-factor models were estimated and results indicated that time-invariant characteristics of ethnicity and gender were not related to polysubstance use. Time-variant characteristics of age and placement were associated with polysubstance use and highlighted the dynamic nature of age as a risk factor. Out-of-home placement was protective against later substance use for youth who had been removed from contexts with their original caretaker where there were higher levels of reported violence. Our results suggest that in the child welfare population, the modeling of multiple substances rather than a single substance in isolation is more informative because it yields information on the confluence of behaviors that tend to occur and evolve together.

Keywords

Adolescent Risk Behavior; Substance Use; Time-variant characteristics; Time-invariant characteristics

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Studies of teen alcohol and drug use have identified a relationship between heavy alcohol use and subsequent illicit substance use (Pape, Rossow, & Storvoll, 2009). Such findings may suggest that illegal drugs tend to be used in a context of drinking (Odgers et al., 2008), consistent with studies that have shown that combined intake of alcohol and marijuana is the most widespread form of polysubstance use among youth in the United States (Midanik, Tam, & Weisner, 2007). Prior work has extended the modeling of polysubstance use among adolescents in the general population (e.g., Conway, et al., 2013; Duncan, Duncan, Biglan, & Ary, 1998; Mason, Kosterman, Hawkins, Haggerty, & Spoth, 2003; Mikulich-Gilbertson, Zerbe, & Riggs, 2014; Morley, Lynskey, Moran, Borschmann, & Winstock, 2015; Odgers et al., 2008) to the unique subgroup of youth in the U.S. child welfare system (CWS; Yarnell, Traube, & Schrager, 2015). This is important given that CWS-involved youth are potentially at greater risk of the development of substance use problems (Aarons et al., 2008; Aarons, Brown, Hough, Garland, & Wood, 2001; Courtney & Dworsky, 2006; Pilowsky & Wu, 2006; Vaughn, Ollie, McMillen, Scott, & Munson, 2007; Wall & Kohl, 2007) and also may experience differing effects of risk and protective factors than youth in the general population (Traube, James, Zhang, & Landsverk, 2012). This greater risk may be exacerbated among CWS youth who are polysubstance users, as seen among general population youth (Conway, et al., 2013; Mason, et al., 2003; Mikulich-Gilbertson, Zerbe, & Riggs, 2014; Morley, et al., 2015; Odgers et al., 2008).

In the current study, we took the next vital step in this research by focusing on key risk factors associated with variation in polysubstance use among CWS youth. This line of inquiry was guided by the social development model (Hawkins & Weis, 1985), which specifies key risk factors that contribute to the development of drug use and posits that risks can be mitigated by important social supports during childhood. To address which CWS youth engage in high levels of polysubstance use and how polysubstance use changes over time in this population, we investigated a series of time-invariant and time-varying demographic and contextual factors to assess their role both overall and at unique points of involvement in the CWS.

Theoretical and Empirical Background

CWS-involved youth have been consistently found to have higher rates of diagnosable substance use disorders than youth in the general population (Aarons et al., 2001; Courtney, Terao, & Bost, 2004; Vaughn et al., 2007). Social development theory (Hawkins & Weis, 1985) offers a meaningful explanation for the increased rate of substance use disorders in this population. The central hypothesis of this theory is that an individual's behavior will be prosocial or antisocial depending on the predominant behaviors, norms, and values held by others to whom the individual is bonded. Furthermore, when children develop in a context fraught with disruption to prosocial bonds, as often occurs for youth in child welfare settings, they are at increased risk of developing antisocial behaviors like substance use, delinquency, teenage pregnancy, school misbehavior, and dropping out (Hawkins, Catalano, & Miller, 1992). For example, although the CWS is intended in part to diminish the impact of maltreatment in the home on adolescent substance use, experience in foster care or other out-of-home placement has been associated with substance abuse in adulthood (Grella & Greenwell, 2006; Gutierres, Russo, & Urbanski, 1994; Zlotnick, Tam, & Robertson, 2004).

Empirical explorations have also identified an abundance of demographic, psychosocial, and contextual risk factors for substance use among youth in CWS, including gender, age, history of abuse and exposure to violence (Aarons et al., 2008; Vaughn et al., 2007), lower levels of caregiver monitoring (Wall & Kohl, 2007), and deviant peer networks (Thompson & Auslander, 2007). Yet little is known about factors related to use of multiple substances in this population.

Variation in Estimates of Substance Use and Abuse

Although CWS-involved youth have been consistently found to have higher rates of diagnosable substance use disorders than youth in the general population, there has been considerable variation in the extent of this estimated use (Aarons et al., 2001; Courtney et al., 2004; Vaughn et al., 2007). In the general population, current rates of substance dependence or abuse for adolescents aged 12–17 years is 5% (Substance Abuse and Mental Health Administration, 2015). Aarons et al. (2001) found that 11% of teenagers involved in CWS in San Diego, California, met criteria for a substance use disorder during the previous year; that figure increased to 19.2% based on their lifetime substance use. In two different studies based in the Midwest United States, Vaughn and colleagues (2007) found that 35% of a sample of 17-year-olds in Missouri met criteria for a lifetime substance use disorder. Yet Courtney and colleagues (2004), estimating rates among former foster youth in the Midwest more widely, found that only 7.3% of a comparable age group met criteria for a substance use disorder in their lifetime.

This discrepancy in estimates of substance use among CWS-involved youth likely relates to discrepancies and deficiencies in the statistical modeling of prior studies. Duncan et al. (1998) provided a critical review of the modeling of substance use among adolescents. First, Duncan et al. (1998) emphasized that models of polysubstance use, i.e., use of multiple substances rather than one substance in isolation, may be more informative than models of use of single substances; this is because polysubstance models yield information on the confluence of behaviors that tend to occur and evolve together (Conway, et al., 2013; Donovan, 2005; Jessor & Jessor, 1977; Mason, et al., 2003; Mikulich-Gilbertson, Zerbe, & Riggs, 2014; Morley, et al., 2015; Odgers et al., 2008). Additionally, Duncan et al. (1998) emphasized that these processes and models should be understood in light of social contextual factors. These factors may include not only characteristics that are stable, or time invariant (such as gender), but also those that represent dynamic, time-varying processes (such as changes in academic performance or peer deviance). Based on these recommendations, we sought to extend prior work to better account for polysubstance use, and the time-invariant and time-varying contextual factors related to this use, in the unique and understudied population of CWS youth.

Current Study

The current study extended the limited prior work on polysubstance use among CWS youth by focusing on critical topics raised by prior research: (a) the potentially greater risk of CWS youth regarding drug use, particularly marijuana, as a secondary substance to alcohol and (b) the causes of interpersonal variation in use and change in use over time, particularly at later

points of involvement in the CWS. We focused on demographic and contextual risk factors that encompass not only basic characteristics of adolescents in general (gender, ethnicity, and age), but also factors that have unique meaning for youth in the CWS system (residential status, including whether its effect is moderated by exposure to violence). Furthermore, we differentiated our approach based on factors that are time invariant versus those that change with time. We addressed the following hypotheses and research questions.

First, with regard to time-invariant characteristics of gender and ethnicity, we generally hypothesized that male CWS youth would exhibit higher levels of polysubstance use than female youth, yet that female CWS youth would exhibit greater change in use over time. This is in line with trends for alcohol use among adolescents and young adults in the general population (see Ehlers et al., 2010; Schuckit, Daeppen, Tipp, Hesselbrock, & Bucholz, 1998). We advanced a similar hypothesis for White versus non-Hispanic Black and Hispanic youth in the CWS, based on trends in the general population for later initiation of alcohol use but also greater probability of the development of alcohol problems in the latter groups (Caetano, 1997; Dawson, 1996; Dawson, Grant, Chou, & Pickering, 1995; Wagner, Lloyd, & Gil, 2002; Williams et al., 2007). We based these hypotheses for lower overall levels but greater change over time among females, non-Hispanic Black and Hispanic youth based on well-documented patterns of alcohol use in adolescents because of the nascent nature of the literature on teen polysubstance use.

Second, we aimed to untangle two aspects of time in the growth process of polysubstance use: age or development and length of time in the CWS. By examining the impact of age on polysubstance use by the time of CWS involvement, we sought to elucidate the role of development at unique points of involvement in the system, rather than simply at baseline (i.e., our models aimed to reveal the association of age in context). We did not hypothesize whether age would have an effect beyond duration of CWS involvement, but we had an exploratory goal of examining if there might be certain periods of CWS involvement in which age may be more influential on substance use.

Third, acknowledging mixed findings regarding the role of residential status as either a risk or protective factor, we explored an interaction between residential status and exposure to violence would be associated with use of substances. This exploration is theoretically supported by social development theory’s suggestion that behavior is prosocial or antisocial depending on the behaviors, norms, and values held by those to whom an individual is bonded (Hawkins & Weis, 1985). Although out-of-home residential status represents disruption of a traditional living situation, it may offer a particularly important and alternative form of positive social support for youth exposed to violence and substance use by their primary caregivers.

Method

Data Source

We used data from the baseline and 18-month and 36-month follow-up time points of the National Survey of Child and Adolescent Well-Being (NSCAW), collected in 1999 through 2002. NSCAW is the first nationally representative, longitudinal study of CWS-involved

youth and was based on a stratified two-stage cluster sampling strategy. One hundred primary sampling units (PSUs) were selected from a national sampling frame, with probability of selection proportional to the size of each PSU's service population. NSCAW researchers ultimately collected child-level data in 92 PSUs representing 96 counties in 36 states. In participating counties, children were randomly selected from the population of children aged 0–14 for whom an investigation of abuse or neglect had been opened by the CWS during a 15-month period beginning in October 1999. The final NSCAW sample featured 5,501 children. NSCAW thus generated national estimates for the full population of children and families referred for child welfare services during this time frame, making available nationally representative, longitudinal data drawn from first-hand reports from children, parents, other caregivers, caseworkers, and teachers, as well as data from administrative records.

Filter—We applied one filter to the data, requiring that participants be at least 11 years of age, because younger participants did not complete substance use questionnaire items. This reduced the sample size to 1,179. We also removed one participant deemed incapable of completing the interview at all three waves, for an analytic sample of 1,178.

Attrition—Of these 1,178 youth who completed a full or partial interview at baseline, 983 (83%) completed a full or partial interview at 18 months and 965 (82%) completed a full or partial interview at 36 months. Logistic regression models showed that missingness at 18 months was not significantly related to baseline demographic characteristics of age, gender, ethnicity, or residential status, nor to baseline responses to items measuring exposure to violence or trauma. Of these characteristics, only non-Hispanic White ethnicity was associated with missingness at 36 months ($p < .001$) in a negative direction (i.e., with a lower probability to be missing). We relied on the default approach in Mplus software of treating missing data for endogenous variables (in this case, indicators of substance use) using full information maximum likelihood estimation (Muthén & Muthén, 2012) and assuming data were missing at random.

Measures

Substance use—We measured substance use based on three items that captured self-reported use of use of alcohol, marijuana, and hard drugs during the previous 30 days at each time point, based on a frequency scale drawn from the Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2015) that ranged from 0 (*I have not done this in the past 30 days*) to 6 (*20 days or more*). The hard drug item included use of cocaine, methamphetamines, heroin, glue, ecstasy, steroids, and injection drugs. The substance use variables were zero inflated at all time points, extremely so for the more severe substances (91% to 82% across waves for marijuana and 97% to 96% for hard drugs, compared to 84% to 74% for alcohol). Therefore, we dichotomized these variables (1 = *use*, 0 = *no use*).

Demographic and contextual variables—Demographic and contextual factors used to explain variation in levels and growth in substance use were gender (1 = *male*); ethnicity (1 = *membership in the indicated group*); residential status (1 = *out of the home*); and age (0 = *less than 15 years* and 1 = *15 years or older*. Age 15 is a recognized cutoff point for early

substance use that has particularly negative consequences (Grant & Dawson, 1997; Grant et al., 2006; Grant, Stinson, & Harford, 2001). Ethnic groups included non-Hispanic Black, Hispanic, and non-Hispanic White, which are the largest ethnic groups represented in the NSCAW data. Residential status (in-home status) was coded as 0 and included living with a biological parent, an adopted parent, or another permanent caregiver; all other living situations were coded as 1.

We also examined exposure to violence as a potential moderator of the effect of residential status on substance use. Specifically, we relied on participants' self-reports of lifetime violence exposure, based on the Violence Exposure Scale for Children (Fox & Leavitt, 1995). Original responses ranged from 0 to 19 at all time points, representing the sum of the number of times having witnessed or experienced acts of violence by adults, including yelling, throwing something, shoving, slapping, beating up, spanking, pointing a gun or knife, stabbing, or shooting either another adult or child or the participant; an arrest; an act of stealing; or a drug deal at the home. Responses had significant (but not unreasonable) positive outliers at all time points (maximum $|z| = 3.28$), with scores of 7 or more uncommon at all time points. Responses greater than or equal to 7 were thus collapsed into a single category, creating lifetime violence counts ranging from 0 (*never*) to 7 (*7+ times*) with nonsignificant skew and kurtosis statistics and no outlier values (maximum $|z| < 1.82$). These scores were centered (by time point) and cross-multiplied with residential status at each time point to create three time-specific interaction terms.

In the current study, gender and ethnicity were considered to be time-invariant characteristics (TICs) and age and residential status were considered to be time-varying characteristics (TVCs).

Analyses

First, we examined means and proportions of the substance use, demographic, and contextual variables in Stata version 12, applying sampling weights specific to each time point. Next, we estimated a series of unconditional and conditional curve-of-factor (COF) models using Mplus version 7.0, applying NSCAW weights appropriate for longitudinal analysis. The COF model recognizes covariation in use of multiple substances by loading all indicators of use at each time point onto a common polysubstance use factor in the lower (or primary) order of the model (see Figure 1). These primary-order factors then load onto higher-order (or secondary) intercept and slope factors representing level and change in use of the substances over time, with the covariance between level and change over time additionally estimated. As in prior work (Yarnell et al., 2015), we loaded the primary-order polysubstance use factors onto the secondary-order slope factor at values of −1.50, 0, and 1.50. This centered growth near the midpoint of the study, rather than at baseline, because this may represent a more legitimate anchor for assessing growth given differences in sample age at baseline. More details on the COF approach can be found elsewhere (see Duncan et al., 1998; McArdle, 1988; Yarnell et al., 2015).

After estimating an unconditional COF model, we analyzed a series of conditional COF models, in which secondary-order factors (for TICs) or primary-order indicators (for TVCs) were conditioned on one of the demographic or contextual variables in sequence. In

regressing the time-specific, primary-order polysubstance use indicators on residential status, we simultaneously entered the violence exposure terms and the interactions between these main effects. Figure 1 displays the level at which each demographic or contextual effect was examined (for examples of similar model setups, see McArdle, 2011). For each COF model, we report both unstandardized and standardized estimated parameters.

Results

Descriptive Statistics

Sample characteristics and TICs—Weighted analyses showed that participants in our analytic sample were 12.72 years old on average at baseline (*SD* = 1.279 years; range = 11–16) and 43% were male. The sample was 49% non-Hispanic White, 28% non-Hispanic Black, 16% Hispanic, 4% Native American, and 3% Asian. The ethnicity dummy variables used in our statistical models reflected these percentages. Additionally, we noted that the majority of participating caregivers were 35–44 years in age at baseline (47%), with smaller proportions younger than 35 years (35%), between 45 and 54 years old (13%), or 55 years or older (5%). The most common level of education among caregivers at baseline was a high school education (40%).

TVCs—Table 1 displays means and proportions for the TVCs of dichotomized age, residential status, and the potential moderator, lifetime exposure to severe violence. Naturally, the proportion of participants having reached 15 years of age increased by wave (from 7% at baseline to 69% at the 36-month time point). In contrast, the proportion of the sample with residential status outside of the home remained relatively constant across the waves (12% to 13%). However, this is not equivalent to residential status remaining constant at the individual level. Slight decreases in lifetime exposure to violence were seen across waves.

In terms of substance use during the previous 30 days, proportions of the sample reporting use increased for alcohol and marijuana (from 16% to 26% and from 9% to 18%, respectively), but remained fairly constant across the waves for hard drugs (3% to 4%). We again caution that these proportions do not indicate that the same individuals used these substances across the time points. At each time point, reports of having used these substances were highest for alcohol, intermediate for marijuana, and lowest for hard drugs.

Unconditional Curve-of-Factors Model

Table 2 displays results of the COF model prior to entering the predictor variables (the unconditional model), featuring loadings and variance parameters that highlight variation in use of substances, given the proportions shown in Table 1. The model had excellent fit overall, particularly according to indexes of absolute fit (RMSEA = .03, CFI = .98), rather than deviance, which is affected by sample size, $\chi^2(28, 1{,}171) = 48.01$, $p = .01$. As in prior work, loadings for marijuana ($\lambda = 1.07$) and hard drugs ($\lambda = 1.18$) were higher than those for the reference indicator, alcohol ($\lambda = 1.00$); this indicates that they are stronger (or more severe) indicators of the latent polysubstance use factor.

In accord with prior work, significant variance in the primary polysubstance use factors remained unexplained by the intercept and slope factors at later waves of CWS involvement ($\sigma^2 = .28$, $p < .01$ for 18 months; $\sigma^2 = .28$, $p < .05$ for 36 months). This indicates that factors other than the higher-order substance use growth factors may explain variation in use of multiple substances at these latter time points, suggesting the usefulness of exploring predictors of this variation. In particular, TVCs entered to predict time-specific substance use indicators can help explain this variation.

Significant secondary-order variance, on the other hand, was found only for the intercept factor, reflecting levels of general substance use ($\sigma^2 = .44$, $p < .001$); variation for the slope factor was nonsignificant ($\sigma^2 = .03$, $p = .30$). This means that the TICs entered to predict the higher-level factors only explained variation in levels of use across time points, not growth over time. There was no significant covariance between the secondary intercept and slope factors ($\sigma = -.02$, $p = .58$).

Effects of Time Invariant Characteristics

Table 3 displays effects of TICs (gender and ethnicity) on interpersonal differences in higher-order factors for polysubstance use. Results showed that the conditional model had good fit in all successive runs (all RMSEA < .03, all CFI > .97). Among the examined demographic effects, only Non-Hispanic Black ethnicity in Model 2 had significant effects on the secondary intercept ($b = -.27$, $p < .01$), with the negative direction of the effect indicating lower overall levels of polysubstance use for this subgroup of CWS youth, in partial support of our first hypothesis. The standardized beta for this parameter ($b^* = -.18$) suggests that the effect of Black ethnicity may be interpreted as medium to large in size (Keith, 2006). Despite the significant effect of Black ethnicity on the secondary intercept, significant variance in the intercept remained in this and all other models (all $p < .001$). This means that Black ethnicity only partially explained variation in levels of polysubstance use in the CWS sample. In fact, Black ethnicity explained about 3.4% of the variance in levels of use, which was greater than the variance explained by any of the other demographic predictors (R^2 statistics available in Table 3), which may be interpreted as a small but meaningful effect (Keith, 2006).

Effects of Time-Varying Characteristics

Age—Table 4 displays effects of TVCs (age and residential status) on use of specific substances, by time point, as modeled on the lower order of the model in the polysubstance use factors. Model 5, highlighting the time-specific effects of age on use of specific substances, had good to sufficient fit according to the RMSEA and CFI fit statistics (.03 and .94, respectively). Results revealed that being 15 years old or older affected substance use differently at various points of CWS involvement, in support of the idea that there are certain periods during CWS involvement, in which age may be more influential on polysubstance use.

Specifically, being 15 years of age or older was positively associated with marijuana use at the beginning ($b = .31$, $p < .05$) and middle of ($b = .35$, $p < .01$) of the trajectory of CWS involvement, but dropped in impact by the last time point ($b = .14$, $p = .10$). This decrease

was not due to lack of variance for age or the marijuana use indicator at this last time point, given that 31% of the sample remained younger than 15 at the third time point and 82% reported not using marijuana. An association was also found between age and alcohol use at 18 months (b = .23, p < .05), with a comparable although marginally significant effect size at baseline (b = .23, p < .10) and a drop in impact by the final time point (b = .12, p = 13), similar to marijuana use. This trend suggests an interaction between age and point of involvement in the CWS.

Residential status—Model 6, highlighting the time-specific effects of residential status in conjunction with its hypothesized moderator, violence exposure, had good fit to the data according to RMSEA and CFI fit statistics (.02 and .96, respectively). A model with residential status entered as the sole main effect (results not shown) showed a single significant negative effect of this TVC on alcohol use at 36 months (b = −.25, p < .05). Yet main effects should be interpreted in light of significant interactions, when significant hypothesized interactions exist (Keith, 2006). Model 6 revealed several intuitive, positive effects of violence exposure on substance use; regarding our hypotheses, the negative main effect of residential status on alcohol use at 36 months remained (b = −.26, p < .05) and no others emerged. Additionally, two significant interactions between residential status and violence exposure were revealed, including for marijuana use at 18 months (b = −.24, p < .01) and alcohol use at 36 months, which was marginally significant yet equivalent in absolute size (b = −.24, p = .06).

To probe the nature of these interactions, we ran the entire FOC model stratified across levels of violence exposure (low versus high), with residential status modeled as the sole main effect, in line with recommended procedures for probing significant interactions (Keith, 2006). Specifically, using subpopulation weighting commands in Mplus, we estimated the FOC model among participants reporting seven or fewer experiences of violence (low) and among those with scores of 7 (which reflected having 7 or more experiences on the original scale; high), as reported at the midpoint of the study (18 months). The high-exposure group constituted 41% of the sample at this time point. Results are displayed in Table 5.

Results of these models consistently revealed, in accord with our third hypothesis, that out-of-home residential status may be a protective factor, but only for youth who experienced higher exposure to violence while living with their original caretaker in the home from which they had been removed. Specifically, Model 7b featuring the high-violence group showed that out-of-home residential status was associated with lower probability of use of hard drugs at baseline (b = −.63, p < .05) and 18 months (b = −.33, p = .01), with the effect dwindling in significance, though not absolute magnitude, by 36 months (b = −.40, p = .10). Out-of-home residential status was also associated with a lower probability of using marijuana in the high-violence group at 18 months (b = −.26, p < .05). Consistency in the direction of the effects for the high-violence group (8 of 9 effects in a negative direction) and the emergence of multiple significant effects bolstered these interpretations. In contrast, effects of residential status for the low-violence group were nonsignificant except for one significant negative effect on marijuana use at 18 months (b = −.23, p < .05). Other effects

on use of alcohol and marijuana were only marginally significant, although consistently in a positive direction, as expected.

Discussion

As previously noted, CWS-involved youth have been consistently found to have higher rates of diagnosable substance use disorders than youth in the general population (Aarons et al., 2001; Courtney et al., 2004; Vaughn et al., 2007). However, estimation of overall use and correlates of use have varied widely in the research literature (Courtney et al., 2004; Vaughn et al., 2007), making it difficult to tailor services for individuals most in need. This is likely related to discrepancies and deficiencies in the statistical modeling of prior studies, including failure to account for polysubstance use or consider confounding social factors that are time invariant and time varying (Duncan et al., 1998). In this study, we addressed these points by extending prior work to better account for polysubstance use and the time-invariant and time-varying contextual factors related to polysubstance use among CWS youth.

We did this through three areas of inquiry: (a) the role of gender and ethnicity as time-invariant characteristics affecting polysubstance use; (b) the role of age as a time-varying characteristic affecting use of substances; and (c) the interactive roles of residential placement and violence exposure in time-varying processes related to substance use. This approach allowed for the identification of the highest-risk teens in an already high-risk population.

Trends in General Polysubstance Use

Our overall model suggested several notable findings regarding polysubstance use among CWS youth. Modeling of the use of alcohol, marijuana, and hard drugs in conjunction was supported by strong fit statistics, logical loadings of the substance use indicators, and alignment with prior research. For instance, marijuana and hard drugs loaded more strongly onto the polysubstance use factor relative to alcohol, supporting the idea that the latent construct of polysubstance use and its associated consequences are more marked with the use of these additional substances. In conjunction with prior research using alternative modeling (Yarnell et al., 2015), unexplained variation in the polysubstance use factor existed at the latter points of involvement in the CWS, suggesting that examining characteristics of CWS youth and contextual factors (timing, location) was warranted. Additionally, our models suggested that interpersonal differences existed among CWS youth in their overall levels of use, but that their general rate of increase in use over time was constant. Hence, TICs predicting these levels and rates of growth were only useful in explaining cross-sectional rates but not change over time.

Gender and Ethnicity

Given the finding of constant rates of growth in polysubstance use, we considered time-invariant characteristics regarding their impact on levels in this use only across the trajectory of CWS involvement. We noted significantly lower levels of use among non-Hispanic Black participants, which was in accord with our first hypothesis based on established trends on

initiation of alcohol use in the general population (Caetano, 1997; Dawson, 1996; Dawson et al., 1995; Wagner et al., 2002; Williams et al., 2007). Although focused on alcohol, this literature is more solidly established than research on marijuana and hard drugs and is applicable here because illegal substances tend to be used in a context of drinking (Conway, et al., 2013; Mason, et al., 2003; Mikulich-Gilbertson, Zerbe, & Riggs, 2014; Morley, et al., 2015; Odgers et al., 2008; Pape et al., 2009). Our finding suggests that on average, across the time points of involvement in the CWS, Black teens in the current sample engaged in lower levels of polysubstance use. However, we did not find support for lower levels of use among girls or Hispanic teens, which we also hypothesized. The only significant effect found for these demographic groups in fact suggests less risky trajectories for non-Hispanic Black teens in the CWS. By honing in on disparities of gender and race identified in other cross-sectional studies of CWS-involved youth (Aarons et al., 2001; Wall & Kohl, 2007) and youth in the general population (Caetano, 1997; Dawson, 1996; Dawson et al., 1995; Wagner et al., 2002; Williams et al., 2007), CWS may be currently implementing effective prevention and intervention efforts with previously identified high-risk adolescent populations such that previously seen disparities are no longer detectable.

Age

Conversely, findings related to the time-varying characteristic of age pointed to several opportunities to leverage preventive interventions. Despite the fact that there were far fewer youth aged 15 or older at baseline (7%) than at 36 months (69%), being 15 years old or older emerged as a significant risk factor at baseline and 18 months, but not at the end point of the study. This highlights the dynamic nature of age as a risk factor, in support of the idea that there are certain periods during CWS involvement, in which age may be more influential on polysubstance use. These findings do not concur with the literature suggesting that drinking before age 15 is particularly risky for the development of alcohol problems, but rather that being older is associated with higher rates of use of alcohol and marijuana during the previous 30 days only at the beginning and middle of a youth's trajectory of involvement in the CWS. This suggests that youth aged 15 or older are no more likely to use substances during the previous 30 days at the third time point; put differently, youth who enter the CWS at a younger age are at greater risk as length of involvement in the system is extended, given that younger age is otherwise protective. This is an important finding because it suggests that younger youth may be in need of additional prevention support over time.

Residential Status and Violence Exposure

Last, we found that residential status on its own had a significant impact on alcohol use at 36 months such that children in out-of-home placement were less likely to use alcohol. This finding is counterintuitive given that the child welfare literature generally describes substance use as a method of coping with trauma and mental health difficulties related to maltreatment and being removed from the home (Grella & Greenwell, 2006; Gutierres et al., 1994; Zlotnick et al., 2004). Given the mixed literature on the impact of out-of-home residence on outcomes among CWS youth, we probed several interaction effects. Results highlighted the novel finding that out-of-home placement was protective against later substance use for youth who had been removed from contexts with their original caretaker where exposure to greater number of violent events were present. This finding is incredibly

important in a field in which removal from the home only occurs when the youth is in imminent danger. Out-of-home placement not only protects the safety of youth but also enhances their well-being in terms of reducing substance use, according to these findings.

Limitations

Notwithstanding these findings, this study has several limitations that should be considered. Results of this study must be interpreted in the context of NSCAW's limitations and strengths. NSCAW is a clinical survey that measures psychosocial functioning across multiple domains and does not specifically target substance use behavior. This might be considered a significant limitation by substance abuse researchers who are used to more specific and comprehensive measures of social and illicit substance use behavior. However, the absence of longitudinal, nationwide data about the risk and protective factors for social and illicit substance use among youth involved with the CWS nevertheless warranted investigation of this topic in the only nationally representative sample currently available. Although limited in the choice of outcomes, this study provided a within-group perspective of social and illicit substance use behavior in this sample of maltreated youth. The NSCAW I study was replicated several years later and there is now a publicly available NSCAW II data set. Unfortunately changes in measurement, most notably the elimination of data on use in the past 30 days for many substances, precludes the use of NSCAW II as a replication sample which could have been a powerful way of verifying results.

We dichotomized two sets of variables that were originally not in dichotomous form: the substance use indicators (originally a set of ordinal variables capturing an underlying count distribution for use of each substance), and age at each wave (originally coded in months and years in NSCAW). While this has the potential to lead to oversimplification of our findings, we made this decision after running a series of models to inform the selection of one on the basis of being computationally viable and defensible from both theoretical and statistical standpoints. Future research should indeed develop greater knowledge of how age affects the development of use of multiple substances among CWS youth, including how growth in use may differ by age at of CWS initiation, and length of involvement (e.g., a few months vs. several years).

Like most studies relying on youth self-report data, the validity and reliability of data obtained from youth about their substance use are unknown. Fear of loss of privacy, concerns about repercussions, and issues of social desirability may undermine accurate reporting on sensitive personal behaviors (Tourangeau & Smith, 1996; Turner et al., 1998). Such concerns might be amplified for youth involved with the CWS, who may have previously experienced intervention by a public institution in the form of continued monitoring and supervision and in some cases removal from their biological family. Youth who experienced multiple placement disruptions in out-of-home placement may also be concerned about loss of another placement if their reported behaviors violate rules set forth by their foster caregiver. These methodological concerns warrant further investigation with this specific population. Placement type might also impact availability of substances. Unfortunately, sample sizes were not sufficient to support examination of subgroup

hypotheses. Future studies on adolescent substance use among CWS involved youth would benefit from exploring this.

Finally, from a theoretical standpoint, many theories of youth risk behavior, including the Social Development Model (Hawkins, Catalano, & Miller, 1992) employed in this study, categorize use of drugs, like alcohol and marijuana as antisocial or deviant behaviors. However, given changes in attitudes and laws towards certain drugs like marijuana, it may be erroneous to categorize use of these substances as risk behaviors. More research differentiating between recreational use versus risky use that better accounts for changing social norms is necessary. This research must also inform diagnostic and intervention standards for teens who use substances.

Implications

Taken together, findings related to the three hypotheses of this study have meaningful implications for child welfare and substance use research, practice, and policy. Our results suggest that in the child welfare population, the modeling of multiple substances rather than one substance in isolation is more informative than models of use of single substances, because polysubstance models yield information on the confluence of behaviors that tend to occur and evolve together (see Conway, et al., 2013; Donovan, 2005; Jessor & Jessor, 1977; Mason, et al., 2003; Mikulich-Gilbertson, Zerbe, & Riggs, 2014; Morley, et al., 2015; Odgers et al., 2008). In keeping with social development theory (Hawkins & Weis, 1985), we highlighted that processes and models must be understood in light of social contextual factors. Future inquiries into substance use among youth in child welfare should seek opportunities to use longitudinal and time-varying and time-invariant modeling to address the continuing problem of a lack of convergence of findings in this area.

Key practice and policy implications that can be informed by our findings center on triaging prevention and treatment services in CWS. Maltreated adolescents currently engaged in CWS are at high risk of becoming the next generation of adults with addiction problems, abusive or neglectful parents, or both (Schuck & Widom, 2001). Given the abundance of risk for CWS-involved teens, the CWS can serve as an important gateway to substance abuse prevention services. Intervening through the CWS offers an opportunity to provide primary and secondary preventive education and treatment that can promote positive transitions to adulthood (Narendorf & McMillen, 2010). The CWS has the potential to serve as a robust nonspecialty service sector platform because it can facilitate identification of high-risk youth, sustain both preventive and substance abuse treatment programs, and allow for the engagement of teens and their caregivers in a mandated treatment setting. A crucial aspect of harnessing the CWS as a nonspecialty service sector is determining appropriate and efficacious prevention strategies for CWS-involved teens. Furthermore, our findings indicate that children who enter child welfare when they are older than age 15 are at increased risk of substance use, although those who enter the CWS at a young age may be at greater risk over time. Therefore, special attention should be paid to providing these youth with services related to substance use prevention and intervention when they enter the CWS. Finally, for youth coming from social and personal contexts with greater violence exposure, out-of-home placement is an important intervention for preventing increased substance use.

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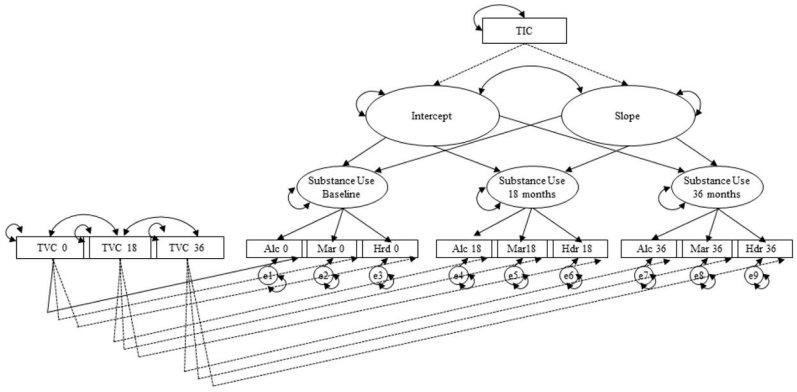

Figure 1.

Curve-of-factors (COF) model, conditional on time-invariant characteristics (TICs) and time-varying characteristics (TVCs)

Note. Solid lines reflect the structural COF model. Dashed lines reflect effects of TICs or TVCs. Ellipses around variables or factors reflect variances or residual variances. TICs include gender and ethnicity dummy variables, entered in successive runs of the COF model. TVCs include age and residential status, the latter entered in conjunction with time-specific lifetime violence exposure and time-specific interaction terms. TVCs were permitted to covary. Alc, alcohol; Hdr = hard drugs; Mar, = marijuana. Numbers indicate time point of the study (0 = baseline, 18 = 18 months, 36 = 36 months).

Table 1

Weighted Means and Proportions for Time-Varying Characteristics and Dichotomized Substance Use Variables

	% or *M* (*SE*)		
	Baseline	**18 months**	**36 months**
Age 15+	7%	40%	69%
Residential status (out of home)	12%	12%	13%
Lifetime violence exposure (range = 0–7)	4.35 (.16)	4.23 (.15)	3.87 (.15)
Substance use (during previous 30 days)			
Alcohol	16%	24%	26%
Marijuana	9%	14%	18%
Hard drugs	3%	4%	3%

Note. *N* = 1,178. Means and proportions nationally weighted by wave. Means and proportions generated for the valid sample by wave.

Table 2

Primary- and Secondary-Order Parameters in Unconditional Curve-of-Factors Model

	Unstandardized	Standardized
Primary order		
Substance use factor loading (λ)		
Alcohol	1.00	.87, .85, .86
Marijuana	1.07	.93, .91, .92
Hard drugs	1.18	1.02, 1.00, 1.01
Residual variance (σ^2)		
Substance use, baseline	.20 (.13)	.26
Substance use, 18 months	.28** (.09)	.39***
Substance use, 36 months	.28* (.13)	.37*
Secondary order		
Variance (σ^2)		
Intercept	.44*** (.08)	1.00
Slope	.03 (.03)	1.00
Covariance, intercept and slope (σ)	−.02 (.03)	−.12
χ^2	48.01*	
RMSEA	.03	
CFI	.98	

Note. N = 1,178. Unconditional model had 28 degrees of freedom. Unstandardized substance use loadings constrained across time points to establish measurement invariance of the substance use factor, as suggested for curve-of-factor modeling (Duncan et al., 1998; McArdle, 1988). Standardized parameters for these loadings at each time point separated by commas. *P*-values represent results of two-tailed tests. CFI, comparative fit index; RMSEA, root mean square error of approximation.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Higher-Order Parameters in a Curve-of-Factor Model Conditional on Time-Invariant Covariates

	Gender		Non-Hispanic Black		Hispanic		Non-Hispanic White	
	***b* (*SE*)**	***b****	***b* (*SE*)**	***b****	***b* (*SE*)**	***b****	***b* (*SE*)**	***b****
Effect of TIC								
Secondary intercept	.05 (.13)	.03	−.27**(.10)	−.18	.17 (.19)	.09	.07 (.12)	.05
Secondary slope	.03 (.06)	.08	−.05 (.05)	−.13	−.09 (.07)	−.16	.11† (.06)	.27
Residual variance (σ^2)								
Higher-order intercept	.44*** (.07)	1.00	.43*** (.06)	.97	.45*** (.07)	.99	.44*** (.06)	1.00
Higher-order slope	.03 (.03)	.99	.03 (.03)	.98	.04 (.03)	.97	.04 (.03)	.93
Covariance, intercept with slope (σ/r)	−.01 (.03)	−.13	−.01 (.02)	−.11	−.02 (.03)	−.11	−.02 (.02)	−.15
R^2								
Higher-order intercept	.001		.034		.008		.003	
Higher-order slope	.006		.016		.026		.072	
χ^2	68.750***		56.430*		55.810*		61.691**	
RMSEA (90% CI)	.03 (.02, .04)		.02 (.01, .03)		.02 (.01, .03)		.03 (.02, .04)	
CFI	.97		.98		.98		.98	

Note. *N*s were 1,171, 1,168, 1,164, and 1,166 for gender, non-Hispanic Black, Hispanic, and non-Hispanic White models, respectively. Models have 35 degrees of freedom. Predictors were coded as 1 = male and 1 = membership in stated ethnic group. *P*-values represent results of two-tailed tests. CFI, comparative fit index; CI, confidence interval; RMSEA, root mean square error of approximation; TIC, time-invariant covariate.

$^{\dagger}p < .10$.

$^{*}p < .05$.

$^{**}p < .01$.

$^{***}p < .001$.

Table 4

Unstandardized Effects of Time-Varying Covariates on Use of Substances by Time Point in Lower Order of Curve-of-Factor Model

	Effects of TVCs and Interaction, *b* (*SE*)			
	Age	**Residential Status**	**Violence Exposure**	**Interaction**
Baseline				
Alcohol	.23† (.14)	−.03 (.12)	.12** (.04)	−.06 (.12)
Marijuana	.31* (.14)	.21 (.14)	.10† (.06)	−.10 (.09)
Hard drugs	.26† (.15)	.19 (.19)	.02 (.06)	.12 (.09)
18 months				
Alcohol	.23* (.11)	−.01 (.13)	.05 (.05)	−.11 (.08)
Marijuana	.35** (.11)	−.07 (.13)	.19*** (.05)	−.24**(.09)
Hard drugs	−.07 (.10)	.27 (.21)	.14† (.08)	−.19 (.13)
36 months				
Alcohol	.12 (.08)	−.26* (.11)	.15* (.08)	−.24† (.13)
Marijuana	.14 (.09)	.16 (.13)	.27*** (.08)	−.16 (.13)
Hard drugs	.21 (.12)	.05 (.19)	−.03 (.06)	−.09 (.14)
χ^2	113.84***		136.97***	
RMSEA (90% CI)	.03 (.03, .04)		.02 (.02, .03)	
CFI	.94		.96	

Note. N = 1,178. The age model had 49 degrees of freedom. The residential status, violence exposure, and interaction model had 82 degrees of freedom. Predictors were coded: 1 = 15+ years old for age and 1 = out of home for residential status. *P*-values represent results of two-tailed tests. CFI, comparative fit index; CI, confidence interval; RMSEA, root mean square error of approximation; TVC, time-varying covariate.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 5

Unstandardized Effects of Residential Status on Use of Substances by Time Point in Lower Order of Curve-of-Factor Model, Stratified by Level of Violence Exposure

	Effect of Residential Status, *b* (*SE*)	
	Low Violence *n* = 698	**High Violence *n* = 275**
Baseline		
Alcohol	.27† (.14)	−.35 (.26)
Marijuana	.31† (.17)	.14 (.36)
Hard drugs	.30 (.23)	−.63* (.30)
18 months		
Alcohol	−.04 (.12)	−.09 (.15)
Marijuana	−.23* (.10)	−.26* (.12)
Hard drugs	−.28 (.18)	−.33* (.13)
36 months		
Alcohol	−.15 (.12)	−.17 (.20)
Marijuana	.21† (.13)	−.22 (.18)
Hard drugs	.33 (.24)	−.40 (.25)
χ^2	72.746**	65.17*
RMSEA (90% CI)	.03 (.01, .04)	.04 (.01, .06)
CFI	.98	.97

Note. N = 1,178. Residential status was coded as 1 = out of home. *P*-values represent results of two-tailed tests. CFI, comparative fit index; CI, confidence interval; RMSEA, root mean square error of approximation.

† $p < .10$.

* $p < .05$.

** $p < .01$.