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Computer-based brief motivational intervention for perinatal drug use

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Abstract

Computer-based brief motivational interventions may be able to reach a high proportion of at-risk individuals and thus have potential for significant population impact. The present studies were conducted to determine the acceptability and preliminary efficacy of a computer-based brief motivational intervention (the motivation enhancement system, or MES). In Study 1, quantitative and qualitative feedback from 30 postpartum women and 17 women in treatment for drug use were used to modify the software. In Study 2, 50 urban postpartum women who reported drug use in the month before pregnancy completed the intervention and provided repeated within-session ratings of state motivation. In Study 3, 30 women were randomly assigned to intervention or control conditions with 1-month follow-up. Overall, women rated the MES as highly acceptable and easy to use and reported significant increases in state motivation at postintervention and at 1-month follow-up ($d = .49$). These preliminary results are encouraging and suggest that further work in this area is warranted.

Keywords

Drugs; Computer-based; Perinatal; Motivation; Brief intervention

1. Introduction

In 2003, according to the National Survey on Drug Use and Health, only 8% of all persons in the United States meeting criteria for a substance-use disorder had received any services in the past year; of the 92% who had not received services, only 5.1% reported that they needed treatment (Office of Applied Studies, 2004a). Further, of those who do enter a treatment program for substance abuse, approximately half will drop out before completing treatment (Joe, Simpson, & Broome, 1999; Wierzbicki & Pekarik, 1993). Thus, there is a tremendous need to identify persons with substance-use disorders proactively to facilitate treatment involvement and/or self-change.

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Brief motivational interventions may address this need, in that they can be presented opportunistically (particularly in primary care settings) to persons who otherwise would not have sought services and who are unlikely to either commit or adhere to extended treatment. Further, despite their relative brevity, effect sizes for brief interventions are generally comparable to those of extended interventions (Burke, Arkowitz, & Menchola, 2003; Moyer, Finney, Swearingen, & Vergun, 2002). However, there are clear challenges to the broad implementation of even brief interventions. For example, training in brief motivational interventions (typically using a two full-day format) has led to changes in provider behavior only on some key skill measures, and many trainees show improvement that is either transient or of insufficient magnitude (Baer et al., 2004; Miller & Mount, 2001). Further, it has been estimated that full compliance with all preventive activities recommended by the U.S. Preventive Services Task Force would require 4.4 hours per working day for primary care physicians working with adults (Yarnall, Pollak, Ostbye, Krause, & Michener, 2003). Perhaps because of this, many primary care providers may also lack sufficient interest or investment in brief intervention approaches (Beich, Gannik, & Malterud, 2002). Brief interventions seeking more than an initial opportunistic session must also contend with significant attrition (e.g., Maisto et al., 2001).

Technology may help to address the above limitations. A computer-based brief motivational intervention, like traditional brief interventions, could be useful in opportunistic, proactive prevention with non-treatment-seeking populations. This approach would also offer advantages over traditional approaches, including (a) requiring negligible time commitments and effort from health-care personnel; (b) obviating the need for training; (c) requiring minimal financial resources to maintain; (d) being perfectly replicable in any setting; and (e) being accessible regardless of literacy or preferred language.

The acceptability and efficacy of such an approach to the treatment of drug-use disorders, however, is unknown. It may be that participants will find interacting with a computer to be overly impersonal, or perhaps the interpersonal aspects of brief interventions—as suggested by motivational interviewing theory—are crucial in facilitating change. Lack of experience with computers could also prove an impediment in many settings. A number of published articles have described the use of brief Internet-based interventions for alcohol use; although these articles suggest that most users of these websites find them helpful and interesting, none provide any data regarding outcomes (Copeland & Martin, 2004). Further, although the Internet has clear potential as a platform for reaching otherwise untreated substance abusers, this approach is limited to those who (a) have Internet access, (b) are aware of the existence of brief intervention websites, and (c) choose to utilize such a site.

The present studies were designed to evaluate the acceptability and preliminary efficacy of a computer-based brief intervention (the motivation enhancement system, or MES) for drug use among postpartum women. The goal of the MES is to facilitate self-change, treatment engagement, and/or motivation to change via a single intervention session. Postpartum women were chosen as a target group to maximize population impact: Pregnancy represents a unique opportunity for intervention, in that nearly all women in the United States choose to give birth in hospitals. This setting, then, allows potential access to nearly all of a key population (parenting women). It also provides the potential for beneficial effects on the mother as well as her children, an important possibility given the clear association between parental substance use and a range of poor child outcomes (e.g., Chaffin, Kelleher, & Hollenberg, 1996; Kilpatrick et al., 2000; Ondersma, 2002). We hypothesized that the MES would be rated as acceptable and easy to use by participants and that it would lead to increases in self-reported motivation to change at posttreatment and 1-month follow-up evaluations.

2. Study 1: MES feasibility and acceptability

2.1. Materials and methods

2.1.1. Participants—A total of 47 women recruited from three settings provided ratings of the acceptability of the MES: 30 were postpartum women recruited from a large urban obstetric hospital; 10 were mothers who were receiving services at a substance-abuse treatment facility; and 7 were women enrolled in a methadone maintenance program. This sampling strategy was chosen not only to include post-partum women but also to oversample women with histories of drug use. All women were recruited expressly as consultants to the project, participated anonymously, and provided verbal informed consent. The Wayne State University Institutional Review Board approved all procedures used in this study.

2.1.2. Measures—The primary measure for this series of feasibility/ acceptability evaluations was a 7-item self-report instrument assessing the extent to which the participant liked the MES and found it to be interesting, easy to use, made up of understandable questions, respectful, bothersome, and humorous. Participants were asked to rate each item on a 1–5 scale (1 = *not at all* and 5 = *very much*). For women recruited from drug-use treatment programs (all of whom reviewed the intervention section of the MES), this measure also included an item regarding the extent to which they would be interested in working with the program again “in a year or so.” Participants were also debriefed after completing their interactions with the MES. Their qualitative responses were recorded, with special emphasis on their preference regarding various synthetic voices for the narrator, and on their preference for interacting with the program via a touch screen versus a standard laptop computer with a touchpad.

2.1.3. Software—The MES consists of an assessment section and an intervention section. The assessment section presents questions one at a time using a visually attractive screen that provides only the most pertinent information for the participant. Pleasing and relevant graphics change with each screen to help maintain interest. A three-dimensional cartoon character capable of over 50 specific animated actions (e.g., smile, wave, read a message, express concern, etc.) does the “talking” for the entire program. This character reads each item for the participant, acts as narrator and guide throughout the process, and provides occasional comic relief. Participants listen to the narrator via headphones to assure privacy.

The intervention section consists of three components that are based on motivational interviewing and brief intervention principles: (1) feedback regarding the negative consequences of drug use that they reported, their self-reported readiness to change, and their drug use as compared to that of all adult women; (2) pros and cons of drug use and related change, in which the participant chooses from a list of options the positive and negative aspects of drug use for them; and (3) a summary and query regarding the participant’s interest in change, followed by optional goal-setting regarding drug use. Throughout the intervention section, the animated narrator “reflects” back the participant’s answers and helps to establish an atmosphere that is as similar as possible to that present during a motivational interviewing session.

2.1.4. Procedure—All women worked with the MES in a private room with only a research assistant present. After agreeing to act as a consultant regarding how to improve the software, participants worked with the MES and provided quantitative and qualitative feedback. They were also encouraged to comment at any point about any aspect of the program. All participants were offered the option of working with either a standard laptop via its touchpad (by which participants drag their finger on the pad to direct the cursor) or to

use a separate touch screen that was attached to the laptop. The postpartum women in the hospital sample were also exposed to three different synthetic voices for the animated narrator: a relatively unnatural-sounding, cartoon-like voice or one of two more natural-sounding synthetic voices (one male and one female). The research assistant recorded all responses by hand, and probed for responses when none were forthcoming. All participants were asked to comment on their preference regarding voice and mode of interaction with the MES (touch screen vs. touchpad). The postpartum women, all of whom denied drug use in the month before pregnancy, were only exposed to the assessment section of the MES. All 17 women from the substance-abuse treatment agencies reviewed both the assessment and intervention sections of the MES.

2.2. Results

Quantitative responses were consistently positive in all groups. As seen in Table 1, mean ratings ranged from a low of 4.1 (in response to “How interesting was it?”) to a high of 5.0 (in response to “Was it easy to use?” and “Did you understand the questions?”). There were no meaningful differences between groups in quantitative ratings of the MES.

Qualitative results were also positive. Participants giving positive feedback cited the program’s ease of use, the humorous animated narrator, and its ability to help them learn/think about themselves. Negative comments focused primarily on the length of the assessment and on frustration with the need to listen to the narrator read the questions (the software allows the narrator’s voice to be read rather than heard, but we did not adequately make participants aware of this option). Of 29 women who reported a preference for one voice over another, 16 preferred the less natural, more cartoon-like voice. However, of the 12 women who preferred either the male or female voice, 6 had strong negative reactions to the cartoon-like voice. Results were more consistent with respect to the touch screen versus the touchpad: Of 25 women with an opinion on this issue, 23 preferred using the touch screen. Women in this study made several specific suggestions for improving the MES, including making it shorter, rearranging certain elements, and integrating more jokes for the narrator.

2.3. Discussion

The MES appears to be accepted by and feasible with drug-using and postpartum women. The samples used as consultants in this study found the MES to be very easy to use, respectful, appropriately humorous, and interesting. Most women preferred interacting with the MES via a touch screen; thus, a Tablet PC (a laptop with an integrated touch screen) was adopted for all future applications. Most women also preferred the cartoon-like narrator voice to other, more natural-sounding voices; this voice was thus retained for future use of the MES. However, a significant minority of women had strong negative reactions to this voice, particularly with the perceived requirement to listen to it throughout. Although we are not yet able to provide users with the ability to choose the voice they prefer, this option should be built into future versions of the MES. We were able to respond to concerns about length by decreasing the overall assessment burden, particularly by replacing a computer-based version of the timeline follow-back procedure (Sobell & Sobell, 1996) with a briefer measure (see below).

3. Study 2: Intervention-associated fluctuations in state motivation

3.1. Materials and methods

3.1.1. Participants—Participants in this study were drawn from 15 participants in a pilot clinical trial (Study 3, below) who were randomly assigned to the intervention condition and 35 participants in a larger clinical trial who also were assigned to the intervention condition.

All participants were postpartum women who had given birth at a large urban obstetric hospital and who endorsed any illicit drug use in the month before becoming pregnant. This liberal standard was utilized for several reasons. First, likely because of fear of negative repercussions or a confrontational lecture, many persons are unwilling to report illicit drug use: agreement between self-report of drug use and objective drug screens is minimal, with kappa estimates averaging .42 in one meta-analysis (Magura & Kang, 1996). This appears to be especially true during the prenatal period (Kline, Ng, Schittini, Levin, & Susser, 1997; Markovic et al., 2000; Ostrea, Brady, Gause, Raymundo, & Stevens, 1992), particularly among African-American women (National Institute on Drug Abuse, 1996). Second, there appears to be a genuine decrease in drug use during pregnancy, with a subsequent return to prepregnancy levels of use after parturition (Office of Applied Studies, 2004b). Thus, we chose to err on the side of inclusivity, given our interest in population impact and the very low burden of our single-session intervention.

Participation was further limited to those who had slept since giving birth, could understand spoken English, were between the ages of 18 and 45 years, and who had not been administered narcotic pain medication in the past 3 hours. All participants provided informed consent separately for the screening (verbal) and for the full study (written), and all study procedures were approved by the Wayne State University Institutional Review Board.

3.1.2. Measures—All baseline data were entered directly by participants onto a Tablet PC, which is a laptop computer with an integrated touch screen. State motivation was evaluated with three items tapping drug-use likelihood (“How likely are you to use drugs, even a little, ever again?”), problem recognition (“How big of a problem is your drug use?”), and treatment motivation (“How interested are you in treatment right now?”). Respondents answered each item via the computer, using a visual analogue scale approach in which “marks” on the scale were coded from 1 to 100. Scores for all three items were averaged after reverse scoring the drug-use likelihood item.

3.1.3. Intervention—The MES was modified based on the results of Study 1. First, a touch screen and the cartoon-like voice were utilized for all participants. Second, the length of the overall procedure was reduced by adopting a briefer substance abuse measure (the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST); see Study 3 for details) and by reducing the amount of talking done by the narrator.

3.1.4. Procedure—Participants were asked to provide ratings of their state motivation before beginning the intervention and again after each of the three intervention components (pros and cons, feedback, and goal-setting). The presentation order of the three intervention components was counterbalanced to allow exploration of any order effects.

3.1.5. Data analysis—Data were analyzed using general linear model (GLM) repeated measures, with self-reported motivation as the single within-subjects factor.

3.2. Results

Self-reported motivation was higher than at baseline after each of the three intervention components; the average of the three during-intervention ratings represented a 60.8% increase from the baseline mean of 29.9 to the average during-intervention mean of 48.0. The GLM repeated measures analysis revealed a significant effect for time, $F(3, 111) = 10.8$, $p < .001$ (sphericity assumption met). All within-subjects contrasts (each intervention component vs. baseline) were significant, $F(1, 39) = 18.9$ for the first intervention component, $F(1, 39) = 24.7$ for the second, and $F(1, 39) = 13.4$ for the third, all $p < .001$.

3.3. Discussion

The intervention appears to be associated with statistically and clinically significant increases in state motivation regarding drug use. However, there are two key shortcomings with respect to these data. First, the changes in self-reported motivation could be a function of the intervention or could simply be because of repeated assessment. Second, if the observed changes are because of the intervention, it is not clear if they would translate into long-term changes in motivation and/or changes in actual drug use. Study 3 was designed to preliminarily evaluate the extent to which observed changes in self-reported motivation (a) were because of the intervention itself, (b) persisted over time, and (c) were associated with changes in drug use.

4. Study 3: Pilot clinical trial

4.1. Materials and methods

4.1.1. Participants—Participants in the pilot clinical trial were 30 postpartum women who had given birth at a large urban obstetric hospital between September 9, 2003, and February 26, 2004, and who endorsed any illicit drug use in the month before becoming pregnant. Of the 30 women included in this trial, 15 (all in the intervention condition) were included in Study 2. All inclusion/exclusion criteria and recruitment procedures were as described for Study 2. Of women meeting all study criteria, most (32/40, 80%) agreed to participate.

4.1.2. Measures—All baseline data other than tracking information were entered directly by participants onto a Tablet PC (laptop computer with integrated touch screen). Follow-up data were collected by telephone. Only measures relevant to the present analysis will be described.

4.1.2.1. Drug-use screener: Participants completed a screener made up of multiple items primarily meant as noninvasive filler/health-related questions within which to embed the key screening item. This key item was, “Did you use any drug such as marijuana, cocaine, heroin, amphetamines (like speed, crank, or ice), or a prescription drug that was not prescribed to you, in the month before you became pregnant?”

4.1.2.2. Alcohol, Smoking, and Substance Involvement Screening Test: The World Health Organization sponsored development of the ASSIST in recognition of the need for a rapid screener that (a) evaluated all classes of substance use, (b) included quantity/frequency assessment as well as items reflecting consequences of substance use, and (c) was applicable across cultures. The ASSIST was validated on a cross-cultural sample of 1,047 adults. Using a structured interview as a gold standard, the ASSIST has demonstrated sensitivity and specificity values of .90 and .78, respectively, in discriminating between substance use and abuse, and values of .82 and .72 in discriminating between abuse and dependence (Newcombe, Humeniuk, Hallet, & Ali, 2003). The ASSIST takes approximately 5–10 minutes to complete.

4.1.2.3. Motivation to change: No existing measure of motivation to change—most of which have not been well-validated (Carey, Purnine, Maisto, & Carey, 1999)—was appropriate for our application. Previously successful measures of this construct have either used continuous scores derived from multiple items (e.g., Joe, Simpson, & Broome, 1998) or a single item representing a broad continuum of motivation (e.g., Biener & Abrams, 1991). Motivation to change was thus evaluated via eight visual analogue scale items tapping self-reported likelihood of future drug use, likelihood of quitting, openness to treatment, self-efficacy, and problem recognition. Items were designed to avoid ceiling and floor effects

with respondents who may not see their drug use as a problem (e.g., “How ready are you to quit using drugs, completely and forever?” and “How likely are you to use drugs, even a little, ever again?”). At follow-up (conducted by telephone), respondents were asked to verbally indicate a response from 1 to 10; this number was subsequently multiplied by 10 to allow comparisons with baseline data. Scores on all eight items were averaged (reverse-scoring two items tapping drug-use likelihood) to yield a combined score ranging from 1 to 100.

Internal consistency of this 8-item measure was acceptable at baseline (.70). However, internal consistency of the same eight items at follow-up was unacceptable (.31), primarily because of the influence of two items (“How interested are you in treatment for your drug use?” and “How much of a problem is your drug use?”). It appeared that these two items, on follow-up, might have become confounded based upon inevitable change among some participants. That is, at follow-up, lower scores on these items for some participants may have reflected declines in motivation; for others, lower scores on these items may have reflected progress in making actual change—thus making their drug use less problematic, and treatment less relevant. These two items were thus dropped for pre–post comparisons, creating a 6-item measure with good internal consistency (.86 at baseline and .77 at follow-up). The distribution of responses to specific items in this measure was favorable.

4.1.2.4. Treatment Services Review: Drug and alcohol use, receipt of services such as substance-abuse treatment, employment, and family relations during the prior 14 days were evaluated using the 14-day edition of the Treatment Services Review (McLellan, Alterman, Cacciola, Metzger, & O’Brien, 1992). The Treatment Services Review was administered by telephone at follow-up only.

4.1.3. Procedure—After completion of the assessment battery, participants were randomly assigned by the software into assessment only or assessment plus intervention conditions. Those receiving the intervention viewed the three components described above (personalized feedback, the pros and cons of drug use, and optional goal-setting) in counterbalanced order. Three visual analogue-scale items from the motivation to change measure (“How likely are you to use drugs, even a little, ever again?” “How interested are you in treatment for your drug use?” and “How much of a problem is your drug use?”) were presented after each counterbalanced component. A research assistant, blind to experimental condition, contacted the participants again by telephone at an average follow-up duration of 38.6 days (range 25–77).

4.1.4. Data analysis—Analyses for this pilot study were primarily descriptive, with emphasis on magnitude of intervention effects on drug use, service involvement, and motivation at follow-up evaluation. All analyses of magnitude of effects used Cohen’s d ($d = M_1 - M_2 / \text{pooled}$) and an intent-to-treat approach, carrying forward baseline data for participants who were lost to follow-up. Supplemental explanatory analyses, considering (a) only participants for whom follow-up data were available and (b) only those participants with daily or almost daily drug use, were also conducted. A final exploratory analysis examined the extent to which during-treatment changes in state motivation were predictive of motivation scores at follow-up.

4.2. Results

4.2.1. Sample characteristics and follow-up attrition—Final participants were almost exclusively African American (29/30, or 97%) and low income (27/30, or 90%, had received some form of public assistance in the past year, and 11, or 37%, had spent the night in a homeless shelter at least once in their lives). Mean age was 23.4 years ($SD = 4.9$, range

18–34). Six participants (20%) reported having been prescribed medication for the treatment of depression, anxiety, or other emotional difficulties at least once in their lives.

Reported drug use was relatively light in this sample: 11 participants (37%) indicated daily or almost daily use of marijuana in the 3 months before becoming pregnant; 8 participants (27%) reported use of cocaine, amphetamines, opiates, hallucinogens, or inhalants in the 3 months before becoming pregnant, but none reported use of any of these drugs more often than monthly. In spite of this, 21 of the 30 participants (70%) merited a brief intervention for drug use, according to ASSIST criteria. There were no significant differences between intervention and control groups on any baseline substance-use variables.

A total of 22 participants (73%), 10 from the intervention condition and 12 from the control condition, provided follow-up data by telephone. Rate of retention did not differ significantly between the experimental and control conditions. The remaining eight participants provided invalid contact information, did not return telephone calls, or otherwise could not be located. Participants who were lost to follow-up scored significantly higher on the ASSIST marijuana use scale [$M = 10$ vs. 5.7 , $t(25) = 2.2$, $p = .04$] but were not significantly different on other baseline characteristics.

4.2.2. Intervention effects on key outcomes at follow-up

4.2.2.1. Drug use and treatment involvement: At follow-up, only two participants reported any drug use (one participant from the control group reported drug use on 3 of the past 14 days and one participant from the intervention group reported drug use on 1 of the past 14 days). One participant from the control group and none from the intervention group reported having attended some substance-abuse treatment in the 14 days before follow-up data collection. No further analyses were conducted on these outcomes given the clear presence of floor effects.

4.2.2.2. Motivation to change: Treatment group means at baseline and follow-up for the 6-item measure of motivation are presented in Table 2. Although motivation decreased slightly in the assessment-only control group, there was a small increase in motivation for participants in the intervention condition. Although the two groups did not differ significantly on baseline motivation, the slightly higher baseline motivation for the intervention group could have biased the results in favor of intervention effects. Thus, effect-size analysis was conducted on change scores derived by subtracting the follow-up motivation score from that obtained at baseline. Analysis of change scores for all participants in an intent-to-treat analysis (carrying forward baseline scores for those lost to follow-up) yielded an intervention effect (Cohen's d) of .49, the 95% confidence interval (CI) of which did include zero (see Table 2). Supplemental explanatory analysis was also conducted restricting inclusion to the 22 participants for whom follow-up data were available. These analyses yielded an intervention effect of $d = .61$ (95% CI -0.27 to 1.44) using change scores, and $d = .68$ (95% CI -0.21 to 1.51) using raw follow-up motivation scores.

The relatively low drug use reported by many in this sample, as well as the differential attrition of heavier drug users, could imply that these results apply only to casual drug users. The above effect-size analysis was thus repeated on the subset of participants who reported daily or almost daily use of marijuana ($n = 11$, 6 intervention and 5 control). Using raw follow-up scores because of similarity in baseline motivation, the effect size estimate was similar to that found in the larger sample ($d = .55$, 95% CI -0.70 to 1.71).

4.2.3. Exploration of dynamic indicators of change likelihood—As noted, 10 participants completed both the intervention and follow-up data collection. Among these 10

women, scores reflecting during-treatment change in motivation were derived by subtracting baseline motivation from mean during-treatment motivation scores. This process yielded nine items reflecting scores for each of the three items, measured after each of three intervention components. Six of the nine items correlated with follow-up motivation at $r = .30$ or higher.

5. Overall discussion

Most persons with substance-use disorders do not seek, obtain, or desire services. Therefore, a tremendous need exists to develop ways to proactively identify and facilitate treatment involvement and/or self-change in this group. The efficacy, relative affordability, and brevity of brief interventions suggest that this approach has potential, particularly as applied in primary care settings. Many persons who would not otherwise participate in formal treatment appear willing to engage in a brief intervention, particularly when only a single session is required. However, issues regarding training, acceptability, added cost, and time all limit the potential population impact of brief interventions.

A computer-based screening, evaluation, and brief intervention process, if acceptable and efficacious, could increase the proportion of persons with substance-use disorders who can be accessed. The present results suggest that such a system is feasible and acceptable to a low-income, urban population. Although very preliminary, the present results also suggest that such a system is promising in terms of efficacy; its effect on motivation in this very small sample—both during intervention and at follow-up—was encouraging. Further, the possibility of using a proximal variable such as during-intervention change in motivation to predict distal outcomes is intriguing. Such a variable could facilitate rapid improvement in software design by serving as a proxy for later response and could also help identify those for whom an alternate approach might be necessary. The software could even be programmed to flexibly modify its approach with a given participant, using empirically based rules to present various intervention components until the desired response is achieved.

A number of limitations must be highlighted, most notably the very small sample size in the pilot clinical trial. Because of this lack of power, a statistically significant difference between groups was not demonstrated, and the 95% CI for the effect size estimate included zero. The present results, thus, should not be construed as validation of the MES. Further, participants in the present study reported drug use at levels too low to evaluate intervention effects on this outcome. It is unclear whether the low level of use reported at follow-up was due to women not yet returning to prior levels of drug use fear of repercussions if their drug use became known (particularly given the frequency with which women at this hospital lose custody of their infants for this reason) or other factors. Regardless, the levels of use at both baseline and follow-up are likely to reflect substantial underreporting: Meconium data from previous studies in this hospital have yielded evidence of cocaine use in up to 31% of a universal sample (Ostrea et al., 1992). A larger clinical trial of the MES currently underway includes urinalysis for drugs of abuse at follow-up evaluation. Importantly, the magnitude of intervention-related changes in motivation did not differ substantially in analyses restricted to those who reported daily or near-daily drug use.

The very low levels of self-reported drug use at follow-up left only self-reported motivation as a means of evaluating potential efficacy. We conceptualized change readiness as a state-like and continuous variable, rather than as a distinct trait-like stage; the approach we took may be more consistent with available findings and may also be preferable for use of motivation as an outcome variable (Carey et al., 1999). Other measures of self-reported motivation regarding drug or alcohol use have shown good ability to predict behavior (e.g.,

Joe et al., 1998). Although this measure may have been subject to the same response biases as the direct questions about actual drug use, it did not suffer from similar restriction of range; further, the use of random assignment suggests that response bias likely played an equal role in each group.

There are a number of possible variations in the design of computer-based brief interventions. They can incorporate videos, interactive games, educational modules, skills-training components, individualized feedback, problem-solving and goal-setting techniques, complex two-way conversations using voice recognition software, and even technology that uses a camera to read and analyze the emotion state of the user in real time. They can match themselves to user characteristics on a nearly infinite number of dimensions. In addition, the efficacy of each individual component can be easily evaluated given the highly modular, definable, and replicable nature of computer-based intervention. (This latter aspect has led some to suggest that computer-based approaches may be ideal platforms from which to test theoretical assumptions, e.g., Bickel & March, 2002).

Thus, motivational adaptations may be only one of many possible uses of computer technology in the addictions. The reach of computer-based approaches, combined with the tremendous array of approaches that have yet to be tested, gives them unique—although as yet unproven—potential for population impact. This potential should be thoroughly explored.

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Table 1

Mean participant ratings on quantitative satisfaction items

Item	Hospital sample (<i>n</i> = 30)		Intensive outpatient sample (<i>n</i> = 10)		Methadone maintenance sample (<i>n</i> = 7)		Total sample (<i>N</i> = 47)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Overall liking	4.7	0.7	5.0	0.0	4.7	0.5	4.7	0.6
Interesting	4.1	1.2	4.2	0.6	4.9	0.4	4.2	1.0
Easy to use	5.0	0.2	5.0	0.0	5.0	0.0	5.0	0.1
Understandable	5.0	0.0	5.0	0.0	4.9	0.4	5.0	0.1
Respectful	4.8	0.7	4.8	0.4	4.7	0.8	4.8	0.6
Annoying	1.6	1.3	2.6	1.8	1.9	1.1	1.8	1.4
Humorous	4.2	1.2	4.1	1.0	3.9	1.1	4.1	1.1
Interested in intervention again	–	–	4.3	1.1	4.0	1.0	4.2	1.0

All ratings are based on a 1–5 Likert scale, where 1 = *not at all* and 5 = *very much*. Participants in the hospital sample completed only the MES assessment section; participants from the two treatment samples completed assessment and intervention sections.

Table 2
Mean motivation at baseline and follow-up for intervention and control conditions (*n* = 30)

Assessment	Assessment only		Assessment plus brief intervention			Effect size (95% CI)
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	
Baseline	15	79.5	21.2	15	82.5	18.9
Follow-up	15	77.4	20.0	15	88.8	10.0

Effect size is based on change scores using the formula $d = M_1 - M_2 / \text{pooled } SD$. Values at follow-up are based on intent-to-treat analysis, carrying baseline values forward for eight participants lost to follow-up.