Comparison of the Concurrent and Predictive Validity of Three Measures of Readiness to Change Marijuana Use in a Clinical Sample of Adolescents*

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ABSTRACT. Objective: The measurement of readiness to change has become common practice in alcohol and drug treatment of both adults and adolescents. Nevertheless, there is relatively little research on the validity of measures of readiness to change among treated adolescents. The purpose of this study was to compare three measures of readiness to change marijuana use commonly used in clinical research and practice with adolescents: the Readiness Ruler, the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES; Factors 1 and 2, Recognition and Taking Steps, respectively), and a staging algorithm. **Method:** The participants were 174 adolescents presenting for intensive outpatient alcohol and drug treatment who reported current marijuana use at the initial assessment. Evidence for concurrent validity was assessed by computing simple correlations among readiness measures, and correlations of each readiness measure with marijuana involvement (percentage of days abstinent in the last 30 days, problem severity score, and marijuana abuse and dependence symptom count [based on *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,* criteria]) at both the initial/baseline assessment and at a 6-month follow-up assessment. Evidence for predictive validity was based on the results of multilevel regression models of the readiness measures in predicting frequency of marijuana use, symptoms, and problems at 6 months from the initial readiness assessment and then in predicting marijuana use, symptoms, and problems at 12 months from the readiness assessment at 6 months. **Results:** The results showed evidence for good concurrent and predictive validity for the ruler, the staging algorithm, and Taking Steps but poor evidence for the validity of Recognition. The ruler emerged as the measure with the most clinical utility when brevity and ease of administration are taken into account. **Conclusions:** Research and clinical implications of the findings are discussed. (*J. Stud. Alcohol Drugs, 72,* 592–601, 2011)

AMONG ADOLESCENTS IN THE UNITED STATES, marijuana is by far the illicit drug used most often (Substance Abuse and Mental Health Services Administration, 2009). Moreover, marijuana often is the most preferred drug among adolescents who present for specialty alcohol and other drug treatment in the United States (Hawke and Kaminer, 2009). Unfortunately, adolescents who present for alcohol or other drug treatment typically show little "intrinsic" motivation to change their substance use patterns because they often present to treatment because of external pressure from school, family, or the legal system (Breda and Heflinger, 2004). Therefore, increasing motivation to change substance use often is a primary problem for clinicians working with adolescents; accordingly, having an empirically supported way to measure readiness to change marijuana use that has clinical utility is a high priority. Such a measure would assist in planning the timing, structure, and content of interventions. Therefore, like the literature with adults, Prochaska and colleagues' work on stages of and readiness to change addictive behavior (Prochaska, 1979; Prochaska and DiClemente, 1982) has been influential in work with adolescents (Bukstein, 1995; Hawke and Kaminer, 2009; Monti et al., 2001; Williams et al., 2007).

Despite the need for a reliable and valid way to measure motivation to change (often used interchangeably with "readiness to change" or "stage of change") marijuana use in clinical populations, there is virtually no published research on the problem. This is not to say that measures of readiness to change marijuana use are not used in clinical and research settings. Three of the more commonly used measures in this regard are the Readiness Ruler, staging (stage of change) algorithm, and the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES). The Readiness Ruler (Miller, 1985, 1999) represents a 1–10 continuum of "readiness to change," with the anchor points *not ready to change* to *unsure* to *ready to change* to *trying to change.* A similar measure, the Marijuana Ladder, consists of a diagram of a ladder with 10 "rungs," several of which are anchored by verbal labels of different degrees of readiness to change. Slavet et al. (2006) found concurrent and predictive evidence at 3-month follow-up for the validity of the Marijuana Ladder in adjudicated adolescents in alcohol and other drug treatment. No comparable published data for readiness to change

Received: November 2, 2010. Revision: April 14, 2011.

*This research was supported by National Institute on Alcohol Abuse and Alcoholism Grants R01 AA14357, R21 AA17128, K02 AA18195, and K05 AA16928.

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marijuana use among adolescents in substance use treatment were identified in the literature on the Readiness Ruler.

Another type of measure of readiness to change substance use that has been commonly used is the staging algorithm, which involves classifying an individual into one of five stages of change: precontemplation, contemplation, preparation, action, or maintenance (Carey et al., 1999; Prochaska et al., 1992). One study showed that youth in the precontemplation stage were more likely than youth in other stages to drop out of residential alcohol and other drug treatment (Callaghan et al., 2005). However, we are not aware of any studies that examined stage of change as a predictor of adolescent marijuana use outcomes.

Miller and Tonigan (1996) reported on the development of the 19-item SOCRATES, a measure of readiness to change alcohol use, in an adult clinical sample. Each of the 19 items is rated on a 5-point Likert-type scale, and the items were shown to load on three factors: Ambivalence, Recognition, and Taking Steps. Maisto et al. (2003) evaluated the 19-item SOCRATES for use with an adolescent clinical sample. The SOCRATES for alcohol was found to have a two-factor structure (Problem Recognition and Taking Steps) in the adolescent clinical samples tested, and both factors showed good internal consistency and construct validity (Maisto et al., 2003). Items that load on the Problem Recognition factor reflect awareness that the individual's alcohol use has caused or is causing problems for him or her in multiple domains, as the factor's label suggests. Similarly, as Taking Steps suggests, that factor includes items that reflect that the individual is preparing to take concrete action to change his or her alcohol use or already has begun to do so. We are not aware of any published data on the psychometric properties of the SOCRATES as a measure of readiness to change marijuana use in a clinical sample of adolescents.

The purpose of this study was to compare the concurrent and predictive evidence for the validity of the Readiness Ruler, the staging algorithm, and the two factors of the SOCRATES in a clinical sample of adolescents. Data were collected as part of a project concerned with relapse and remission among adolescents presenting for outpatient treatment of alcohol and other drug use disorders. In this longitudinal observational study, adolescents were assessed immediately before their first treatment session and provided follow-up data on marijuana, alcohol, and other drug use and related functioning at multiple time points up to 2 years after treatment initiation. Data presented in this study were collected at the initial (before the first treatment session), baseline, 6-month, and 12-month assessments.

It was expected that the marijuana readiness-to-change measures would be moderately and positively correlated with each other, given the hypothesis that they are measuring the same construct. In addition, we predicted a moderate correlation between each readiness measure and concurrent percentage of days abstinent (PDA) from marijuana (positive relationship), marijuana-related negative consequences (negative relationship), and number of *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV; American Psychiatric Association, 1994), marijuana abuse and dependence symptoms (negative relationship). In this regard, there is empirical evidence that measures of readiness to change tend to be inversely related to measures of frequency of drug use (Napper et al., 2008). For tests of predictive validity, the direction of the relationships expected was the same as that described for the counterpart concurrent validity analyses.

For prediction of 12-month data, the direction of the predictive validity associations was expected to be the same as for the initial to 6-month predictions, but the magnitude of variance accounted for was expected to be greater. In this regard, we expected that the treatment experiences for each teen between the initial and 6-month assessments would tend to result in finer discriminations among their perceptions of readiness to change their marijuana use.

Method

Sample characteristics

Adolescents ages 14–18 were recruited before attendance at the first treatment session from seven community-based treatment sites offering group-based intensive outpatient (IOP) treatment for adolescent substance users. All sites were located within the greater Pittsburgh, PA, area. Six of the seven sites were run by a not-for-profit multisite rehabilitation center. The seventh site was an adolescent dual diagnosis clinic. Among the 184 participants eligible to complete 1-year follow-up, analyses were restricted to the individuals who reported that they use marijuana (N = 174) at the initial assessment. Marijuana users (included in analyses) and nonusers (excluded from these analyses) did not differ on demographic variables (i.e., sex, race, age).

A majority (65.5%) of the 174 adolescents were male, 86.2% were White, 8.0% were African American, and 5.7% were of other ethnicities (e.g., biracial). The sample had a mean age of 16.67 years (SD = 1.20, range: 14.20–18.97) and represented a range in socioeconomic status (Hollingshead, 1975) (M = 2.47, SD = 1.08, range: 1–5; the mean reflects a level between lower middle and middle class). Slightly more than one third (37.4%) were recruited from the dual diagnosis clinic, and 62.6% were recruited from not-for-profit sites. Participants reported at baseline that they were abstinent from marijuana 56.97% of the days in the last month (SD = 43.12%).

Marijuana was reported as the most frequently used drug for 66.5% of the participants, 10.4% reported that alcohol was their "primary" drug, and 3.0% said that both were their primary drugs. Among the remaining participants, the drug class that most often was rated primary was opiates (9.1%).

At baseline, the majority met criteria for a current (past 6 months) DSM-IV marijuana diagnosis (96.5%: 58.6% marijuana abuse, 37.9% dependence). Almost half (48.3%) of the sample met criteria for a current DSM-IV alcohol diagnosis (40.8% abuse, 7.5% dependence) at baseline.

The majority (85.6%) of the participants (n = 149) completed the 6-month follow-up, and 148 (85.1%) completed the 12-month assessment. At 6 months, there were no statistically significant differences between completers and noncompleters on race, sex, age, socioeconomic status, baseline PDA from marijuana in the last 30 days, or marijuana-problem severity score. The 12-month follow-up completers and noncompleters differed in marijuana-problem severity score, with noncompleters reporting greater marijuana problem severity at baseline ($p < .01$) and more marijuana abuse and dependence symptoms at baseline ($p < .05$) relative to completers.

Study recruitment and assessment procedures

On admission to IOP treatment, all adolescents were told about an ongoing research project. Staff at recruitment sites approached adolescents based on the following criteria: age 14–18, admitted to IOP treatment but had not yet attended the first treatment session, not in Children and Youth Services or foster care system, and expressed interest in hearing about a research study. Adolescents who expressed interest in voluntary research participation (n = 519) and who were screened as meeting preliminary eligibility criteria (n = 367, or 70.7%) were then introduced to research staff, who provided a description of study procedures. Among the adolescents approached for study participation, 67% (n = 248) provided informed assent (youth ages 14–17) for study participation and consent from the minor adolescent's parent or informed consent (youth age 18) for study participation. A total of 88 of the 119 (74%) who did not participate declined to consent, and 31 potential participants were excluded for reasons such as having no parent available. It is not possible to compare demographic characteristics of those who declined participation with those who provided consent. Among adolescents who provided consent for participation at the initial assessment, 74% (n = 184) completed the baseline assessment. Among the 64 individuals who did not complete the baseline assessment, 38 were no longer interested in participating in the study, and 26 could not be scheduled after multiple attempts to do so. There were no differences by sex, age, or race between those who did versus those who did not complete the baseline assessment.

The initial assessment (15–20 minutes long) occurred after the completion of consent procedures and before the first IOP session. The initial assessment included several measures of readiness to change. The baseline assessment (2.0–2.5 hours) was usually completed within 2 weeks of starting IOP treatment (M = 18.30 days, SD = 14.80) and included the adolescent's lifetime history of substance involvement, psychiatric conditions, and readiness to change substance use. Because of logistical problems, it was not possible to conduct the baseline assessment before the first IOP treatment session. Thus, we collected readiness measures before the first treatment session and the more comprehensive baseline assessment soon after the start of IOP treatment. Note that the initial assessment of readiness to change rather than the baseline readiness measures was used in the main analyses reported in this article because the baseline measures were confounded by the participants' initiation of treatment. The 6-month and 12-month follow-ups, which each took 1.5 hours to complete, collected data on the same domains covered at baseline. In addition, adolescents completed monthly phone follow-ups (about 15–20 minutes) between baseline and 6-month follow-up and between the 6-month and 12-month follow-ups. The monthly phone follow-ups collected data on substance use and treatment use in the past month. Participants were compensated for their time. The university's institutional review board approved the study protocol.

Treatment program characteristics

Each IOP treatment program from which adolescents were recruited to the study adhered to a goal of abstinence from alcohol, marijuana, and other substances and recommended participation in 6–8 weeks of IOP treatment. Each site ran one rolling-admissions adolescent IOP treatment group, which met three times per week for 3 hours per session.

Measures

DSM-IV substance use disorder diagnoses and symptoms. An adapted version of the Structured Clinical Interview for the DSM-IV (SCID) substance use disorders (First et al., 2002; Martin et al., 1995, 2000) was used at baseline and at 6 months and 12 months to determine the presence of substance use disorder diagnoses and symptom counts. SCID adaptations accommodate developmental considerations in symptom assessment with adolescents. The maximum number of marijuana symptoms is 10 (4 abuse and 6 dependence symptoms). The adapted SCID has fair to high retest reliability for DSM-IV alcohol abuse (κ = .64) and dependence (κ = .69), cannabis abuse (κ = .45) and dependence (κ = .87), and nicotine dependence (κ = .66; Chung et al., 2004). Retest intraclass correlations (ICCs) for total symptom count were high ($ICC_{alcohol}$ = .91; $ICC_{cannabis}$ = .95; $ICC_{nicotine}$ = .89; Chung et al., 2004).

Readiness ruler (Miller, 1999). The marijuana ruler is a questionnaire that uses a 10-point scale, where 1 = *not ready to change,* 4 = *unsure,* 6–7 = *ready to change,* and 10 = *trying hard to change.* If the adolescent marked "I don't

use this drug" for the marijuana ruler item at the initial assessment, the adolescent was excluded from the analyses.

Staging algorithm. This study's staging algorithm was developed by Belding et al. (1996) and consisted of four interview questions: "Have you used marijuana in the past 30 days?" "Have you used marijuana in the past 6 months?" "In the next 6 months, do you intend to cut down on your level of marijuana use or to stop?" and "In the next 30 days, do you intend to cut down on your marijuana use or to stop?" Following Belding et al., youth were in precontemplation if they reported use in the last 30 days with no intention to reduce or to stop use in the next 6 months. Contemplation represented those who reported use in the last 30 days and intention to reduce or stop use in the next 6 months but not in the next 30 days. Preparation included youth who used in the last 30 days but who intended to reduce or discontinue use in the next 30 days. Action represented those who reported no use in the last 30 days but use in the last 6 months. Maintenance included those who reported no use in the last 6 months. The algorithm created a scale that classified individuals into one of five stages of increasing readiness to change (i.e., 1 = *precontemplation,* 2 = *contemplation,* 3 = *preparation,* 4 = *action,* 5 = *maintenance*).

SOCRATES. Maisto et al.'s (2003, in press) evaluation of the SOCRATES for alcohol showed that 14 items loaded on two factors, "Amrec" (a merging of "Ambivalence" and "Recognition") and "Taking Steps," each of which showed good internal consistency and concurrent and predictive evidence for validity in clinical adolescents. Using data from the initial assessment, we ran a confirmatory factor analysis (CFA) of SOCRATES items for marijuana use. The CFA included the 14 items representing the Maisto et al. (2003, in press) Amrec and Taking Steps factors and an additional item (hypothesized to load on Amrec) that was inadvertently omitted from the Maisto et al. (2003) study. Example Amrec items included, "I am addicted to marijuana" and "I have serious problems with using marijuana." A sample Taking Steps item is "I have already started making some changes in my use of marijuana." CFA for marijuana items supported the two-factor structure in this sample (comparative fit index = .94, Tucker–Lewis index = .93, standardized root mean squared residual = .08, $N = 172$). The factor loadings for the Amrec (Recognition in this study) factor ranged from .58 to .91, all statistically significant. Similarly, the factor loadings for the Taking Steps factor ranged from .62 to .87, all $p < .05$. Cronbach's α for Recognition was .91 and for Taking Steps was .91. The two factors were correlated $r = .17$ ($p < .05$) at initial assessment in the CFA sample. The analyses reported here considered the Recognition and Taking Steps factors as separate measures of readiness to change marijuana use. The average of the items loading on each respective factor was used in analyses.

Timeline Followback (TLFB; Sobell and Sobell, 1995). The TLFB calendar method was used to collect data at baseline (past 30 days) and at subsequent assessments on the number of days of marijuana use. Youth provided information "since the last assessment" if a monthly assessment was missed. TLFB data collected from adolescents have good reliability and validity (Donohue et al., 2004, 2007; Lewis-Esquerre et al., 2005; Waldron et al., 2001). The TLFB yielded the measure PDA from marijuana. PDA was computed by dividing the number of days abstinent from marijuana during the assessment interval by the total number of days and then multiplying by 100. The distribution of PDA was skewed, but attempted square root transformation of these data did not significantly increase the approximation of their distribution to normal. Therefore, both the PDA raw scores and transformed scores were analyzed for the models summarized in Tables 5 and 6. The results reported later showed no differences between these two sets of analyses, and therefore the analyses of the raw data are reported.

Urine drug screens. Urine drug screens were conducted at baseline, 6 months, and 12 months at in-person interviews. At baseline and at 12 months, there were no discrepancies between urine drug screen results and reports of recent marijuana use. At 6 months, in one case there was a positive urine drug screen for marijuana but no report of marijuana use in the past 6 months. All of the analyses reported were run with this participant included and excluded, respectively, and showed that the only differences between the two sets of findings was in the magnitude of one bivariate correlation: between initial staging algorithm and baseline symptom count in the full sample ($r = -.16$, $p < .05$) and in the smaller sample ($r = -.14$, $p = .07$). Therefore, the analyses reported here were conducted with the full sample.

Rutgers Marijuana Problem Index (RMPI; White et al., 2005). This questionnaire includes 21 marijuana-related problems that assess the frequency of problem occurrence using 5 response options (i.e., 0, 1–2, 3–5, 6–10, and >10 times). At baseline, the time frame was past year ($\alpha = .95$), and at 6 months and 12 months, the time frame was the past 6 months ($\alpha = .94$ and .95, respectively).

Inpatient or residential treatment days. To control for time spent in a controlled environment where access to marijuana would be limited, the number of days attended inpatient or residential treatment was collected in the TLFB and was summed over the days between the baseline and 6-month follow-up assessment, and between month 7 to the 12-month follow-up assessment, respectively. The inpatient/residential treatment summary variable was highly skewed; therefore, a square root transformation was used to normalize its distribution.

Statistical analyses

The analyses proceeded in several steps. First, evidence for the concurrent validity of each of the three readiness

measures was tested by computing the simple Pearson correlations between scores on each of the readiness measures at the initial assessment. Correlations also were computed between each readiness measure completed at the initial assessment and the baseline TLFB PDA in the last 30 days, RMPI, and DSM-IV symptom count, respectively.

There were two main considerations in determining our approach to the predictive validity analyses. First, because participants were recruited from ("nested in") seven different treatment sites, we tested for the possibility that there was a correlation among participants' responses within site, so that their responses were not statistically independent. A design effect criterion greater than 2.00 (Peugh, 2010) suggested response dependencies within site for four of the six outcomes (3 outcomes × 2 time periods). As a result, we used multilevel modeling for the predictive validity analyses. In these analyses, Level 1 (participants) predictors were modeled as fixed effects and included readiness score at the initial assessment to predict 6-month PDA, RMPI, and symptom count, respectively, in the context of the covariates: demographic variables, number of days of alcohol/drug residential and inpatient treatment in the last 30 days, and the level of the criterion marijuana use variable at baseline. The Level 2 predictor, participants across sites, was modeled as a random effect.

We repeated the concurrent validity analyses with the 6-month readiness and three "outcome" variables. For the prediction of 12-month PDA from 6-month readiness, we tested the same multilevel models, except that the criterion variables were 12-month PDA, RMPI, or symptoms. The main readiness predictor was 6-month readiness, and the number of days in inpatient and residential treatment for the last 30 days before the 12-month interview and the 6-month level of the criterion variable were used as covariates.

The second main consideration in conducting the predictive validity analyses concerned the coding of the staging algorithm. Thus far in this article, we have presented analyses involving the staging algorithm as both a "continuous" and categorical ordinal variable. The descriptive and simple correlation analyses (Tables 1–4) are not affected in major ways by how the staging data are coded (i.e., continuous or categorical). For regression analyses, probing of the staging data suggested a minor departure from linearity (i.e., linearity would be assumed when using staging as a "continuous" variable) in predicting 12-month outcomes from the 6-month staging data. Accordingly, we reran the three relevant models presented in Table 6 with the staging algorithm as a dichotomous variable, with precontemplators and contemplators coded as "0" and the remaining classes of participants coded as "1," based on the premise that the first two groups reported marijuana use in the past 30 days and that the remaining three groups already did or had immediate intention to change use. The results from the dichotomous and continuous coding approaches yielded identical findings; therefore, we retained the findings with the continuous data for consistency with the concurrent validity analyses.

Results

Concurrent validity analyses

Table 1 summarizes the descriptive data for each of the readiness-to-change, marijuana use, RMPI, and symptoms measures at each of the time points. One-way analyses of variance with repeated measures (listwise deletion of cases with missing data) conducted on the four continuous measures showed a significant effect of time on ruler scores ($p < .05$), the staging algorithm ($p < .05$), SOCRATES Recognition ($p = .01$) and Taking Steps ($p < .01$), symptom count ($p < .01$), and total RMPI score ($p < .01$). Trends over time indicated fewer marijuana-related problems and symptoms and generally lower readiness to change, except for the staging algorithm, which suggested a small average increase over time, reflecting the greater proportions in maintenance over follow-up.

Table 2 shows the percentage of participants classified into each stage of change by use of the staging algorithm at each assessment point. McNemar's test for correlated pro-

Table 1. Descriptive statistics for marijuana consumption, related problems and symptoms, and readiness measures across assessment points

	Initial			6 month			12 month		
Measure	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Readiness Ruler	174	7.41	2.79	123	6.58	3.37	115	6.37	3.46
SOCRATES Taking Steps (STS)	172	3.71	1.09	149	3.59	1.29	144	3.37	1.39
SOCRATES Recognition (SR)	172	2.67	1.17	149	2.55	1.16	144	2.30	1.21
Staging algorithm	173	3.16	0.17	148	3.37	1.41	147	3.46	1.49
	Baseline			6 month			12 month		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
% Days abstinent	174	56.97	43.12	159	55.94	45.98	151	60.73	45.72
RMPI	170	25.56	20.45	147	13.78	16.06	143	9.79	14.90
DSM-IV symptoms	174	3.24	2.13	150	1.63	2.08	147	1.43	1.87

Notes: All data are raw scores. STS and SR are item scores (range: 1–5), with higher scores indicating "more ready" to change. SOCRATES = Stages of Change Readiness and Treatment Eagerness Scale; RMPI = Rutgers Marijuana Problem Index; DSM-IV symptoms = total count of *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,* marijuana abuse + dependence symptoms (range: 0–10).

Table 2. Classification of adolescents' readiness according to the staging algorithm at the initial, 6-month, and 12-month assessments

Stage	Initial (N = 174) %	6 month (n = 148) %	12 month (n = 147) %
Precontemplation	3.5	16.2	18.4
Contemplation	4.0	8.8	6.1
Preparation	69.4	25.7	22.4
Action	19.1	20.3	17.0
Maintenance	4.0	29.1	36.1

*Note: n*s vary because of missing data or loss to follow-ups (for 6-month and 12-month assessments).

portions revealed a significant increase in the proportion of teens classified as precontemplators and in the maintenance stage, respectively, from the initial to the 6-month assessment ($p < .01$) but no significant change in the class proportions from the 6-month to the 12-month assessment.

Table 3 presents the Pearson correlations among the four initial readiness measures and the correlation between each readiness measure and baseline percentage of days abstinent, RMPI, and DSM symptoms count, respectively. The correlations among the ruler, the staging algorithm, and SOCRATES Taking Steps were positive and in the small-to-large range. In contrast, Recognition was correlated with the ruler and Taking Steps but not with the staging algorithm. Similarly, all of the readiness measures correlated moderately and significantly with PDA, but Recognition met neither criterion. On the other hand, Recognition had large and positive correlations with the RMPI and symptoms, but among the other three readiness measures, the only finding was a small, negative, significant correlation of the staging algorithm with symptoms.

Table 4 presents concurrent 6-month readiness and PDA and marijuana-related problems and symptoms measures. The pattern of data strongly supports the concurrent evidence for validity hypotheses presented earlier for all of the measures except Recognition. In this regard, Recognition showed a positive but low correlation with the ruler, was moderately and positively related to Taking Steps, and was not correlated with the staging algorithm. Recognition also was not correlated with PDA, and its correlations with both the RMPI and symptoms were positive rather than negative.

Predictive evidence of validity

Table 5 summarizes the results of testing the multilevel models and shows that only SOCRATES Taking Steps significantly ($p = .054$) predicted 6-month PDA. However, the ruler, staging algorithm, and Taking Steps all explained significant and independent variance in the 6-month RMPI scores. Both the ruler and Taking Steps explained significant independent variance in predicting marijuana symptoms at 6 months. Note also that between-site differences were negligible and that a considerable amount of variance in the outcomes still could be explained (significant residual estimate).

Table 6 is a summary of 6-month readiness measures predicting 12-month marijuana outcomes. Both the stag-

Table 3. Intercorrelations among initial readiness measures and correlations between initial readiness and baseline PDA, RMPI, and DSMS

Variable	IRR	ISA	ISR	ISTS	PDA	RMPI	DSMS
Initial Readiness Ruler (IRR)	–	.43**	.19*	.73**	.30**	.04	.04
Initial staging algorithm (ISA)		–	.05	.47**	.30**	-.05	-.16*
Initial SOCRATES Recognition (ISR)			–	.23**	.10	.62**	.48**
Initial SOCRATES Taking Steps (ISTS)				–	.31**	.00	.01

Notes: PDA = percentage of days abstained from marijuana, last 30 days, as measured by the Timeline Followback Interview; RMPI = Rutgers Marijuana Problem Index; DSMS = total count of *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,* marijuana abuse + dependence symptoms; a square root transformation was applied to the RMPI data; *n*s for the analyses ranged from 168 to 174.
*$p \leq .05$; **$p \leq .01$.

Table 4. Intercorrelations among 6-month readiness measures, and correlations between 6-month readiness and 6-month PDA, RMPI, and DSMS

Variable	6RR	6SA	6SR	6STS	PDA	RMPI	DSMS
6-month Readiness Ruler (6RR)	–	.75**	.27**	.75**	.44**	-.27**	-.33*
6-month Staging Algorithm (6SA)		–	.07	.68**	.50**	-.45**	-.47*
6-month SOCRATES Recognition (6SR)			–	.36**	.03	.38**	.33**
6-month SOCRATES Taking Steps (6STS)				–	.47**	-.18*	-.29**

Notes: PDA = percentage of days abstained from marijuana, last 30 days, as measured by the Timeline Followback Interview; RMPI = Rutgers Marijuana Problem Index; DSMS = total count of *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,* marijuana abuse + dependence symptoms; a square root transformation was applied to the RMPI data; *n*s for the analyses ranged from 121 to 149.
*$p \leq .05$; **$p \leq .01$.

TABLE 5. Evidence for predictive validity: Prediction of abstinence from marijuana use and related problems and symptoms at 6 months from initial readiness

	IRR		ISA		ISR		ISTS	
Variable	Estimate	*SE*	Estimate	*SE*	Estimate	*SE*	Estimate	*SE*
6-month PDA								
Fixed effects								
Sex (1 = female, 2 = male)	-8.24	6.87	-6.86	6.84	-7.24	6.92	-7.65	6.83
Age	-3.06	2.66	-3.31	2.71	-2.96	2.68	-3.75	2.67
Race (1 = White, 2 = other)	-7.57	9.41	-7.93	9.48	-8.59	9.59	-7.44	9.38
ADT: #inpt. + #residential days, last 30 days	1.64	0.81*	1.62	0.82*	1.73	0.83*	1.56	0.81*
BL PDA, last 30 days	0.39	0.08*	0.40	0.08**	0.41	0.08**	0.36	0.08**
Initial readiness	1.52	1.25	3.37	5.38	-1.02	2.85	6.54	3.24*
Random effects								
Intercept (site differences)	20.90	44.66	23.45	46.45	26.23	48.16	21.51	44.32
Residual	1,622.61	184.67**	1,637.98	187.02**	1,644.22	188.29**	1,606.91	183.98**
n	159		158		157		157	
6-month RMPI								
Fixed effects								
Sex	-1.04	0.36**	0.86	0.36*	0.92	0.38*	0.83	0.36*
Age	-0.01	0.14	0.05	0.14	-0.02	0.14	0.04	0.14
Race	-0.08	0.55	-0.12	0.55	-0.04	0.56	-0.18	0.54
ADT	0.08	0.05	0.08	0.05	0.06	0.05	0.08	0.05
BL RMPI	0.04	0.01**	0.04	0.01**	0.03	0.01**	0.04	0.01**
Initial readiness	-0.17	0.06**	-0.79	0.28**	0.10	0.20	-0.57	0.17**
Random effects								
Intercept	0.11	0.17	0.14	0.18	0.17	0.20	0.07	0.14
Residual	4.16	0.50**	4.13	0.50**	4.35	0.53**	4.09	0.49**
n	143		142		142		142	
6-month DSMS								
Fixed effects								
Sex	0.53	0.30	0.43	0.30	0.45	0.30	0.36	0.29
Age	0.10	0.11	0.11	0.12	0.09	0.12	0.14	0.11
Race	0.91	0.42*	0.95	0.43*	0.93	0.43*	0.89	0.42*
ADT	0.08	0.03*	0.08	0.03*	0.08	0.03*	0.08	0.08*
BL DSMS	0.48	0.07**	0.46	0.07**	0.49	0.08**	0.49	0.07**
Initial readiness	-0.15	0.05**	-0.24	0.22	-0.09	0.14	-0.46	0.13**
Random effects								
Intercept	0.05	0.10	0.09	0.13	0.11	0.13	0.04	0.09
Residual	2.73	0.32**	2.82	0.33**	2.86	0.34**	2.69	0.32**
n	149		148		148		148	

Notes: A square root transformation was applied to the Rutgers Marijuana Problem Index (RMPI) and alcohol and other drug treatment (ADT) data. *n*s differ because of missing data, and parameter estimates are unstandardized. IRR = Initial Readiness Ruler; ISA = Initial Staging Algorithm; ISR = Initial SOCRATES Recognition; ISTS = Initial SOCRATES Taking Steps; PDA = percentage of days abstinent, measured by use of the Timeline Followback Interview and references 30 days before the interview date; inpt. = inpatient; BL = baseline; DSMS = *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,* marijuana abuse and dependence symptom count.
*$p \leq .05$; **$p \leq .01$.

ing algorithm and Taking Steps explained a significant but modest amount of independent variance in the 12-month PDA data. However, all of the readiness measures except Recognition explained significant additional variance in the 12-month RMPI data. The ruler and the staging algorithm also explained significant independent variance in predicting symptoms, but both Recognition and Taking Steps did not. Again, site differences were negligible.

Discussion

All of the readiness measures, with the exception of Recognition, showed good evidence for concurrent validity based on correlations with each other and with PDA at the initial/baseline and 6-month assessments in predicted magnitude and direction. The evidence for the predictive validity of the ruler, staging algorithm, and Taking Steps also was good, because they accounted for significant increases in variance explained in a total of 4, 3, and 5 of the 6 models tested, respectively, across the two follow-up points examined. In contrast, Recognition was significantly and moderately highly correlated with marijuana-related problems but in a direction opposite to that hypothesized. In addition, Recognition explained no significant independent variance in any of the predictive validity models. Based on these findings and on the brevity of the measure and its ease of administration, it would seem that the Readiness Ruler is the measure of choice among those examined. Taking Steps is a good choice for clinicians if time to complete the measure is not a major concern.

TABLE 6. Evidence for predictive validity: Prediction of abstinence from marijuana use and related problems and symptoms at 12 months from 6-month readiness

	6RR		6SA		6SR		6STS	
Variable	Estimate	*SE*	Estimate	*SE*	Estimate	*SE*	Estimate	*SE*
12-month PDA								
Fixed effects								
Sex (1 = female, 2 = male)	-1.85	7.84	-5.66	6.71	-5.55	6.82	-3.92	6.69
Age	-1.00	2.94	0.95	2.61	0.70	2.66	0.65	2.59
Race (1 = White, 2 = other)	-14.17	10.78	-15.72	9.38	-16.50	9.55	-18.12	9.34
ADT: #inpt. + #residential days, last 30 days	1.42	0.87	1.43	0.69*	1.31	0.70	1.23	0.68
6-month PDA, last 30 days	0.37	0.11**	0.30	0.12*	0.50	0.07**	0.37	0.09**
6-month readiness	2.50	1.46	8.23	3.84*	0.66	2.81	8.04	3.06**
Random effects								
Intercept (site differences)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residual	1,456.81	192.96**	1,346.73	162.13**	1,400.06	167.94**	1,334.25	160.05**
n	114		138		139		139	
12-month RMPI								
Fixed effects								
Sex	0.47	0.38	0.47	0.33	0.58	0.34	0.45	0.33
Age	-0.10	0.14	-0.11	0.13	-0.05	0.13	-0.07	0.13
Race	0.00	0.52	0.36	0.45	0.67	0.47	0.64	0.45
ADT	0.09	0.04*	0.05	0.03	0.04	0.03	0.05	0.03
6-month RMPI	0.07	0.01**	0.07	0.01**	0.08	0.01**	0.08	0.01**
6-month readiness	-0.18	0.06**	-0.48	0.11**	0.08	0.15	-0.34	0.12**
Random effects								
Intercept	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residual	3.23	0.44**	2.92	0.36**	3.27	0.40**	3.09	0.38**
n	106		129		131		131	
12-month DSMS								
Fixed effects								
Sex	0.50	0.34	0.33	0.28	0.40	0.29	0.32	0.29
Age	0.06	0.13	0.05	0.11	0.09	0.11	0.08	0.11
Race	0.07	0.45	0.22	0.38	0.35	0.40	0.34	0.39
ADT	0.03	0.04	0.02	0.03	0.02	0.03	0.02	0.03
6-month DSMS	0.39	0.08**	0.38	0.07**	0.48	0.07**	0.46	0.07**
6-month readiness	-0.13	0.05**	-0.35	0.10**	0.06	0.12	-0.20	0.11
Random effects								
Intercept	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residual	2.59	0.35**	2.27	0.27**	2.43	0.29**	2.38	0.29**
n	112		136		138		138	

*Notes: n*s differ because of missing data, and parameter estimates are unstandardized. A square root transformation was applied to the Rutgers Marijuana Problem Index (RMPI) and alcohol and other drug treatment (ADT) data. 6RR = 6-month Readiness Ruler; 6SA = 6-month Staging Algorithm; 6SR = 6-month SOCRATES Recognition; 6STS = 6-month SOCRATES Taking Steps; PDA = percentage of days abstinent, measured by use of the Timeline Followback Interview and references 30 days before the interview date; inpt. = inpatient; DSMS = *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,* marijuana abuse and dependence symptom count.
*$p \leq .05$; **$p \leq .01$.

This study's results raise the question of whether these three (and other) measures of readiness to change a given behavior should be used interchangeably. The discrepant findings across measures may simply reflect the fact that each of the three measures has face validity as a measure of motivation or readiness to change, but, at the same time, the content of each measure differs considerably. Such content differences suggest that there might be important differences, as well as similarities, in what is being measured.

Overall, this study shows the need for research on the construct validity of these and other putative measures of readiness to change (Carey et al., 1999; Sutton, 2001). For example, it would seem important to be precise about what construct a measure is designed to reflect and to design its content to be as consistent with that construct's meaning as possible. Such increased precision would allow finer tests of convergent and discriminant validity and, thus, of construct validity. Stronger evidence for construct validity among these different measures would advance the field by, for example, allowing clinicians and researchers to choose a measure that is best suited for use in a particular clinical or research context. Similarly, it would allow the use of "readiness" measures in more sensitive tests of mediation and moderation of treatment effects than now are possible, which would result in a better understanding of how treatments work and increased effectiveness in their application with specific individuals in specific contexts.

The factor structure of the SOCRATES replicated Maisto et al.'s (2003, in press) findings for alcohol, which lends additional confidence in its use in relation to marijuana with a

clinical sample of adolescents. Furthermore, the predictive evidence for validity of the Taking Steps score as a measure of readiness to change was good in this study, also consistent with the conclusions that Maisto et al. (2003, in press) drew from their data. However, it is notable that the Recognition score consistently had the worst performance among the four measures, and this finding is consistent with Maisto et al. for alcohol (2003, in press). This is an interesting finding because of the low-to-moderate correlation between Taking Steps and Recognition found in this study (and in Maisto et al., 2003, in press). Along these lines, Maisto et al. (2003) suggested that the Recognition subscale is more a measure of self-perception of the severity of an individual's substance-related problems than of readiness to change behaviors leading to such problems, and, in this study, the pattern of concurrent validity correlations at both the initial/baseline assessments and at 6 months is consistent with that view. The perception of marijuana problem severity may be evident among people who are taking action to change a problem behavior and likely accounts for the correlation between Taking Steps and Recognition. On the other hand, a person's self-perception of the severity of his or her problem behavior does not necessarily reflect taking any action to change it, so that the correlations between a severity measure and any measures of readiness to change and related behavior measures could be small in magnitude.

The staging algorithm data revealed the important finding of a significant increase in the percentage of participants classified as precontemplators from the initial to the 6-month assessment, and this change was maintained at 12 months. Of course, one possible explanation for this trend is that the three time points do not include the same individuals because of sample attrition patterns. However, a more likely explanation is that individuals in this sample tended to be in treatment for reasons other than internal desire to change marijuana use. That, combined with the end of the index treatment episode, could account for the increase in the proportion of precontemplators and for the reduction in ruler ratings of readiness to change marijuana use. However, at the same time, it is important to note that Table 2 also shows a substantial increase in the proportion of individuals classified in the Maintenance stage between the initial and 6-month assessments, and that proportion increased again between 6 months and 12 months along with reductions in marijuana symptom and problem severity from baseline to 12 months. Such reductions in marijuana severity are what would be hoped for in a group of individuals who had completed an episode of outpatient alcohol and drug treatment.

There are several limitations to this study that could affect the generalizability of its findings. All data consisted of the participants' self-reports. In addition, sample attrition could have biased the findings; 12-month noncompleters differed from the completers in marijuana problem severity and symptom count. However, sample attrition over the course of the study's 12 months was not high and was consistent with that reported by other major follow-up studies of clinical samples of adolescents. A related point is that the 6-month ruler data show a lower sample size for analyses than the other three measures do. Probing of this result revealed that it was primarily because of adolescents marking "I don't use this drug" in response to the marijuana ruler item because of abstinence from marijuana over follow-up (note that the maximum code of "10" on the ruler corresponds to the anchor *trying to change*). The upshot of this pattern of response is that the 12-month predictive validity analyses likely underestimate the ruler's predictive power and suggest that the ruler's maximum anchor might need to be modified to better reflect those who have successfully reduced or stopped use over follow-up. Another limitation was that the baseline and initial assessments did not occur at the same time; as a result, any investigation of relationships among measures collected at the two respective assessments, such as measures of initial readiness and baseline marijuana use, may have underestimated the strength of those relationships. Finally, the version of the ruler used in this study had four verbal anchor points, and our findings may not generalize to versions of the ruler that use fewer or more anchor points. This is a point that is pertinent in general to research involving the use of ladder and ruler measures of readiness, because studies are not consistent in the number or content of the verbal anchor points used.

In conclusion, study results suggest that scores for three of the four readiness measures investigated have good concurrent validity. However, results also suggest that the scores on the measures should not be used interchangeably and that readiness to change varies over time, specifically in relation to an index episode of treatment. Our findings suggest that, among the Readiness Ruler, staging algorithm, SOCRATES Taking Steps, and Recognition, the first three measures have good support for predictive validity and thus for potential clinical utility. However, if brevity of measure and ease of administration are considered, then the Readiness Ruler emerges as the measure with the most clinical utility among adolescents in treatment for marijuana use.

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