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Indices of lifetime polydrug use among adolescents

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Abstract

The functional equivalency for three indices of lifetime polydrug use was examined in a sample of adolescents ($N = 794$). The following indices were included in analyses: (a) a count of lifetime self-report of substances used; (b) an index weighted by the severity of the substances used; and (c) a hierarchical index of substance use. Analyses for each index was conducted twice with abstinent youth (no report of substances over their lifetime) included and excluded from analyses.

Relationships between the indices with gender, age, ethnicity, and country of origin were examined. The only difference between the indices found was for ethnicity in the full sample. African Americans had higher scores on the hierarchical substance use index than Latinos or Asian/Pacific Islanders. With the exception of the relationship between the hierarchical index and ethnicity, the relationships between the other demographic variables with indices were consistent. Implications for utilizing the count or weighted index versus a hierarchical index of lifetime polydrug use are discussed.

Introduction

According to Problem Behaviour Theory, adolescents may exhibit 'multiple problem behaviours' including substance use, early onset of sexual behaviour, and delinquency (Jessor & Jessor, 1977). To the extent that an adolescent engages in one problem behaviour, they may also be likely to engage in other problem behaviours (Bingham & Crockett, 1996; Ebin et al., 2001; Ensminger, 1990). Substance use represents one component of externalizing behaviours found within Problem Behaviour Theory. Within the theory, substance use may also co-occur such that an adolescent who uses one substance may also be likely to use other substances (Neumark-Sztainer, 1997; Ebin et al., 2001). The use of more than one substance has typically been referred to as polydrug use (Collins, Ellickson, & Bell, 1998). Polydrug use during adolescence may have implications for later more serious and frequent drug use (see Mackesy-Amity, Fendrich, & Goldstein, 1997; Galaif & Newcomb, 1999). To date, researchers have used a variety of indices to quantify substance use among adolescents. It is important to note that the indices may not be functionally equivalent. For example, the use of one index may reveal an ethnic or gender difference where a second index does not. The subsequent conclusions drawn from a research study may have important implications for policy and the development of intervention programs to reduce substance use among adolescents. It is, therefore, important that conclusions be based on valid measures for research conducted on adolescent substance use.

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Indices of lifetime polydrug use

Count index—A count index is an index of the number of substances that the adolescent has reported using (Martin, Arria, Mezzich, & Bukstein, 1993; Harrison, Fulkerson, & Beebe, 1997; Botvin et al., 2000; Siliquini, Faggiano, Geninatti, Versino, & Mitola, 2001). For example, a respondent may receive a count index of three representing the lifetime use of alcohol, cigarettes, and marijuana. In contrast, a respondent may receive a count index of three that represents the lifetime use of alcohol, marijuana, and cocaine. The former respondent may have a less serious drug problem than the latter. However, the count index makes no distinction between the two. Thus, count indices may fail to take into consideration the severity of substances used.

Weighted index—In a weighted substance use index, each substance receives a weight based on its severity (see Rotheram-Borus, Murphy, & Swendeman, 1999; Rotheram-Borus et al., 2001). For example, the following weights could be assigned: cigarettes* (1), alcohol* (2), marijuana* (3), and cocaine* (5). Self-reported use of alcohol, cigarettes, and marijuana would receive a weighted substance use index of six. Whereas, self-reported use of alcohol, marijuana, and cocaine would receive a weighted index of 10. In contrast to a count index, the weighted index takes into account the severity of the substances as well as the number of substances used.

Hierarchical index—The hierarchical index has served primarily as the basis of a research paradigm to examine the “gateway hypothesis” of substance use. According to the gateway hypothesis, use of “soft drugs” in adolescence and usually precedes the use of illicit substances (Kandel & Logan, 1984; Kandel & Yamaguchi, 1993; Miller, 1994; Guerra, Romano, Samuels, & Kass, 2000). Utilizing a hierarchical index, respondents are placed into categories based on the severity and number of the substances they have used. For example, a respondent who has used cigarettes and alcohol would be in a lower category than a respondent that has used cigarettes, alcohol, and marijuana. The drawback of using a hierarchical index may include the inability to classify substance users who do not use substances in a sequential pattern (see Mackesy-Amiti et al., 1997). The ordering of substances is also problematic with regard to the use of a hierarchical index. It is not clear, for example, if alcohol should precede cigarettes or vice versa in the hierarchy. There may be even less clarity on the order of illicit substances (e.g. speed, heroin, ecstasy). In an effort to distinguish the proper order, researchers have examined multiple sequences (Martin et al., 1993), and have classified alcohol or cigarettes leading to marijuana use which may lead to use of host of other illicit substances (Mackesy-Amiti et al., 1997). In addition, the index may fail to take into account ethnic group differences in substance use patterns (Galaif & Newcomb, 1999; Guerra et al., 2000). Regardless of drug sequence, most adolescents who have used illicit substances (e.g. cocaine, crack) have previously tried marijuana (see Mackesy-Amiti et al., 1997).

In the current study, the count, weighted and hierarchical indices of polydrug use are compared for functional equivalency. Relationships between the indices with gender, age, ethnicity, and country of origin will be examined to compare their functional equivalency. Functional equivalency among the indices implies that an analysis of the same data with the three different polydrug use indices leads to the same conclusion. However, the functional equivalency of different indices has not been examined in the same data set.

Method

Participants

Adolescents between the ages of 11–19 ($M = 15$) years were recruited from two public health clinics in Los Angeles County. The *full sample* included 794 youth (49% female). The ethnic

breakdown of the *full sample* was: 77.8% Latinos, 9.4% Asian Americans, 8.0% African Americans, 4.7% other (including Biracial, Caucasian, and unspecified). Detailed information on the sample and recruitment procedures can be found in Sneed et al. (2001). All analyses with indices were carried out twice: with abstinent youth included and excluded. The *substance using sample* included 330 youth (42% female). The ethnic breakdown of the *substance using sample* was: 76.7% Latino, 11.8% African American, 7.6% Asian/Pacific Islander, and, 3.9% other (including Biracial, Caucasian, and unspecified). The respondents were recruited to participate in a preventive tuberculosis (TB) treatment adherence intervention. The adolescents were referred to the clinics after being screened for TB and receiving a positive diagnosis for a non-active case of TB. Most of the adolescents were screened as a requirement prior to attending school.

Instruments

The survey was completed via face-to-face interview. The respondents were asked to report if, in their lifetime, they had ever used cigarettes, alcohol, marijuana, inhalants, crack/rock, cocaine, uppers/stimulants, downers, steroids, heroin, and hallucinogens. Where relevant, street names were included in the descriptions of substances. The respondents were also asked to self-report ethnicity, age, gender, and country of birth (US or foreign born).

Procedure

The adolescents were recruited after their first clinic appointment. At the time of recruitment, they were informed of the purpose of the study and were asked to sign a consent form. The findings presented in this study come from the baseline instrument administered to the adolescent approximately 1 month after the initiation of TB drug treatment and prior to their participation in the intervention.

Indices of polydrug use

Count of substances used—An unweighted count variable of lifetime substance use was calculated. The count increased by an index of one for each substance used over the lifetime of the adolescent. The count index can range from zero to 11. See Martin et al. (1993) for similar use of a count index applied to polydrug use among adolescents.

Weighted substance use index—Each of the substances were assigned a weight based on their severity: cigarettes (1), alcohol (2), marijuana (3), inhalants (4), downers (4), steroids (4), crack (5), cocaine (5), uppers (5), heroin (6) and hallucinogens (6). The weighted index was created to document cumulative use of substances based on their severity. For example, if the respondent used two substances [e.g. alcohol (2) and cigarettes (1)], they scored a three on the weighted index. The weighted substance use index can range from zero to 45. See Rotheram-Borus et al. (1999) for the application of a weighted substance use index.

Hierarchical index—The following categories were used to provide a lifetime hierarchical index of substance use: (1) alcohol or cigarettes, (2) use of alcohol and cigarettes, (3) use of alcohol or cigarettes, and marijuana (4) alcohol, cigarettes, and marijuana, plus one illicit substance (e.g. crack, speed, cocaine) and (5) alcohol, cigarettes, and marijuana, plus two or more illicit substances (e.g. crack, speed, cocaine). The hierarchical index can range from zero to five. See Kandel and Yamaguchi (1993) and Grunbaum, Tortolero, Weller, and Gingiss (2000) for a similar hierarchical index of substance use.

Analyses

The following analyses were used to examine the relationship between demographic variables and the three indices of lifetime substance use. A series of independent group *t*-tests were

conducted with gender and country of birth as independent variables and the indices as the dependent variables. Zero-order correlations were used to examine the relationship between age and the three indices. One-way ANOVA was used to examine the relationship between ethnicity and the three indices. All analyses were conducted twice: with abstinent youth included and excluded from the indices. Removing abstinent youth from analyses lowers sample size and impacts the probability of finding significant results. Effect sizes (for the appropriate statistic) are discussed and compared for analyses in which there are discrepant findings for the full versus substance using sample.

Results

Abstinent participants (self-report of no substances over their lifetime) were coded as zero on all indices. Abstinent participants accounted for 59% the sample. The count index ranged from one to seven ($M=0.83$, $s.d.=01.21$). A majority of participants (97%) self-reported lifetime use of three or fewer substances. The weighted substance use index ranged from 0 to 26 ($M=0.81$, $s.d.=1.18$). The hierarchical index ranged from 0 to 5 ($M=1.67$, $s.d.=3.19$). A majority of the participants (97%) scored a 3 or lower on the hierarchical index. With abstinent participants excluded, the mean and standard deviations of the indices were as follows: count ($M=1.99$, $s.d.=1.12$), weighted ($M=2.01$, $s.d.=1.02$), hierarchical ($M=4.02$, $s.d.=3.88$).

Gender

Full sample—Table 1 presents the t -values and means for males and females on the count, weighted, and hierarchical indices for the full and substance using sample. Independent group t -tests were used to examine the differences between males and females on the three indices. All three t -tests with the entire sample were significant. The observed t -values for the count, weighted and hierarchical index were; 3.6, 3.1, and 3.7, respectively (all p 's <0.01). The largest mean difference between males and females was found using the hierarchical index.

Substance using sample—None of the t -tests revealed significant differences between males and females with abstinent youth excluded from analyses. Regardless of significance, males scored higher on all three substances use indices when compared to females.

Effect size comparisons—Effect sizes for observed t -tests were calculated for the full and substance using sample. The effect sizes for all t -tests were small (ranging from 0.25 to 0.16). The effect sizes were similar indicating that significant differences may have been detected in the substance using sample if the sample size was larger.

Age

Full sample—The correlations between age and the indices with the entire sample were all significant (count, $r = 0.34$; weighted, $r = 0.29$; hierarchical, $r = 0.35$ all p 's <0.001).

Substance using sample—The correlations between age and the indices with abstinent youth excluded were also significant (count, $r = 0.15$ weighted, $r = 0.14$; hierarchical, $r = 0.15$ all p 's <0.05). Older participants had higher scores on the indices than younger participants.

Effect size comparisons—According to Cohen's conventions (Cohen & Cohen, 1983), the effect sizes for full sample are close to medium, whereas the effect sizes for the substance using sample could be classified as small.

Ethnicity

Full sample—Table 2 presents F -values and means across ethnic groups on the count, weighted, and hierarchical indices for the full and substance using sample. Including the entire

sample, only the one-way ANOVA with the hierarchical index was significant ($F\ 3,769=4.7$, $p<0.05$). Bonferroni post hoc analyses revealed significant differences between African Americans with Latinos and Asian/Pacific Islanders. African Americans scored higher on the hierarchical substance use index than Latinos or Asian/Pacific Islanders.

Substance using sample—None of the ANOVAs were significant with abstinent youth excluded from analyses. However, the analyses with the hierarchical index was marginally significant ($F\ 3,305=2.6$, $p = 0.051$).

Crosstab categories—A crosstab with the full sample was used to examine the distribution of the ethnicity on the hierarchical index. When compared to Latinos and Asian/Pacific Islanders, a larger percent of African Americans (32%-within group) could be classified in group 3 (alcohol or cigarettes, and marijuana). Only 5.4% of Asian/Pacific Islanders and 6.5% of Latinos could be classified in group 3 of the hierarchical index. None of the African American participants were found in the higher categories of the hierarchical index (i.e. no self-report of lifetime use of illicit substances other than marijuana). Only a small percent of Asian/Pacific Islander's (2.8%) and Latino's (2.8%) could be classified in groups 4 or 5 of the hierarchical index.

Country of birth

Full sample—Table 3 presents t -values and means for US and foreign-born participants on the count, weighted, and hierarchical indices for the full and substance using sample. Independent group t -tests were used to examine the differences between US and foreign-born participants on the count indices. All three t -tests with the entire sample were significant. The observed t -values for the count, weighted and hierarchical index were 4.2, 3.9, and 4.4, respectively. All p values were less than 0.01.

Substance using sample—All t -tests with abstinent youth excluded were also significant, all p 's<0.05. Foreign-born participants scored lower all indices than US born participants.

Discussion

In this study, the functional equivalence of three indices of lifetime polydrug use among adolescents was examined. Demographic variables frequently used in research on adolescents substance use (gender, age, ethnicity, and county of birth) were used to examine the functional equivalency of a count, weighted, and hierarchical index of substance use. The analyses revealed functional equivalence of the indices across three of the four demographic variables. The hierarchical index revealed ethnic differences full sample that were not identified by the count or the weighted index.

Demographic differences in polydrug use among adolescents are a consistent and ubiquitous finding in several studies. In the current study, we examined gender, age, ethnicity and country of origin. Researchers have found that adolescent males often fare worse than females on indices of polydrug use (see Martin, Kaczynski, Maisto, & Tarter, 1996) and older youth fare worse than younger youth (CDC, 2000). Foreign born youth often fare better than US born youth on substance use (Ebin et al., 2001). In addition, nationally representative samples of youth show different substance use patterns among adolescents from different ethnic groups (CDC, 2000). Overall, our findings on the demographic variables are consistent with the findings of prior research. We found that males reported more severe substance use than females, older youth reported more severe substance use than younger youth, and US born participants reported more severe substance use than foreign-born participants. Overall, the indices may have been less sensitive to ethnic differences found in prior research.

When comparing the full and substance using sample, the results from the current study on gender and ethnic differences are mixed and have implications for the inclusion or exclusion of abstinent youth in the calculation of lifetime substance use indices. When abstinent youth were excluded from analyses, there were no significant gender differences. However, the effect sizes associated with the findings were similar indicating that significant differences may have been found had substance using sample been larger. Across all three indices for both the full and substance using sample, age was associated with more severe substance use. However, the effect sizes found in the full sample were medium whereas the effect sizes found in the substance using sample were small. With the inclusion of abstinent youth, the analyses revealed significant ethnic differences with the hierarchical index. None of the remaining analyses concerning ethnic differences were significant. Post hoc analyses for ANOVA revealed that African American Youth score higher on the substance use index than Latino or Asian/Pacific Islander youth. And, these findings were similar for both the full and substance using sample. The findings were consistent for the full and substance using sample across the indices for US versus foreign-born participants. Overall, it appears that how the sample is defined has important implications for researchers interested in studying substance use patterns among adolescents; especially researchers interested in examining patterns of substance use among males versus females or older versus younger adolescents.

The hierarchical index can also be used to examine the type substance used based on the category the youth is placed in. A larger percentage of African Americans could be classified as using alcohol or cigarettes, and Marijuana (a score of 3 on the hierarchical index) when compared to Asian/Pacific Islanders, Caucasian, and Latino respondents. However, none of the African American respondents could be classified using other illicit substances (e.g. cocaine or heroin) in addition to alcohol, cigarettes, and marijuana. Excluding marijuana use, other research has also found that African American youth are less likely to report use of illicit substances (Catalano et al., 1993; Ellickson, Collins, & Bell, 1999; Merrill, Kleber, Shwartz, Liu, & Lewis, 1999). The current findings may indicate that African American youth are more resilient when compared to other youth when considering use of illicit substances. Within the social context, the drugs of choice or the drugs more likely to be represented in social situations may include alcohol and marijuana for African Americans. Other illicit substances may be more prevalent in social situations for Latino and A/PI youth. Given the small number of youth who have tried illicit substances other than marijuana is small, the prevalence of these substances in social situations may also be small. Examining the placement of youth in specific drug categories helps to interpret the finding that African Americans fared worse than other ethnic groups on the hierarchical index, though not on the count or weighted indices. African Americans scored higher on the hierarchical index through a larger number of youth, on average, using alcohol and marijuana—not other substances (e.g. cocaine, speed, steroids).

Hierarchical versus the count or weighted index of substance use provide qualitatively different information on polydrug use and may lead to different interpretations—albeit not different statistical conclusions. Count indices document the number of substances used. The weight index is similar to the count index except the researcher weights each substance used by its severity. Hierarchical indices can provide researchers with information on sequential patterns of substance use among adolescents. In the current study, depending on the inclusion or exclusion of abstinent youth we found different relationships between demographic variables with count and weighted index versus hierarchical index of polydrug use. Indices selected to document lifetime polydrug use should depend on the rationale of the study. As mentioned in the introduction, it is important to document and describe lifetime polydrug use among adolescents. Adolescents who report use of more than one substance are at greater risk for later more serious substance use (Mackesy-Amiti et al., 1997; Galaif & Newcomb, 1999). An appropriate taxonomy of lifetime polydrug use may identify adolescents at early

experimentation stages of substance use and allow time to intervene and reduce their risk for progression to more frequent substance use.

The findings of this study should be placed within the broader context of studying adolescent substance use. Researchers may employ the indices when they want to summarize cumulative substance use among adolescents. Researchers have also conducted more detailed studies on the use of one or two substances among adolescents (e.g. Chen, Kandel, & Davies, 1997; Topp, Hando, Dillon, Roche, & Solowji, 1999). In depth analyses of one substance may include questions to assess frequency of use and age of onset. Examining the use of a single substance, however, is not incompatible with the use of a polydrug use index. Utilizing a polydrug use index may add a greater conceptual understanding on the use of any one substance within a target population. Self-reported use several substances may indicate an unconventional attitude or predisposition toward risk that is associated with frequent use of one drug or engagement in other high-risk behaviours (see Merrill et al., 1999). Also, based on our findings, the importance of carrying out research with abstinent youth included and excluded from analyses should not be overlooked.

The actual choice of the index depends primarily on the specific aims of the research. When compared to the count index, the weighted index allows the researcher to take into consideration the severity of substances used. Assuming substances were used in a sequential manner, the hierarchical index may allow the research to examine the progression of substance use. That is, the hierarchical index may allow the researcher to distinguish among respondents who have used anywhere from “soft to hard drugs”. As mentioned in the introduction, this characteristic of the hierarchical index is important for examining the gateway hypothesis of drug use. The results of this study support the hierarchical index for identifying important ethnic differences in substance use (differences that are in fact consistent with prior research). Given the choice of one or both of these indices the researcher is still left with the task of assigning weights for the weighted index and/or identifying categories for the hierarchical index. Thus, this research is only a first step in evaluating the functional equivalence of indices of polydrug use among adolescents.

Our findings should be interpreted cautiously due to the fact that generalizability may be restricted to adolescents receiving treatment for TB. Specifically, there may be differences in our sample (as a result of their health status) that may restrict our ability to generalize our results. There was also a small percentage of ethnic groups represented other than Latinos. However, our discussion of effect sizes helps to put our findings into the appropriate context. In addition, it should be noted that our findings with regard to ethnic group differences using a hierarchical index are consistent with findings from previous research. Further studies should be conducted to examine the relationship between lifetime use with the frequency of use of one or more substances and general risk behaviours. In addition, future analyses should include other demographic variables in the analyses.

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Table 1

T-Values and means for males and females on the count, weighted, and hierarchical indices: full and substance using sample

	<i>T</i> -value	Mean	
		Male	Female
<i>Full sample</i>			
Count index	3.6**	0.98	0.67
Weighted index	3.1**	2.0	1.3
Hierarchical index	3.7**	0.96	0.65
<i>Substance using sample</i>			
Count index	1.7	2.1	1.9
Weighted index	1.4	4.3	3.7
Hierarchical index	1.9	2.1	1.9

*
 $p < 0.05$.

**
 $p < 0.01$.

Table 2
F-values and means across ethnic groups on the count, weighted, and hierarchical indices: full and substance using sample

	F-Value	Means for ethnic groups			
		African American	Asian/PI	Latino	Other
Full sample					
Count index	2.6	1.17	0.63	0.81	0.93
Weighted index	2.0	2.40	1.37	1.61	2.17
Hierarchical index	4.7*	1.33	0.64	0.77	0.93
Substance using sample					
Count index	1.0	1.92	1.88	1.98	2.39
Weighted index	1.0	3.95	3.80	3.95	5.56
Hierarchical index	2.6	2.33	1.96	1.94	2.74

* *p*<0.05.
** *p*<0.01.

Table 3

T-Values and means for US- and foreign-born participants on the count, weighted, and hierarchical indices: full and substance using sample

	<i>T</i> -value	Mean	
		US born	Foreign born
<i>Full sample</i>			
Count index	4.2**	1.24	0.72
Weighted index	3.9**	2.76	1.39
Hierarchical index	4.4**	1.24	0.70
<i>Substance using sample</i>			
Count index	2.3*	2.24	1.89
Weighted index	2.8*	4.98	3.66
Hierarchical index	3.3*	2.36	1.89

* $p < 0.05$.

** $p < 0.01$.