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Short communication

Readiness-to-change as a moderator of a web-based brief intervention for marijuana among students identified by health center screening

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ABSTRACT

Introduction: Electronic screening and brief intervention has been identified as a low cost strategy to address marijuana use among students, however there is little known about who may be most responsive to this intervention approach. This study examined whether readiness-to-change moderated the influence of a web-based intervention on frequency of use at 3-month outcomes.
Methods: One-hundred twenty-three students who smoked marijuana at least monthly were identified by screening in a student health center. Baseline and 3-month outcome assessments were conducted on-line. Participants were randomly assigned to either eCHECKUP TO GO-marijuana or a control condition after completing marijuana measures and the Readiness-to-Change Questionnaire (RTCQ). Negative binomial regression analyses were conducted to examine whether the effect of the intervention on marijuana use at 3-month outcomes was moderated by the Action and Problem Recognition dimensions of the RTCQ, adjusting for baseline use.
Results: Analyses showed a significant Intervention × Action interaction. Probing of interaction effects showed that among those with high scores on the Action scale participants in the intervention group reported significantly fewer days of use than those in the control condition at follow-up (IRR = 0.53, 95%CI: 0.94, 2.08). The Problem Recognition dimension did not moderate the influence of the intervention on outcomes.
Conclusion: These results suggest that this eSBI may bolster change efforts among students who have begun taking steps toward changing their marijuana use.

1. Introduction

Marijuana use presents a significant risk to the health and well-being of university students. Students with more frequent marijuana use are more likely to experience a variety of consequences that compromise their academic performance, physical health, and relationships (Caldeira et al., 2008). Despite this, students typically do not recognize their marijuana use as problematic or presenting risks and therefore do not seek resources to promote change (Stephens et al., 2007).

One way to address this has been through screening and brief intervention. Drawing from the success of electronic screening and brief intervention (eSBI) for alcohol use among college students (Carey et al., 2012), investigators have begun to examine the utility of marijuana eSBI among adolescents and young adults (e.g., Cunningham and van Mierlo, 2009; Lee et al., 2010; Walton et al., 2013). This approach allows health care providers and administrators to overcome a number of potential barriers to implementing interventions for marijuana use including insufficient staff resources and low rates of substance-related treatment seeking among this population (Kypri and Lee, 2009). Although there have been increased efforts to develop web-based marijuana eSBIs, relatively few of these have been empirically evaluated (see Tait et al., 2013). Moreover, the few studies that have evaluated interventions among non-treatment seeking student marijuana users have provided limited evidence that they reduce marijuana use or consequences (e.g., Elliott and Carey, 2012; Elliott et al., 2014; Lee et al., 2010).

Given the equivocal evidence for the efficacy of eSBI for marijuana, identification of moderators may help specify those who may benefit most from this approach and provide insight about how to improve eSBI approaches. Although empirical support for

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readiness-to-change as a moderator has varied across substance use intervention studies (see Burke et al., 2002), this construct has been used as a key target in the development of motivational interventions (e.g., Stephens et al., 2004) and a tailoring variable for a variety of substance use interventions (Connors et al., 2001). Unfortunately, there has been little research that has examined whether readiness-to-change moderates the influence of marijuana eSBI among students. Lee et al. (2010) found that, among first-year students recruited on-line in their transition to college, those who were higher on the Contemplation scale of the Readiness to Change Questionnaire reduced marijuana use more than those lower on Contemplation when exposed to an eSBI. However, it is currently not known whether web-based interventions delivered to a broader population of undergraduates students (e.g., students across all 4-years) in other contexts (e.g., in student health services) are more efficacious for those higher on indices of readiness-to-change.

The current study examined this question among marijuana using students presenting to a student health center (Palfai et al., 2014). Undergraduate students who presented to student health services (SHS) participated in a brief electronic health behaviors screener. Those who were regular marijuana users (i.e., use at least monthly) were asked to participate in a study in which they would complete online assessments and receive health-related feedback. Students were randomized to receive either the eCHECKUP TO GO for marijuana intervention (described below) or a control intervention that consisted of feedback on general health-related behaviors. Results showed little evidence of an overall effect of the intervention on 3-month frequency of use (Palfai et al., 2014). In this secondary analysis, it was hypothesized that baseline ratings of readiness-to-change would moderate the influence of the intervention such that evidence of an intervention effect on frequency of use would be observed among those who were higher on indices of readiness-to-change.

2. Materials and methods

2.1. Participants

Participants were 123 undergraduates who presented to SHS and reported using marijuana at least monthly over the past 90 days (Mean number of days used = 34.99, SD = 28.87). Because the efficacy of this eSBI approach was not known, those whose marijuana-specific ASSIST scores indicated a high likelihood of substance risk (i.e., marijuana ASSIST $\geq$ 27) were not enrolled in the trial. The study was approved by the Boston University Institutional Review Board and informed consent was obtained for both screening and study participation.

2.2. Measures

2.2.1. NIDA-modified ASSIST-marijuana. The NIDA-modified ASSIST (Humeniuk et al., 2008; NIDA, 2009) provides an indication of level of substance use risk (i.e., low, medium high) and has been validated in primary care populations. Coefficient alpha for the ASSIST was 0.62.

2.2.2. Frequency of marijuana use-90 days. Number of marijuana use days in the past 90 days was asked with the following question, "During the past 90 days, on how many days did you use any kind of marijuana, blunts, or hashish?" This question has been adapted for use among adolescents and young adults (Lee et al., 2010). The item was accompanied by a 3 month calendar starting from the present date to provide anchors.

2.2.3. Readiness to Change Questionnaire (RTCQ). This 12-item measure (Budd and Rollnick, 1996) that is modified for marijuana use (Stephens et al., 2007) was employed to assess the level of motivation to change marijuana use. Because previous work has shown both two and three factor solutions for the RTCQ (Crackau et al., 2010; Raes et al., 2010), we first conducted a principal component analysis (PCA) of the 12 items using orthogonal (varimax) rotation forcing three and two component structures. Determination of the scale component structure was based on Kaiser's rule (i.e., eigenvalue > 1), item component loading >0.4, item factorial complexity of one, and interpretability. A two-factor solution representing Problem Recognition (i.e., awareness that marijuana use may be excessive) and Action (i.e., engaging in behaviors to reduce marijuana use) was identified. One item did not load on either factor resulting in a 7-item Problem Recognition Factor (loadings 0.51–0.82) and a 4-item Action factor (loadings 0.68–0.86). Coefficient alphas for the scale scores were 0.87 for Problem Recognition and 0.82 for Action.

2.3. Intervention conditions

Following completion of baseline assessment, students were randomly assigned to Intervention (n = 61) or Control (n = 62) conditions. The intervention was eCHECKUP TO GO-marijuana which is a commercially available web-based intervention that is used widely in universities and colleges in the US and Canada (San Diego State Research Foundation, 2014). The intervention consists of an assessment section followed by personalized feedback about marijuana use including costs, descriptive norms, risks, consequences, and potential alternative activities. Students are also provided with a series of harm and frequency reduction strategies (e.g., deciding which days not to use, leaving a party early). Those in the Control condition were given minimal, non-personalized health feedback regarding recommended national guidelines for sleep, exercise, and nutrition (see Palfai et al., 2014 for details of study methods).

2.4. Procedures

Students who visited SHS were asked by the research assistant to complete a one minute electronic screening questionnaire on undergraduate student health behaviors. Those who agreed were presented with the 9-item screening measure that included the marijuana frequency question from the ASSIST. Students who reported at least "monthly" marijuana use in the past 90 days were identified as potentially eligible for the study. After completing the full ASSIST and baseline measures, eligible students were randomized to intervention condition (Marijuana eCHECKUP TO GO vs. control). Students were compensated $25 for their participation in baseline assessment procedures and $25 for 3-month online assessment participation.

3. Results

3.1. Readiness to change as a moderator of intervention

Negative binomial regression analyses were used to examine the interaction between readiness-to-change indicators and the intervention condition on number of days using marijuana in the past 90 days at 3-month outcome. Because these count data were not normally distributed, we used the robust maximum likelihood estimator (MLR) to accommodate missing data. Intervention condition was coded as an indicator variable [0,1] with 1 representing the active intervention condition. Readiness-to-change was operationalized as Problem Recognition (items from Contemplation and reversed scored Precontemplation subscales) and Action. Mean ratings for subscale scores (possible range −2 to 2) were −0.74

Table 1
Negative binomial regression analysis examining the interaction between intervention and readiness-to-change on frequency of marijuana use ($n = 123$).

Variable	IRR	CI	*p*-Value
Baseline-FQ	1.03	(1.02, 1.03)	<0.001
Intervention	0.94	(0.63, 1.41)	0.77
Action	1.13	(0.80, 1.61)	0.49
Problem Recognition	0.96	(0.70, 1.31)	0.80
INTV × Action	0.58	(0.37, 0.91)	0.02
INTV × Problem	1.34	(0.94, 2.08)	0.10

IRR: incident rate ratio; CI: 95% confidence interval; Baseline FQ: number of days use of marijuana in the past 90 days at baseline; INTV: Control vs eCHECKUP TO GO; Action: Action subscale of the Readiness-to-Change Questionnaire; Problem Recognition: composite subscale based on items from the Precontemplation and Contemplation subscales of the Readiness-to-Change Questionnaire.

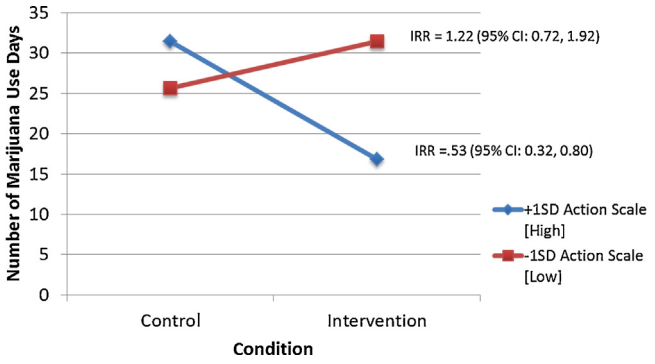

Fig. 1. Interaction between intervention and action on days of marijuana use in the past 90 days (Simple slopes analyses at +1SD and −1SD of Action subscale scores). NB: Figure indicates the slopes plotted at 1 standard deviation above ("high" on the Action subscale) and 1 standard deviation below ("low" on the Action subscale) the mean Action subscale score of the sample. The +1SD line indicates significantly fewer days of marijuana use for those in the intervention compared to control condition at 1SD above the mean on the Action subscale (i.e., "high"). No significant effect is observed at 1SD below the mean.

(SD = 0.83, range −2.0 to 1.7) for Problem Recognition and −0.17 for Action (SD = 1.04, range −2.0 to 2.0). Interaction effects between intervention condition and each subscale were computed for each subscale and they were entered in the same model. Full model effects are presented in Table 1.

Results showed that the Intervention × Problem Recognition interaction was not significant [adjusted incidence rate ratio (aIRR) = 1.34; 95%CI, 0.70–1.31, $p = 0.10$].[1] However, there was a significant Intervention × Action interaction effect, (aIRR = 0.58; 95%CI, 0.37–0.91, $p = 0.02$). To examine the nature of this interaction, the Intervention × Action interaction effect was probed at 1SD above the mean of the Action subscale (defined as "high") and 1SD below the mean of the Action subscale (defined as "low") using simple slopes analyses Hilbe (2011). Simple slopes analysis is a method of characterizing the interaction effect by plotting regression equations at standard values (e.g., +1SD and −1SD) of the moderator (Aiken and West, 1991). As shown in Fig. 1, the intervention differentially influenced outcomes among those with high versus low Action scores. Results indicated that at the high level of the Action subscale, students smoked marijuana less frequently when they received the eCHECKUP TO GO intervention compared to those in the control condition (aIRR = 0.53; 95%CI, 0.32, 0.80). The intervention did not significantly influence frequency of use at 3 months at the low level of the Action subscale (aIRR = 1.22; 95%CI, 0.72, 1.92).

4. Discussion

The current study examined the influence of readiness-to-change as a moderator of the eCHECKUP TO GO for marijuana intervention. Regression analyses showed that the degree to which individuals were taking steps to change their marijuana use (as measured by the Action scale) moderated the influence of the intervention. Specifically, those who were high on the action scale showed fewer days of marijuana use at 3 months when exposed to the intervention compared to controls. The intervention did not significantly influence outcomes among those low on the Action subscale. Conversely, concern about one's marijuana use (as measured by the Problem Recognition scale) did not act as a significant moderator for the intervention when included in the same model.

These findings have implications for understanding the characteristics of those who may benefit from the eCHECKUP TO GO-marijuana intervention and provides suggestive evidence about how eCHECKUP TO GO may foster change. It appears that the content of the intervention, including information about norms and personal costs/consequences, and strategies for reducing use, may help enhance change behaviors for those who are already taking steps to reduce use. The web-based content may increase the salience of information that supports change and provide potentially novel approaches to help students who are high on the Action subscale enhance their behavior change efforts.

It is interesting to note that Problem Recognition (and the component Contemplation subscale) did not appear to significantly moderate the impact of the intervention. Thus, eCHECKUP TO GO does not appear to be more effective for those who are more aware that their use may be problematic. Although Lee et al. (2010) found that individuals higher in Contemplation showed reductions in smoking when receiving a feedback intervention compared to assessment only, the moderating effects of Contemplation were not observed in this study. Indeed, consistent moderators for brief interventions for marijuana use have not yet been identified. Such differences may be due to a variety of factors including the sample, setting and intervention content. It is important to consider study limitations when interpreting these findings including the small sample size, homogeneity of the sample, exclusion of those with high scores on the ASSIST (i.e., ≥27), and short-term (3 month) outcomes.

Despite these limitations, the current work suggests that web-interventions may be an effective catalyst for students in health settings who have begun to make changes in their use. This suggests that eCHECKUP TO GO may help prompt those who have begun to modify their use of marijuana continue to change. It also suggests that it may be useful to modify intervention content for those who are low on readiness-to-change. Future work should examine whether tailoring intervention content based on measures of readiness-to-change (e.g., Freyer-Adams et al., 2014) may improve the efficacy of marijuana eSBI and examine the role of readiness-to-change as a mediator of intervention effects.

Conflict of interest

There are no conflicts to declare.

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[1] To permit direct comparison with previous work that has examined readiness-to-change as a moderator of marijuana interventions (i.e., Lee et al., 2010), we also conducted analyses to examine the influence of contemplation as a moderator. The Contemplation subscale did not significantly moderate the influence of the intervention [aIRR = 0.84; 95%CI, 0.61–1.07].

Contributors

Each author contributed to the article and has approved the final version. Tibor Palfai and Richard Saitz contributed to protocol development, analyses and the writing of the paper. Kelli Tahaney contributed to the implementation of the protocol, literature review, and the writing of results. Michael Winter contributed to the implementation of the study, programming and data analyses.

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