Concurrent and predictive validity of the Substance Dependence Severity Scale (SDSS)

Gloria M. Miele *, Kenneth M. Carpenter, Melissa Smith Cockerham, Kristin Dietz Trautman, Jack Blaine, Deborah S. Hasin

Research Assessment Associates, Inc., 60 Haven Avenue, Suite 4D, New York, NY 10032, USA

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Abstract

This study investigated the concurrent and predictive validity of the Substance Dependence Severity Scale (SDSS), a clinician-administered interview designed to assess the severity and frequency of DSM-IV dependence symptoms for a range of substances. A total of 172 (107 males and 66 females) treated substance users participated in the study. Of those, 89% (n = 153) received at least one follow-up interview within 1–6 months of an initial assessment. For alcohol, cocaine and heroin, convergent and discriminant validity was supported by significant relationships between SDSS scores at baseline and other baseline measures of substance use consequences, such as the Addiction Severity Index (ASI), as well as significant relationships between SDSS change scores from baseline to follow-up and change scores of other measures of consequences. SDSS scores were significantly associated with time to first post treatment use of alcohol, cocaine and heroin, although the nature of the associations was complex. Scale applications and areas for further study are discussed. © 2000 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Substance Dependence Severity Scale; Assessment; Predictive validity

1. Introduction

As treatments for substance use disorders are developed, tested and refined, measures of treatment outcome that assess change in patient status are increasingly needed. While many outcome measures have been used in substance use disorder treatment research, no instrument assesses severity of substance disorders according to standard diagnostic criteria and also allows for the assessment of severity of a range of different substances. The Substance Dependence Severity Scale (SDSS) was designed for this purpose: to yield continuous ratings of severity of DSM-IV dependence across a range of substances (Miele et al., 2000).

The SDSS is a semi-structured, clinician-administered interview that assesses DSM-IV dependence and abuse and ICD-10 harmful use for alcohol, cocaine, heroin, cannabis, sedatives, stimulants, licit opiates, methadone, and ‘other’ drugs of abuse (e.g. inhalants). The SDSS is also unique in that it assesses two dimensions of symptom severity: (1) the frequency of symptoms; and (2) severity of symptoms (see Miele et al., 2000 for a complete description of the rationale for the scale and its development). For each symptom, the SDSS assesses total number of days a symptom occurred (DAYS), usual severity of the symptom (SEV) and worst severity of the symptom (WORST SEV) over a 30-day time frame. In contrast, other measures are limited because they assess only one substance (e.g. alcohol or opiates) or one dimension, such as how often a symptom occurred or how intense or severe a symptom was.

Test-retest, joint rating and internal consistency reliabilities of substance-specific SDSS scales were previously reported, as well as preliminary indicators of validity (Miele et al., 2000). The test-retest reliability of the SDSS in 175 treated substance users (112 male and 63 female) ranged from good to excellent for alcohol, cocaine, heroin and sedatives (intraclass correlation coefficients [ICC] = 0.75–0.88 for severity, 0.67–0.85

* Corresponding author. Tel./fax: + 1-212-781-1678.
for frequency). Results for cannabis were lower, ranging from fair to good (ICCs = 0.50–0.62). Results for joint rating and internal consistency reliability were comparable to test-retest findings.

In a prior report, the concurrent validity of the scale was also addressed by examining the relationship between SDSS scale scores and three validators: (1) independent clinical ratings assigned by a senior research associate; (2) frequency of alcohol and drug use; and (3) a measure of overall functioning (the Global Assessment Scale [GAS]; Endicott et al., 1976; Spitzer et al., 1978). The SDSS severity scores were highly and significantly correlated with clinical dependence severity ratings for alcohol, cocaine, heroin and cannabis (r’s ranging from 0.86 to 0.97). SDSS severity and frequency ratings were also significantly correlated with number of days of alcohol, cocaine, heroin and cannabis use, with frequency ranging from \( r = 0.54 – 0.82 \) and severity ranging from \( r = 0.39 – 0.53 \). As predicted, SDSS severity scores were moderately correlated with the GAS for alcohol, cocaine, and heroin (r’s ranging from \(-0.30 \) to \(-0.42\)), with higher severity scores related to lower functioning. Taken together, these results provided preliminary evidence that the SDSS is a valid measure of alcohol, cocaine and heroin dependence.

In the current paper the authors continue to investigate the concurrent and predictive validity of the SDSS. For concurrent validity, we compare SDSS scores to alcohol and drug composite scores from the Addiction Severity Index (ASI; McLellan et al, 1992) and substance-specific measures of consequences related to substance use adapted from the Drinker Inventory of Consequences (DrInC; Miller et al., 1995). We also examine how well the SDSS assesses change in severity over time by comparing change scores on the SDSS from baseline to follow-up with change scores on the ASI, DrInC and GAS. For predictive validity, we use survival models to see how well SDSS scores predict periods of substance use over a follow-up interval ranging from 1 to 6 months.

2. Methods

2.1. Sample

All participants were recent admissions to treatment at four different types of treatment settings: (1) an inpatient alcohol rehabilitation program; (2) an outpatient drug and alcohol program; (3) an inpatient dual diagnosis unit; and (4) two methadone maintenance programs. Two hundred individuals met the following eligibility criteria: admission to treatment within the past 90 days; 18–65 years of age; ability to understand English well enough to complete the scale; and substance use within the 2 weeks prior to screening. There were no significant differences in race (\( x^2_{(1)} = 1.9 \), NS), gender (\( x^2_{(1)} = 1.44 \); NS) or age (\( t_{(436)} = 1.32 \), NS) between those who were determined to be eligible and those who did not meet eligibility criteria.

2.2. Participants

A total of 180 individuals completed the baseline assessment (90% of those eligible at recruitment). Of those, 172 were eligible for follow-up. Eight subjects became ineligible for follow-up due to an administrative decision at one of our sites that withdrew permission to contact patients for follow-up. Of those eligible, 89% (\( n = 153 \)) had at least one follow-up interview. Since this paper addresses the concurrent and predictive validity of the SDSS, the data reported are based only on those subjects who completed the baseline interview and were also eligible for the follow-up component of the study. Of those eligible for follow-up, 62% were male; 60% were white of non-Hispanic origin, 27% were black and 13% Hispanic; 89% non-married, and about 24% had not completed high school. The mean age of all subjects was 35.4 years (S.D. = 8.47). Recruitment sites yielded the following sample sizes: inpatient alcohol rehabilitation (\( n = 55 \)), outpatient drug and alcohol (\( n = 21 \)); inpatient dual diagnosis (\( n = 27 \)); and methadone maintenance (\( n = 69 \)).

2.3. Procedures

2.3.1. Baseline

A site coordinator screened consecutive recent admissions to treatment for eligibility and explained the purpose and procedures of the study. If an eligible individual agreed to participate, the site coordinator obtained informed consent and scheduled the interviews. Subjects were paid US $25 for their participation. The main assessment battery consisted of demographic and lifetime substance use history questionnaires; the SDSS; the DrInC and/or substance-specific version(s) of the Inventory of Drug Use Consequences (InDUC, see below); the GAS; timelines reflecting substance use and treatment during the 30-day period prior to the interview; and the ASI (McLellan et al., 1992). Demographics, treatment timeline and lifetime substance use history were always administered prior to the SDSS. The 30-day consumption timeline was completed immediately after the SDSS. Other questionnaires were rotated for counterbalancing and administered after the consumption timeline. For the substance-specific scales, the interviewer asked the respondent to choose the two substances that he/she considered to be the focus of treatment or to be most problematic. The interviewer administered the substance-specific DrInC and/or InDUC for those two substances (see Miele et al., 2000...
for full description of interviewer qualifications and training). All questionnaires were administered verbally, in an interview format, so that the administration procedure was held constant. An independent interviewer administered the ASI 1–7 days after the main assessment battery was completed, in conjunction with the ‘retest’ SDSS interview for the reliability component of the study (see Miele et al., 2000). Ninety-six percent of the sample completed the ASI at retest. Given the variations in patterns of substance use and completion of different components of the assessment protocol, the full sample yielded differing (non-independent) sample sizes for different substances. At baseline, the following sample sizes were obtained for subjects who completed the SDSS and the ASI: alcohol ($n = 122$), cocaine ($n = 84$), heroin ($n = 68$), cannabis ($n = 61$); and for subjects who completed the SDSS and the DrInC: alcohol ($n = 101$), cocaine ($n = 78$), heroin ($n = 72$), cannabis ($n = 32$).

2.3.2. Follow-up

The study design allowed for two follow-up assessments: one at 1-month after the baseline interview and one at 3-months after the baseline interview. If we were unable to contact a subject at the scheduled time of follow-up, we continued to attempt contact for up to approximately 6 months after the baseline interview. Follow-up evaluations were conducted between 23 and 193 days after the baseline interview (mean = 93.89 days, S.D. = 35.1). Approximately 89% of those assessed at baseline completed one follow-up interview (68% were assessed twice).

Our follow-up analyses are based on the last interview completed during the 6-month follow-up period. This represents the only assessment for those who completed the SDSS and the ASI. The ASI comprises 7–30 items which include both objective data and subjective ratings by the client and interviewer. In each area clients provide an estimate of the seriousness of the problem and their need for treatment. In addition, the interviewer provides a severity rating for each area and time frame. For a dependence diagnosis with three mild (SDSS = ‘2’) symptoms, the SDSS yields a SEV score of ‘6’, while a dependence diagnosis with three extreme (SDSS = ‘5’) symptoms yields a SDSS SEV score of 15. The frequency variable is scored on an 8-point scale ranging from 0 (symptom did not occur) to 7 (symptom occurred every day of past 30). Total scores for the 11 dependence items range from 0 to 43 for Usual Severity (SEV), 0–35 for Worst Severity (WORST SEV), and 0–77 for Total Days (DAYS). Since cannabis does not have a withdrawal syndrome, fewer items are needed to assess cannabis dependence. Total scores for the eight dependence items for cannabis range from 0 to 34 for the SEV scale, 0–30 for the WORST SEV scale, and 0–56 for the DAYS scale. Frequency variables are not included in the diagnostic algorithms, since they are conditional on the presence of the symptom, which is coded in the severity score. Substance-specific scores are derived for each variable by summing the items for each substance used in the past 30 days. The validity of these sum scores is the focus of the current study.

2.4. Instruments

2.4.1. SDSS

The SDSS assesses the severity of DSM-IV substance dependence during the 30 days prior to the interview. The main component of the scale consists of substance-specific DSM-IV and ICD-10 symptom questions. Screening questions that assess frequency, recency and amount of use of each substance in the past 30 days provide a context for assessing the severity and frequency of DSM-IV and ICD-10 symptoms. Severity variables are scored on a 6-point scale ranging from 0 (absent) to 5 (extreme), with a score of ‘2’ indicating that the diagnostic criterion was met within the 30-day time frame. For a dependence diagnosis with three mild (SDSS = ‘2’) symptoms, the SDSS yields a SEV score of ‘6’, while a dependence diagnosis with three extreme (SDSS = ‘5’) symptoms yields a SDSS SEV score of 15. The frequency variable is scored on an 8-point scale ranging from 0 (symptom did not occur) to 7 (symptom occurred every day of past 30). Total scores for the 11 dependence items range from 0 to 43 for Usual Severity (SEV), 0–35 for Worst Severity (WORST SEV), and 0–77 for Total Days (DAYS). Since cannabis does not have a withdrawal syndrome, fewer items are needed to assess cannabis dependence. Total scores for the eight dependence items for cannabis range from 0 to 34 for the SEV scale, 0–30 for the WORST SEV scale, and 0–56 for the DAYS scale. Frequency variables are not included in the diagnostic algorithms, since they are conditional on the presence of the symptom, which is coded in the severity score. Substance-specific scores are derived for each variable by summing the items for each substance used in the past 30 days. The validity of these sum scores is the focus of the current study.

2.4.2. The ASI (McLellan et al., 1992)

The ASI is a semi-structured interview that assesses seven problem areas often affected by substance use: medical, employment, legal, alcohol, drug, family-social functioning, and psychological status. Each section comprises 7–30 items which include both objective data and subjective ratings by the client and interviewer. In each area clients provide an estimate of the seriousness of the problem and their need for treatment. In addition, the interviewer provides a severity rating for each
problem area by considering the objective data presented by the client and the need for treatment. Composite scores ranging from 0 to 1.0 represent a linear composite of items within each section, which can be used to assess change over time. ASI alcohol and drug composites were calculated by a computer program (Accurate Assessments, 1998) and were used to test the concurrent and predictive validity of the SDSS.

2.4.3. The DrInC (Miller et al., 1995)

The DrInC is a self-report questionnaire that provides a comprehensive sampling of possible alcohol problems. The instrument contains 50 questions that can cover two time frames: Lifetime or Recent (past 3 months) Consequences. The scale yields a total consequence score and five subscale scores: physical, intrapersonal, social responsibility, interpersonal and impulse control consequences. The DrInC demonstrated good to excellent internal consistency (alphas) and test-retest reliability (r’s) in a combined inpatient and outpatient sample of individuals seeking treatment for alcohol problems (Miller et al., 1995). For the current study, the DrInC was modified to an interviewer administered format and to cover a 30-day time frame. These modifications made the administration method and assessment time frame consistent with the other instruments used in this study. DrInC total scores in this sample had excellent internal consistency (alpha = 0.97) and were used to validate the SDSS alcohol scales.

Miller et al. (1995) also developed the InDUC to assess consequences of both alcohol and drug use. It differs from the DrInC only in the addition of ‘drug use’ to the wording of items. For this study, we modified each scale item of the InDUC to create versions of the scale that assess consequences specific to cocaine use (InDUC-COC) and heroin use (InDUC-HER) and another that could be used for any drug, in this case cannabis (InDUC-CAN). For example, InDUC item # 3 reads, “I have missed days of work or school because of my drinking or drug use” (italics added). The modified InDUC-COC item reads, “I have missed days of work or school because of my cocaine use” (italics added). We changed the instructions to reflect the focus on the drug of interest and an interviewer-administered format and modified the time frame assessed to the past 30 days. InDUC-COC, HER and CAN total scores all had good to excellent internal consistency reliability (alphas ranging from 0.95 to 0.96; Miele et al., 1998). Substance-specific InDUC scores were used as validators for the SDSS cocaine, heroin and cannabis scales.

2.4.4. GAS (Endicott et al., 1976; Spitzer et al., 1978)

The GAS is a highly reliable, widely-used scale that was the basis for the Global Assessment of Functioning, Axis V of DSM-III-R and DSM-IV. The GAS provides a clinical assessment of an individual’s overall functioning in social, occupational and psychological realms, with a score that can vary from 0 (lowest possible functioning) to 100 (highest possible functioning). The relationship between the GAS and the SDSS should be inverse and moderate, since higher levels of dependence should be related to lower levels of global functioning.

2.4.5. Consumption and treatment timelines

Daily use and treatment timelines were charted across the assessment period. Each day represented one unit of the timeline (hence a 30-day timeline grid had 30 units). Using a modification of the Timeline Follow-Back Method (Sobell and Sobell, 1992), level of consumption of all substances covered in the SDSS was charted on the consumption timeline. For alcohol consumption, timeline ratings ranged from 0 (no drinking) to 5 (10 or more drinks). For drug consumption, timeline ratings ranged from 0 (no drug use) to 4 (used 5 or more times per day). Days of inpatient and outpatient treatment were recorded on the treatment timeline, with treatment on a given day coded ‘1’ and no treatment coded ‘0’. The Baseline timeline recorded use and treatment for the 30 days prior to the assessment. The Follow-up timelines covered use and treatment from the day after the previous interview until the day of the follow-up. Interviewers used a calendar, noting weekends, holidays, beginnings or endings of treatment episodes, or other significant dates to assist subjects in recall. Consumption, abstinence and treatment data for survival analyses were generated from these timeline data.

2.5. Analyses

2.5.1. Concurrent validity of SDSS scale scores. Correlations with validators

To assess the convergent and discriminant validity of the SDSS, we examined the Pearson correlations between substance-specific SDSS scale scores and the following validators: ASI Alcohol composite, ASI Drug composite, DrInC, and substance-specific InDUC. To demonstrate convergent and discriminant validity, the SDSS alcohol scales should be significantly associated with the ASI alcohol composite but not with the ASI drug composite, and the SDSS cocaine, heroin and cannabis scales should be significantly associated with the ASI drug composite but not with the ASI alcohol composite. We investigated this hypothesis with hierarchical multiple regression analyses. This is a somewhat exacting test due to the propensity of substance abusers to use multiple substances. Age, gender, race and level of education were entered simultaneously as a first block to control for the possible effects of demographics. SDSS scores (DAYS, SEV, and WORST SEV)
were entered simultaneously in a second block as independent variables, and the concurrent validity scales were the dependent variables.

2.5.2. Concurrent validity of SDSS scale scores. Correlations of difference scores

We assessed the relationship between the magnitude of SDSS change scores and concurrent changes in the ASI alcohol and drug composite scores, the DrInC/InDUC and GAS scores. Similarities among the distributions of change scores for the different instruments would support the concurrent validity of the SDSS. That is, changes in the level of the dependence construct over time should be evidenced by changes in the different measures tapping a similar construct. We calculated Pearson correlations between substance-specific SDSS change scores and change scores of the other variables. Difference scores were derived by subtracting follow-up scores from baseline scores for each substance-specific measure: the SDSS scales, ASI alcohol and drug composites, DrInC and InDUC scales, and GAS.

2.5.3. Predictive validity of SDSS scale scores: survival analyses

The predictive validity of the SDSS scale scores was investigated in two sets of survival analyses for alcohol, cocaine, heroin, and cannabis. First, we tested the relationship between substance specific baseline SDSS scale scores and the time to the occurrence of first substance use. For example, baseline alcohol dependence scales were used to predict alcohol use. In these analyses time to use was represented in days, from the first day of no inpatient treatment (see below) to the day of first use. Second, we investigated the validity of the SDSS’s two-dimensional approach for assessing the level of DSM-IV dependence problems. The SDSS was designed to assess DSM-IV dependence along a severity dimension and a frequency (or duration) dimension. To accomplish this aim each substance specific model included a severity score, a duration score, and their interaction. We tested the interaction term to evaluate if a multiplicative severity and duration term conferred added predictive power above each of the two dimensions, when used separately.

Note that some participants were in an inpatient treatment facility during the baseline assessment and others entered an inpatient treatment facility or restricted environment during the follow-up period. We handled the influence of inpatient treatment status in two ways. First, the number of days until the event of interest (i.e. survival time) began at the first day of non-inpatient treatment participation. Thus, for those participants assessed in an outpatient treatment facility, survival time began at the end of the baseline SDSS interview. For those participants assessed in an inpatient treatment facility, survival time began the day of discharge. Participants who were enrolled in an inpatient program for the entire follow-up period were excluded from the analyses. Second, inpatient treatment entry during follow-up was entered in the survival analyses as a time dependent covariate (Allison, 1995), i.e. a variable whose value for any participant may differ over time. This adjusted for the effects of entering a substance restricted environment.

The extended Cox model (Kleinbaum, 1995) was used for the survival analyses. The proportional hazards model was not appropriate due to the inclusion of the time-dependent covariate (i.e. treatment entry) and the severity x duration interaction term. A three step entry procedure was used for each survival model. First, a block of demographic variables was entered to statistically control for their effects of demographics when testing the predictive validity of the SDSS scales. The demographic variables included the following time-independent variables: age at baseline interview, sex (0 = female, 1 = male), education (0 = < high school, 1 = high school), race (0 = non-white, 1 = white) and marital status (0 = married, 1 = single). Inpatient treatment entry was included in the demographic block as a time varying covariate. Second, the severity and duration (i.e. SEV and DAYS scales) scales were entered together. Third, the severity x duration interaction term was entered. The statistical significance for the SDSS scale block and their interaction was evaluated with the change in the − 2 log-likelihood statistic at each entry. The same analysis was conducted for the WORST SEV scale alone, since it is conceptually distinct from the DAYS and SEV scales. Demographics and inpatient status was entered in the first block; then WORST SEV was entered separately.

For all the analyses outlined above, it is important to note that subjects were assessed for multiple substances, so each substance group is not an independent group of substance users. However, separate validity analyses for each scale was warranted since the SDSS was developed to assess DSM-IV dependence severity across a range of substances.

3. Results

3.1. Concurrent validity

3.1.1. Correlations with validators

As shown in Table 1, the SDSS alcohol scales were significantly correlated with the ASI alcohol composite, but not significantly correlated with the ASI drug composite. These results support the convergent and discriminant validity, respectively, of the SDSS alcohol scales. The same pattern of results was found for the SDSS cocaine and heroin scales, which were signi-
Table 1
Pearson correlation coefficients between SDSS and validators: ASI composites and substance-specific DrInC scales

<table>
<thead>
<tr>
<th></th>
<th>ASI alcohol (122)</th>
<th></th>
<th></th>
<th>ASI drug (122)</th>
<th></th>
<th></th>
<th>DrInC/IndUC (101)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAYS</td>
<td>SEV</td>
<td>WORST SEV</td>
<td>DAYS</td>
<td>SEV</td>
<td>WORST SEV</td>
<td>DAYS</td>
<td>SEV</td>
<td>WORST SEV</td>
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<td>Alcohol</td>
<td></td>
<td></td>
<td></td>
<td>(84)</td>
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<td>0.19</td>
<td>(68)</td>
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<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(n)</td>
<td></td>
<td></td>
<td>(61)</td>
<td>0.19</td>
<td>0.19</td>
<td>(61)</td>
<td>0.12</td>
<td>0.02</td>
</tr>
<tr>
<td>ASI alcohol</td>
<td>0.82**</td>
<td>0.82**</td>
<td>0.82**</td>
<td>-0.08</td>
<td>-0.21</td>
<td>-0.19</td>
<td>0.08**</td>
<td>0.68**</td>
<td>0.60**</td>
</tr>
<tr>
<td>ASI drug</td>
<td>-0.08</td>
<td>-0.21</td>
<td>-0.19</td>
<td>0.47**</td>
<td>0.33**</td>
<td>0.31**</td>
<td>0.65**</td>
<td>0.47**</td>
<td>0.44**</td>
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<tr>
<td>DrInC/IndUC</td>
<td>0.80**</td>
<td>0.85**</td>
<td>0.86**</td>
<td>(78)</td>
<td>0.60**</td>
<td>0.69**</td>
<td>0.70**</td>
<td>0.60**</td>
<td>0.93**</td>
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<tr>
<td>Cannabis</td>
<td></td>
<td></td>
<td></td>
<td>(78)</td>
<td>0.60**</td>
<td>0.69**</td>
<td>(72)</td>
<td>0.60**</td>
<td>0.93**</td>
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<tr>
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<td>(61)</td>
<td>0.12</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* SDSS, Substance Dependence Severity Scale; ASI, Addiction Severity Index; DrInC, Drinker Inventory of Consequences; IndUC, Inventory of Drug Use Consequences; DAYS, Total Days; SEV, Usual Severity; WORST SEV, Worst Severity.
** P<0.01.
significantly correlated with the ASI drug composite but not the ASI alcohol composite. Further support for the convergent validity of the SDSS alcohol, cocaine and heroin scales was evident in significant correlations with the DrInC, InDUC-COC and InDUC-HER, respectively. SDSS cannabis scales were not significantly correlated with the ASI alcohol or drug composites, but all SDSS cannabis measures were significantly correlated with the InDUC-CAN.

Results of the regression analyses that examined how SDSS alcohol scales predict ASI alcohol composites when controlling for demographics demonstrated a significant relationship between the SDSS alcohol block and the ASI alcohol composite ($R^2 = 0.71; F(3,114) = 109.91; P = 0.0001$), as well as the SDSS alcohol block and the DrInC ($R^2 = 0.77; F(3,93) = 116.43; P = 0.000$).

Evaluation of individual SDSS alcohol scales indicate a significant relationship between SDSS alcohol T scale (i.e. total number of days) and the ASI alcohol composite ($b = 0.49, P = 0.0001$) and SDSS alcohol T scale and the DrInC ($b = 0.28, P = 0.001$). The SDSS block for alcohol was non-significant ($R^2 = 0.04; F(3,114) = 1.88; P = 0.14$) in predicting the ASI drug composite.

The SDSS cocaine block and the SDSS heroin block each predicted the ASI drug composite (cocaine $R^2 = 0.22; F(3,77) = 7.42; P = 0.0001$; heroin $R^2 = 0.38; F(3,61) = 13.99; P = 0.0001$). Similar to the results for the individual SDSS alcohol scales, the SDSS cocaine T scale and the SDSS heroin T scale each had a significant relationship to the ASI drug composite (cocaine T: $b = 0.46, P = 0.0001$; heroin T: $b = 0.65, P = 0.0001$). Neither SDSS cocaine scales ($R^2 = 0.06; F(3,77) = 1.63; P = 0.19$) nor heroin scales ($R^2 = 0.005; F(3,61) = 0.10; P = 0.96$) scales predicted ASI alcohol composites. The SDSS cocaine block predicted total InDUC-COC scores ($R^2 = 0.58; F(3,77) = 35.93; P = 0.0001$), and the SDSS heroin block predicted total InDUC-HER scales ($R^2 = 0.62; F(3,64) = 46.15; P = 0.0001$). Post hoc analyses of the individual scales indicated that the cocaine T scale significantly predicted InDUC-COC scores ($b = 0.39, P = 0.001$), but no one SDSS variable was significantly related to InDUC-HER scores. SDSS cannabis scales did not predict ASI alcohol or drug composites, but did predict total InDUC-CAN scores ($R^2 = 0.64; F(3,50) = 10.60; P = 0.004$). No one SDSS variable was significantly related to InDUC-CAN scores.

### 3.1.2. Correlations of change scores

Table 2 presents means, standard deviations and ranges of SDSS scores at baseline and follow-up. SDSS scores decreased consistently and substantially over time for alcohol, cocaine and heroin. Cannabis scores also decreased, but not at the same magnitude. These results provide a global picture suggesting that the SDSS is measuring changes in dependence severity across administrations that correspond with course of treatment.

To further examine changes in SDSS scores, correlations were calculated among the difference scores of the SDSS scales and validators for alcohol, cocaine, heroin, and cannabis (see Table 3). Generally, significant relationships were demonstrated between changes in all SDSS scales and change scores for the ASI, DrInC or

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### Table 2

<table>
<thead>
<tr>
<th>Substance</th>
<th>Total days (DAYS)</th>
<th>Usual severity (SEV)</th>
<th>Worst severity (WORST SEV)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Follow-up</td>
<td>Baseline</td>
</tr>
<tr>
<td>Alcohol (n = 107)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>14.43</td>
<td>4.15</td>
<td>15.15</td>
</tr>
<tr>
<td>S.D.</td>
<td>12.61</td>
<td>9.87</td>
<td>11.01</td>
</tr>
<tr>
<td>Range</td>
<td>0–49</td>
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<tr>
<td>Cocaine (n = 78)</td>
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<tr>
<td>M</td>
<td>18.03</td>
<td>4.24</td>
<td>20.35</td>
</tr>
<tr>
<td>S.D.</td>
<td>12.42</td>
<td>9.24</td>
<td>9.30</td>
</tr>
<tr>
<td>Range</td>
<td>1–56</td>
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<td>Heroin (n = 67)</td>
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<tr>
<td>M</td>
<td>25.88</td>
<td>7.60</td>
<td>19.13</td>
</tr>
<tr>
<td>S.D.</td>
<td>15.38</td>
<td>11.48</td>
<td>8.57</td>
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<tr>
<td>Range</td>
<td>2–66</td>
<td>0–56</td>
<td>3–34</td>
</tr>
<tr>
<td>Cannabis (n = 34)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.D.</td>
<td>6.52</td>
<td>1.89</td>
<td>5.05</td>
</tr>
<tr>
<td>Range</td>
<td>8–37</td>
<td>6–14</td>
<td>8–27</td>
</tr>
</tbody>
</table>

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*SDSS, Substance Dependence Severity Scale; M, mean; S.D., standard deviation.*
Table 3
Pearson correlation coefficients between difference scores: SDSS, ASI composites, DrInC/InDUC and GAS\textsuperscript{a}

<table>
<thead>
<tr>
<th></th>
<th>Alcohol</th>
<th>Cocaine</th>
<th>Heroin</th>
<th>Cannabis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAYS SEV WORST SEV</td>
<td>DAYS SEV WORST SEV</td>
<td>DAYS SEV WORST SEV</td>
<td>DAYS SEV WORST SEV</td>
</tr>
<tr>
<td>ASI alcohol</td>
<td>(75) 0.78** 0.80** 0.80**</td>
<td>(58) 0.39** 0.42** 0.44**</td>
<td>(57) -0.08 0.27* 0.27*</td>
<td>(25) 0.10 0.05 0.02</td>
</tr>
<tr>
<td>ASI drug</td>
<td>(75) 0.30** 0.17 0.20</td>
<td>(58) 0.59** 0.54** 0.58**</td>
<td>(57) 0.54** 0.42** 0.40</td>
<td>(25) 0.41 0.18 0.07</td>
</tr>
<tr>
<td>DrInC/InDUC</td>
<td>(94) 0.80** 0.79** 0.79**</td>
<td>(71) 0.66** 0.75** 0.75**</td>
<td>(65) 0.60** 0.79** 0.80**</td>
<td>(28) 0.31 0.56** 0.56**</td>
</tr>
<tr>
<td>GAS</td>
<td>(107) -0.41** -0.54** -0.53**</td>
<td>(78) -0.46** -0.54** -0.57**</td>
<td>(67) -0.34** -0.44** -0.45**</td>
<td>(34) -0.06 -0.02 0.00</td>
</tr>
</tbody>
</table>

\textsuperscript{a} SDSS, Substance Dependence Severity Scale; ASI, Addiction Severity Index; DrInC, Drinker Inventory of Consequences; InDUC, Inventory of Drug Use Consequences; GAS, Global Assessment Scale; DAYS, Total Days; SEV, Usual Severity; WORST SEV, Worst Severity.

* \( P < 0.05 \)
* * \( P < 0.01 \).
InDUC and GAS for the substances of alcohol, cocaine, and heroin. Shared variance estimates between the SDSS change scores and change scores on other measures ranged from 10 to 64%. Negative correlations were expected for the GAS, since improvement over time is reflected by an increase in GAS scores while improvement on the SDSS is represented by a decrease in SDSS scores. There were several patterns worth noting. First, for all substances, changes in SDSS scales were more strongly associated with changes in the DrInC/InDUC scores. Second, the associations between changes in the SDSS scales and ASI composite scores were in the theoretically consistent direction. That is, changes in the SDSS alcohol scales were associated with greater changes in the ASI alcohol composite score relative to changes in the ASI drug composite. The reverse pattern was demonstrated for heroin and cocaine. Third, few significant associations were demonstrated between changes in SDSS cannabis scales and the other measures.

3.2. Predictive validity

3.2.1. Survival analyses

Results of the two sets of survival analyses indicated a pattern of results that was similar for alcohol and heroin and somewhat different for cocaine (see Table 4). For time until first use, the inclusion of both the SEV and DAYS scales significantly improved the survival models for alcohol ($\Delta - 2$ log-likelihood = 8.36 df = 2, $P < 0.05$) and heroin ($\Delta - 2$ log-likelihood = 7.79 df = 2, $P < 0.05$). The independent evaluation of each scale indicated different associations between time to first use and the measures of severity (SEV) and frequency/duration (DAYS). For both alcohol and heroin the usual severity scale (SEV) conferred a protective effect (i.e. negative association), i.e. the severity of dependence at baseline predicted a longer time until substance use. The frequency/duration of the dependence symptoms as assessed at baseline (DAYS scale) was associated with a decrease in time until first substance use.

For cocaine, the SEV and SEV scale interaction significantly contributed to the model ($\Delta - 2$ log-likelihood = 4.19, df = 1, $P < 0.05$). However the independent effects alone did not ($\Delta - 2$ log-likelihood = 0.49, df = 2, $P > 0.25$). For cocaine, the evaluation of the individual variables indicated that the multiplicative effect of severity and frequency was an important component in the model predicting time until first cocaine use. The individual coefficients are presented in Table 4. No significant relationships were demonstrated between the cannabis dependence SEV and DAYS scales and time to first cannabis use ($\Delta - 2$ log-likelihood = 2.64, df = 2, $P > 0.05$). Analyses of the WORST SEV scale did not reveal significant predictive relationships for either outcome variable across all substances.

4. Discussion

The results of this study confirm the preliminary concurrent validity results obtained in our first report on the reliability and validity of the SDSS (Miele et al., 2000). In these current analyses, we found that the SDSS alcohol, cocaine and heroin scales were significantly related to a series of different validators. Both the convergent and discriminant validity of the SDSS were demonstrated in the differential relationships between substance-specific SDSS scores and ASI alcohol and drug composites. SDSS alcohol scales were significantly related to the ASI alcohol composite but not the ASI drug composite, while the SDSS cocaine and heroin scales were significantly related to the ASI drug composite but not the ASI alcohol composite. All SDSS scales were also significantly related to substance-specific measures of consequences related to the use of that particular substance. Examining the individual SDSS scales, regression analyses indicated that the SDSS assessment of total days of symptoms was most predictive of consequences and problems related to substance use, as assessed by the ASI and DrInC. The ASI and DrInC are coded based on frequency of problems or consequences; therefore, we could expect
that the SDSS DAYS scale would have the strongest relationship with these variables.

A closer look at the magnitude of effect of these relationships also speaks to the validity and utility of the SDSS. Recall that one of the unique and important features of the SDSS is its ability to derive substance-specific indicators of dependence severity. Our results indicate stronger relationships between the SDSS and substance-specific validators than more general indicators of severity. For example, while all relationships were statistically significant, the relationship between the SDSS alcohol scales and ASI composite was stronger \((r' = 0.83)\) that those between the ASI drug composite and the SDSS cocaine scales \((r' \text{ ranging from } 0.43 \text{ to } 0.43)\) or SDSS heroin scales \((r' \text{ ranging from } 0.45 \text{ to } 0.61)\). The ASI alcohol composite is a specific indicator of problems with alcohol, whereas the ASI drug composite is a global indicator of problems with drugs. In comparison, the SDSS cocaine and heroin scales demonstrated stronger relationships with the substance-specific versions of the drug use consequence scales.

There were also significant relationships between changes in SDSS scores from baseline to follow-up and changes in validators over the same time period. For alcohol, cocaine and heroin, there were moderate to strong significant relationships between SDSS scores and validators. Again, substance-specific measures had a greater magnitude of effect than more global measures of severity, including the GAS. The general pattern of convergent and discriminant validity was replicated with some exceptions. For alcohol, the ASI drug composite was significantly related to the SDSS alcohol scale total number of days, while the ASI alcohol composite was significantly related to the SDSS cocaine scales \((r' \text{ ranging from } 0.43 \text{ to } 0.43)\) or SDSS heroin scales \((r' \text{ ranging from } 0.45 \text{ to } 0.61)\). The ASI alcohol composite is a specific indicator of problems with alcohol, whereas the ASI drug composite is a global indicator of problems with drugs. In comparison, the SDSS cocaine and heroin scales demonstrated stronger relationships with the substance-specific versions of the drug use consequence scales.

The results of the survival analyses supported both the predictive validity of the SDSS’s usual severity scale scores and the two-dimensional assessment of DSM-IV dependence for the substances of alcohol, heroin, and cocaine. For alcohol and heroin, the total number of days the dependence symptoms were present (DAYS) predicted a shorter period of time until using each substance. This was in the theoretically predicted direction with relatively more chronic dependence resulting in shorter periods of non-substance use. In contrast, the usual severity of alcohol and heroin dependence symptoms (SEV) predicted a longer period of time until alcohol and heroin use, respectively. Although, this finding was not in the expected direction, it suggests different effects of symptom severity and duration on future substance use among treated drug and alcohol users. For example, the severity variable represents the negative or ‘punishing’ aspects of substance use, such as withdrawal symptoms, loss of control, and other psychological or physical consequences. Upon treatment entry, report of these experiences may confer a protective effect in enabling abstinence. For cocaine, neither main effect was significant but the interaction between the total days of symptoms and the usual symptom severity predicted a shorter period of time until cocaine use.

These results also highlight the importance of scaling issues when conceptualizing and assessing the dependence construct. Specifically, the independent additive effects of severity and duration were important in predicting survival time for alcohol and heroin. However, the multiplicative relationship between the two dimensions did not increase the predictive power. Among cocaine users, the multiplicative relationship between severity and duration was more predictive of substance use than either dimension alone. These findings, in conjunction with the different effects demonstrated for dependence severity (i.e. protective) and dependence symptom duration (i.e. risk effect) among alcohol and
heroin users, support the SDSS’s two-dimensional approach for assessing DSM-IV dependence. Future studies assessing the theoretical implications of the relationships between severity and duration dimensions and drug and alcohol use outcomes would be an important addition to the literature. In the context of the present study these results indicate that SDSS provides one means to address these important issues. For cannabis the null findings were not surprising. A majority of the participants did not view cannabis use as a problem and thus were not in treatment for cannabis dependence nor abstained from using.

Across all substances, the results of survival analyses did not support the predictive validity of the worst severity scale (WORST SEV) for predicting time to first substance use. The null findings for the worst severity scale could be attributable to the unique nature of this variable. Worst severity usually reflected binge use or other clinically significant but less frequent variations in dependence symptoms. Therefore, this variable did not predict outcome.

In this study, we report the validity of the SDSS scales for alcohol, cocaine, heroin and cannabis. While we previously reported excellent reliability for SDSS measures of sedative dependence (ICCs ranging from 0.76 to 0.83), there were too few sedative users in this sample to adequately test the validity of the SDSS sedative scales. The validity of the SDSS for sedatives, as well as stimulants, licit opiates, methadone, hallucinogens, needs to be demonstrated in future studies. However, alcohol, cocaine and heroin are the drugs that are most frequently the focus of treatment. Therefore, investigators could utilize the SDSS as an outcome measure in these samples.

Taken together, the reliability and validity results of the individual SDSS scales have implications for the content and use of the scale itself. The reliability and concurrent validity results were comparable for DAYS, SEV and WORST SEV scales. However, as described above, the predictive validity results indicate that DAYS and SEV are stronger indicators of follow-up within a 1–6 month time frame. Given these results, we will retain DAYS and SEV as the main indicators of severity in the SDSS. However, we believe that the WORST SEV scale is clinically useful and may assist in determining risk factors for relapse, e.g., times when symptoms are at their worst could reveal something about triggers, patterns, etc. As a result, we have reformatted the SDSS so that the clinician can use the WORST SEV scale as an option to collect additional information about worst severity. This will shorten the scale yet still give clinicians and researchers the option to collect these data.

The SDSS offers clinical researchers unique advantages as a measure of treatment outcome that may be more sensitive to changes in clinical status than outcome measures routinely used, such as self-reported substance use, urinalysis results or diagnostic status. For example, an individual meets criteria for heroin dependence at treatment entry. Over the course of treatment, he cuts down substantially on heroin use and experiences less severe symptoms of dependence. Using conventional outcome measures, this individual still reports heroin use, has positive urine screens and continues to meet criteria for heroin dependence. If one were to judge outcome by these three factors, treatment has not been effective. However, the SDSS would reflect improvements in the dependence syndrome, such as changes in individual symptom severity, changes in frequency of symptoms or both. As a result, the SDSS would reflect the treatment’s effectiveness in these areas. Another application of the SDSS is in clinical trials of pharmacotherapies designed to target a specific substance, e.g., a specific drug to treat cocaine use. Since the SDSS is substance-specific, it could enable researchers to evaluate the drug’s relative effects on cocaine use and dependence compared to alcohol or heroin dependence, if these diagnoses were also present. Investigators may also appreciate that the SDSS is a clinician-administered scale based on diagnostic criteria and not exclusively on patient’s self report of substance use. Therefore, the information obtained is less influenced by subjects’ minimization that is often a concern with self-reported substance use. While level of substance use is an important component of the assessment, the SDSS enables the clinician to go beyond self-report in assessing with the patient symptom areas that can be evaluated more objectively.

In summary, the concurrent and predictive validity results of the SDSS supports its use for assessing severity of DSM-IV alcohol, cocaine, and heroin dependence. Clinical researchers could benefit from using the SDSS in clinical studies to assess treatment outcome. Further demonstrations of the SDSS’s sensitivity to change over longer assessment intervals will be useful in supporting these results.

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