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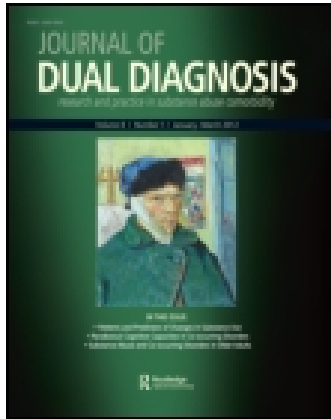
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^a Dartmouth Psychiatric Research Center, Department of Psychiatry, The Geisel School of Medicine at Dartmouth, Hanover, New Hampshire, USA

^b Department of Psychiatry, The Geisel School of Medicine at Dartmouth, Concord, New Hampshire, USA

^c Center for Psychiatric Rehabilitation, Boston University, Boston, Massachusetts, USA

^d Thresholds-Dartmouth Research Center, Chicago, Illinois, USA

^e Center on Mental Health Services Research and Policy, Department of Psychiatry, University of Illinois at Chicago, Chicago, Illinois, USA

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Do Symptoms and Cognitive Problems Affect the Use and Efficacy of a Web-Based Decision Support System for Smokers With Serious Mental Illness?

Joelle C. Ferron, PhD,¹ Mary F. Brunette, MD,² Susan R. McGurk, PhD,³ Haiyi Xie, PhD,¹ Rochelle Frounfelker, MSSW, MPH,⁴ Judith A. Cook, PhD,⁵ Jessica A. Jonikas, MA,⁵ and Gregory J. McHugo, PhD¹

Objective: People with severe mental illnesses are more likely to have nicotine dependence than the general population and do not use effective cessation treatment when they try to quit. Previous research has shown that a web-based motivational decision support system tailored for this population is associated with increased use of evidence-based cessation treatment. This study examines how user characteristics, including cognitive functioning and psychiatric symptoms, impact use and outcomes of this website. **Methods:** One hundred twenty-eight smokers with severe mental illnesses were assessed at baseline for demographics, smoking characteristics, symptoms, cognition, and reading ability. They used the decision support system within 2 weeks of the baseline interview. Two months after use of the decision support system, researchers assessed participants' smoking behaviors, use of evidence-based cessation treatment, clinician contact, and other quitting behaviors. Analyses modeled the relationship of participant characteristics to (a) process outcomes, including time spent on the website, and (b) behavioral outcomes, including use of effective cessation treatment. **Results:** Thirty-two percent of smokers initiated one or more of the recommended treatments after using the decision support system and 51% demonstrated some kind of smoking cessation behavior. When controlling for cigarette use, symptoms, cognition, and other potential predictors, regression analysis showed that being older, having a diagnosis of a schizophrenia spectrum disorder, and cognitive impairment were associated with a greater amount of time spent in the motivation section. Older age and diagnosis of schizophrenia were associated with time spent in the decision support section. Controlling for multiple characteristics, participants' self-reported readiness to quit smoking was the only characteristic that predicted use of cessation treatment and other cessation behaviors over the following 2 months. **Conclusions:** Smokers with serious mental illness compensated for symptoms, old age, lower cognition, and lower reading capability by taking more time using the motivational decision support system. Following use, one-third of smokers engaged in treatment regardless of individual characteristics. The flexible design of this intervention may allow participants to tailor their use of it to meet individual needs. Future research should address both process and outcomes of motivational smoking cessation interventions. (*Journal of Dual Diagnosis*, 8:315–325, 2012)

Keywords *dual diagnosis, smoking cessation, computerized intervention, serious mental illness, nicotine addiction*

Smoking is the number one preventable cause of mortality in the United States (CDC, 2008; Doll, Peto, Boreham, & Sutherland, 2004; Mucha, Stephenson, Morandi, & Dirani, 2006). People with serious mental illnesses (i.e., schizophrenia, schizoaffective disorder, bipolar disorder, and severe mood disorders) are more likely to smoke than others without serious mental illness (Anonymous, 2008; de Leon & Diaz, 2005; de

Leon, Diaz, Rogers, Browne, & Dinsmore, 2002; Etter, Mohr, Garin, & Etter, 2004; Forchuk et al., 2002; Herran et al., 2000; Kotov, Guey, Bromet, & Schwartz, 2010; Lasser et al., 2000; Lawrence, Mitrou, & Zubrick, 2009); indeed, nicotine dependence co-occurs among 50% to 80% of people with serious mental illness. Moreover, studies have found that people with serious mental illness are dying 25 years earlier than the general population, due in large part to smoking-related diseases (Brown, Inskip, & Barraclough, 2000; Chwastiak & Tek, 2009; Colton & Manderscheid, 2006; Hoang, Stewart, & Goldacre, 2011; Mauer, 2006; Tiisonen et al., 2009).

Many smokers with serious mental illness want to quit smoking (Addington, el-Guelbaly, Addington, & Hodgins, 1997; Baker et al., 2007; Dixon et al., 2007; Esterberg & Compton, 2005; Etter et al., 2004; Mann-Wrobel, Bennett, Weiner, Buchanan, & Ball, 2011; Moeller-Saxone, 2008; J. J. Prochaska et al., 2011; Siru, Hulse, & Tait, 2009). Smoking cessation medications, provided in combination with behavioral interventions, improve outcomes for people with

¹Dartmouth Psychiatric Research Center, Department of Psychiatry, The Geisel School of Medicine at Dartmouth, Hanover, New Hampshire, USA

²Department of Psychiatry, The Geisel School of Medicine at Dartmouth, Concord, New Hampshire, USA

³Center for Psychiatric Rehabilitation, Boston University, Boston, Massachusetts, USA

⁴Thresholds-Dartmouth Research Center, Chicago, Illinois, USA

⁵Center on Mental Health Services Research and Policy, Department of Psychiatry, University of Illinois at Chicago, Chicago, Illinois, USA

Address correspondence to Joelle C. Ferron, PhD, Dartmouth Psychiatric Research Center, 85 Mechanic St., Suite B4-1, Lebanon, NH 03766, USA. E-mail: joelle.ferron@dartmouth.edu

schizophrenia (Baker et al., 2006; Dutra, Stoeckel, Carlini, Pizzagalli, & Evins, 2011; Evins et al., 2007; Evins et al., 2005; Ferron, Alterman, McHugo, Brunette, & Drake, 2009; George et al., 2008; George et al., 2002; Gershon Grand, Hwang, Han, George, & Brody, 2007; Nino-Gomez et al., 2010; Tsoi, Porwal, & Webster, 2010; Weiner et al., 2011), bipolar disorder (Baker et al., 2006; Gershon Grand et al., 2007), and active major depression (Evins et al., 2008; Gershon Grand et al., 2007; Hall et al., 2006). Unfortunately, many of these smokers attempt to quit without the use of these effective treatments (Davis, Brunette, Vorhies, Ferron, & Whitley, 2010; Lucksted, Dixon, & Sembly, 2000; Mann-Wrobel et al., 2011; Morris, Waxmonsky, & May, 2009; J. J. Prochaska et al., 2011), in part due to a lack of knowledge about or negative attitudes toward treatment (Esterberg & Compton, 2005; Kelly et al., 2012; Lucksted, McGuire, Postrado, Kreyenbuhl, & Dixon, 2004; Mann-Wrobel et al., 2011; Morris et al., 2009).

People with serious mental illness can be engaged in smoking cessation treatment through clinician- (Steinberg, Williams, & Ziedonis, 2004) or consumer-delivered (Williams et al., 2010) motivational interviewing. Although motivational interviewing is effective (Lai, Cahill, Qin, & Tang, 2010), most mental health centers and primary care settings where this population typically accesses treatment do not have the resources to provide it (Brunette et al., 2008; Levit et al., 2008; Morris et al., 2009; Truffer et al., 2010; Weinberger, Reutenauer, Vessicchio, & George, 2008). Websites can provide treatments that are not available in clinics (Bock, Graham, Whiteley, & Stoddard, 2008; Shahab & McEwen, 2009), but some people with serious mental illness find it difficult to use these websites (Brunette, Ferron, Devitt, et al., 2011), likely due to their lack of computer experience, lack of access, and cognitive impairments.

With extensive usability testing and state-of-the-art research on web design for people with cognitive impairments (Rotondi et al., 2007), the authors developed a web-based motivational decision support system that is tailored to be usable by people with serious mental illness to address nicotine dependence (Ferron, Brunette, Martin, & Devitt, 2011). This web-based system engages and motivates people to quit by using evidence-based smoking cessation treatment. Initial studies suggest that smokers with serious mental illness who use the system are more likely to use cessation treatment than those who are given a pamphlet (Brunette, Ferron, McHugo, et al., 2011). Further, usability research showed that people with serious mental illness were able to navigate the system with its flat, linear interface, large buttons, one-click mousing, and 5th-grade reading level, but little is known about how the clinical profile of users may influence treatment outcomes. Specifically, do people with prominent cognitive impairments and persistent psychiatric symptoms use the system and achieve outcomes that are similar to smokers with fewer impairments? This study examined whether cognitive functioning (i.e., cognition, reading ability, and reading comprehension), clinical characteristics (diagnosis, psychiatric symptoms, and level of

nicotine dependence), and computer experience predict time spent using the website and whether these variables predict the main proximal outcome, engagement in smoking cessation treatment, and other quit behaviors.

METHODS

Overview

In 2011, 131 adult smokers with severe mental illnesses received full information about the study; gave written informed consent to participate; were assessed for smoking characteristics, symptoms, and cognition; and used the web-based motivational decision support system. After 2 months, they completed a second interview to assess efficacy outcomes including cessation treatment initiation and other quit behaviors. Analyses tested whether individual differences in symptoms and cognition predicted time spent with the decision support system and response to the intervention (engagement in smoking cessation treatment and other quit behaviors). This study is a secondary analysis of data from this parent study that evaluated a randomized controlled trial of whether use of feedback from a carbon monoxide monitor was a necessary ingredient in the decision support system. Results from the main study are submitted for publication elsewhere. This study was conducted in accordance with the Declaration of Helsinki and reviewed and approved by the Committee for the Protection of Human Subjects at Dartmouth College.

Participants

Through flyers and clinician referrals, we recruited English-speaking adult smokers with serious mental illness who were receiving care at seven service locations within a large, urban psychiatric rehabilitation center. Research and clinical staff screened 1,297 adult clients for eligibility and invited 286 potentially eligible clients to participate. Exclusion criteria included (a) not smoking cigarettes daily, (b) having a current alcohol or drug dependence diagnosis without active treatment for the addiction, (c) psychiatric instability, and (d) inability to provide informed consent. Of the 286 individuals clinical staff invited to participate, 144 (50%) declined. One hundred forty-two individuals consented, 135 completed baseline assessments, and 131 completed the motivational decision support system. Following the use of the system, three more dropped out before the 2-month interview ($n = 128$). Reasons for leaving the study included having a busy schedule, losing interest in the study, disliking the cognitive testing, and moving away. The final study group included 131 participants whose use of the intervention provided data for the process analysis and 128 (94.8%) participants who completed the 2-month follow-up assessments of engagement in cessation treatment.

Measures

Demographics, Diagnoses, and Computer Use

Research staff used structured interviews to collect information about demographics (age, level of education, race, ethnicity, marital status), smoking history, history of computer use, and lifetime psychiatric hospitalizations. Clinic records were reviewed to obtain psychiatric diagnoses.

Tobacco Measures

At baseline and 2 months, research staff administered the following measures by in-person interview. The Fagerström Test for Nicotine Dependence assessed nicotine dependence with scores that can range from 1 (indicating the least dependence) to 10 (most dependence; Weinberger et al., 2007). Additional measures of smoking included average number of cigarettes smoked per day and number of quit attempts. A single question assessed stage of change related to smoking cessation at baseline and at the end of the motivational decision support system (1 = want to quit and trying to quit right now; 2 = want to quit in the next month; 3 = want to quit but not within the next month; and 4 = do not want to quit; Donovan, Jones, Holman, & Corti, 1998).

Psychiatric Symptoms

The modified Colorado Symptom Index (CSI; Shern, Wilson, & Coen, 1994) is a 14-item questionnaire that assesses psychiatric symptoms. Respondents report the frequency of symptoms in the past month using a scale from 0 (not at all) to 4 (at least every day). The CSI has been found to be reliable and valid in people with mental illness and/or substance use disorder (Conrad et al., 2001). It has high internal consistency and good test-retest reliability (Boothroyd & Chen, 2008). The scores range from 0 to 56, with higher scores indicating more severe symptoms.

Cognitive Assessments

The Brief Assessment of Cognition in Schizophrenia (BACS; Keefe et al., 2004) is a valid, reliable, and brief assessment of cognitive functions in severe mental illness. The BACS has 6 tests that measure the cognitive domains of reasoning and problem solving, information processing speed, verbal learning, working memory, and motor speed. Raw BACS scores from the subtests were standardized (i.e., z scores were formed) and then summed.

The Wide Range Achievement Test IV (WRAT; Wilkenson & Robertson, 2006) is an academic achievement test. The Word Reading subtest—the dependent measure is total words correctly read (0 through 70)—and Sentence

Comprehension—the dependent measure is the total correct words correctly provided to complete each sentence (0 through 50)—were administered.

Outcome Measures

The main outcomes of the study were twofold: first, process variables, including length of time spent on the two motivational decision support system subsections and choice of video host, and second, behavioral outcome variables, including number of behaviors indicative of motivation to quit smoking (e.g., evidence-based treatment initiation).

Process Measures

Use of the audio function of the program (yes/no); choice of video host (a young African American woman, a middle-aged Latina woman, or a middle-aged Caucasian man); length of time using the two website sections and the total website were automatically recorded as the participants used the program. Data obtained from the server were validated through screencast software recordings of participants using the website, which was compared with data collected by the program. The results of the validation showed that the data were 100% accurate.

Behavioral Outcomes

Behaviors indicative of motivation were assessed with the Behavior Motivation Index, a checklist developed by the authors that assessed whether the participant (a) made a quit attempt without treatment, (b) met with a smoking cessation specialist to discuss cessation treatment, (c) met with a physician to discuss cessation treatment, (d) attended at least one session of a cognitive behavioral treatment group for smoking cessation, (e) attended at least one session of cognitive behavioral individual smoking cessation treatment, and (f) initiated a medication for smoking cessation. Research staff verified self-report of these indicators through administrative and medical records and verbal clinician report if needed.

Procedures

Within 2 weeks of the baseline assessment, participants used the motivational decision support system in a clinic office with research staff present, following a structured protocol. All participants who attended the visit to use the decision support system completed it. After using the system, staff offered participants the opportunity to make an appointment with the smoking cessation specialist that day or later during the 2-month follow-up period. Participants were told that they could talk with the specialist about treatment options for

smoking cessation, meet with a counselor or a psychiatrist to discuss smoking cessation, receive medication for smoking cessation (including nicotine replacement therapy, bupropion, and varenicline), and/or attend a weekly cognitive behavioral therapy group for smoking cessation. Prescribers for cessation medication and cognitive behavioral smoking cessation groups were available to all participants at all sites.

Intervention

The motivational decision support system has both content and functionality that is tailored for people with co-occurring severe mental illness and nicotine dependence. This simple, interactive web-based program has functionality designed specifically for people with psychotic symptoms, cognitive deficits, and minimal computer experience (Ferron et al., 2011). We applied national guidelines for usability by people with cognitive deficits (Anonymous, 2007), results of previous research on usability by people with schizophrenia (Rotondi et al., 2007), and extensive user testing (Ferron et al., 2011) to guide the development of the following usability features. An optional mouse tutorial is available at the beginning for those who have not used a computer. The program offers an optional audio function, in which the text is read aloud to the user as it is highlighted on the screen (for people who either cannot read or prefer to have the program read to them). The system provides a small amount of information on each page. As shown in Figure 1, the large-font text is at the fifth-grade reading level and is formatted on a blank background with a simple border graphic.

The system contains content, including role models, that is designed to motivate people with severe mental illness from all ethnic and racial backgrounds to quit smoking with an evidence-based treatment. First, participants choose from three video-recorded program hosts (a young African American woman, a middle-aged Latina woman, and a middle-aged Caucasian man), who identify themselves as ex-smokers with

mental illness. The host introduces each section of the program and encourages users to quit smoking.

The first half of the program is designed to increase motivation for quitting by helping the user become more familiar with the personal impact of smoking. Initially, the system assesses a user's smoking by asking how much he or she smokes and how much money is spent on tobacco. The user completes a checklist of short-term and chronic health problems that are related to tobacco use. The program then provides the user feedback on these assessments. The program also gives information about the health risks of smoking within an outline of a human body, upon which users can hover their cursors to get more information. Users answer questions about their personal views of the pros and cons of smoking and create a summary in the form of a decisional balance. These types of interactive exercises were designed to personalize the impact of smoking, improve attitudes about quitting, increase self-efficacy for quitting, and ultimately motivate smoking cessation behaviors.

The second half of the program provides decision support for cessation treatment with video consumer testimonials and text about quitting through use of evidence-based smoking cessation treatments. Users can access additional information about different treatments by clicking a "get more information" button. The cessation treatment information is designed to prepare users for a discussion with a clinician about choosing a treatment. At the end of the program, users can print out a personal report, which contains the individualized feedback they were given throughout the program.

Data Analyses

We used Statistical Analysis Software (SAS 9.3) to conduct the analyses. Variables were assessed for collinearity. When collinearity was present among similar constructs, only one variable was selected to represent that construct within the models. Ordinary least squares regressions were used to create models that predicted time spent in the motivation and

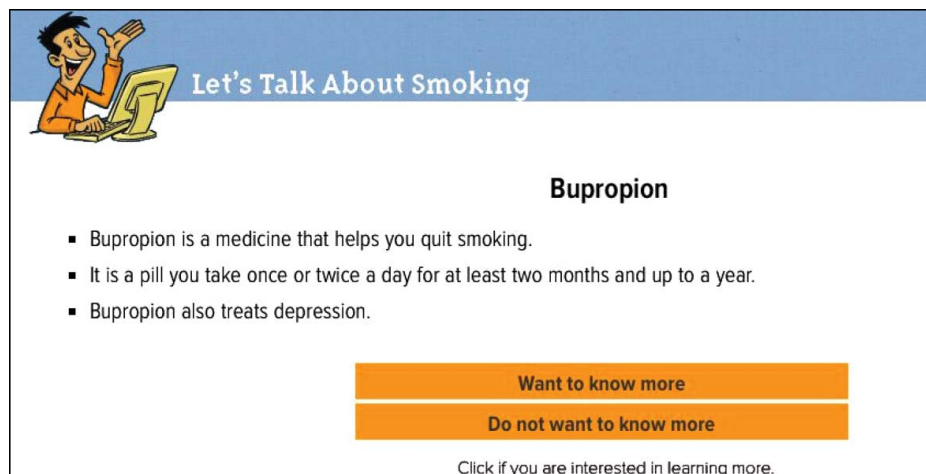


FIGURE 1 Screenshot of the motivational decision support system (color figure available online).

treatment sections of the program. Negative binomial regression was used to model number of smoking cessation engagement behaviors because these are count data with numerous zeros and a limited range. We included multiple variables in these models to control for a range of individual differences. Where there was missing data, regression models used listwise deletion, and thus sample sizes vary slightly across tables.

RESULTS

Participant Characteristics

Participant characteristics are shown in Table 1. Most of the participants were male (72%), single (74%), and in their mid to late forties. About half were African American (47%). On average, participants had not completed high school and of those who did not, few had passed the General Education Development test ($n = 28$, 24%).

Cognitive performance scores indicated functioning from the low average to moderately impaired range. This level of cognitive performance is consistent with BACS performance levels in other studies of persons with schizophrenia (Keefe et al., 2008). Participants' scores on the WRAT Reading and Comprehension subtests reflected an overall ninth-grade level of reading and sentence comprehension.

Process and Behavioral Outcomes

Outcomes are described in Table 2. More than half (55%) of the participants chose a young African American woman to be the program host. Participants spend an average of 92 minutes on the website, split evenly between the motivation and the treatment sections. Seventy-four percent of participants used the audio function of the program. Sixty-one percent ($n = 82$) reported having used a computer more than five times in their life, and 22% ($n = 30$) reported having no computer experience.

As shown in Table 2, about one-third of the group initiated cessation treatment. Additionally, almost a third met with a smoking cessation specialist to discuss treatment and almost 40% of participants discussed using a quit smoking medication with their doctor. Indeed, as seen in Figure 2, more than 50% of the participants engaged in one or more behavioral indicator of motivation.

Choice of Program Host

African American participants were more likely to choose the African American host than the Caucasian or Latina hosts; $\chi^2(1, N = 131) = 6.5, p = .01$. Caucasian and Latino participants were not significantly more likely to choose race- or

TABLE 1
Baseline Demographics ($N = 135$)

Variable	<i>n</i>	%/ <i>M</i>	<i>SD</i>	Range	
				Lower	Upper
Male	97	71.85			
Age	135	46	10	21	65
Highest grade completed	135	11.41	2.41	6	19
Race					
Black	64	47.41			
White	49	36.3			
Other	22	16.3			
Latino (yes)	19	14.07			
Marital status					
Single	100	74.07			
Cohabiting/married	10	7.41			
Divorced/separated	24	17.78			
Diagnosis					
Schizophrenia/schizoaffective disorder	95	70.37			
Mood disorder	34	25.19			
Other	6	4.44			
Colorado Symptom Index	135	15.95	9.81	0	44
Number of cigarettes smoked per day	135	15.04	10.94	0.15	57.14
Fagerström (level of dependence)	135	3.91	1.85	0	7
Cognitive scores					
BACS total <i>z</i> -score	132	-2.23	1.37	-5.95	1.27
WRAT Reading (raw)	128	50.39	12.14	-2.09	69
WRAT Sentence Comprehension (raw)	127	33.31	11.2	3	50

Note. WRAT = Wide Range Achievement Test; BACS = Brief Assessment of Cognition for Schizophrenia.

TABLE 2
Process Measures and Behavioral Outcomes (N = 131)

Computer Process Variables	n	%/M	SD	Range	
Used audio function	97	74.05		Lower	Upper
Time spent on website (minutes)	131	92.27	32.77	32.12	190.3
Total time spent on the Decision Support Section	131	46.05	21.34	10.5	111.38
Total time spent on the Motivation Section	131	46.22	17.38	20.28	109.33
Computer experience					
Never	30	22			
Less than 5 times	23	17			
More than 5 times	82	61			
Video host					
African American female	72	54.96			
Latina female	27	20.61			
White male	32	24.43			
Behavioral outcomes					
Engaged in smoking cessation treatment	39	32.2			
Met with a smoking cessation specialist	41	32.03			
Met with a doctor to discuss cessation meds	50	39.06			
Attended a smoking cessation group/class	27	21.09			
Attended individual smoking cessation counseling	13	10.16			
Took a smoking cessation medication	33	25.78			

ethnically matched hosts; $\chi^2(1, N = 131) = 1.4, p = .23$ and $\chi^2(1, N = 131) = 3.5, p = .06$, respectively. Younger people were more likely to choose the young African American female host; $F(2, 131) = 3.98, p = .02$. Gender was not associated with choice of host; $\chi^2(1, N = 131) = 0.23, p = .63$.

Time in the Motivation and Decision Support Sections of the Program

When controlling for nicotine use, symptoms, cognition, and other potential predictors, regression analysis showed that older age, a diagnosis of schizophrenia or schizoaffective disorder, and greater cognitive impairment predicted

spending more time in the motivation section of the program (see Table 3). Likewise, regression analysis showed that older age and a diagnosis of schizophrenia or schizoaffective were associated with a longer time spent in the decision support section of the program (see Table 4). In addition, users who were ready to quit (higher stage of chance score) spent more time in the decision support section of the program.

Engagement in Cessation Activities

Controlling for cognitive functioning, level of symptoms, nicotine use, and other possible predictors, results of the regression analysis indicated that participants' stage of change

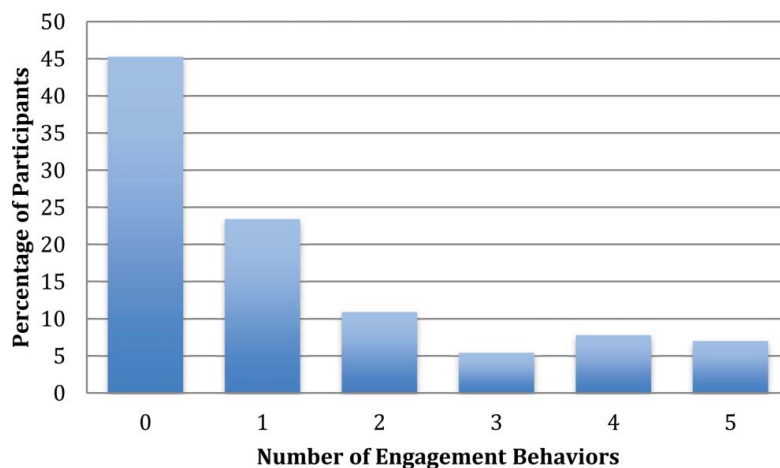


FIGURE 2 Histogram of number of smoking cessation engagement behaviors (color figure available online).

TABLE 3
Predictors of Time Spent in Motivation Section ($N = 122$)

Covariates	β	SE β	t	p	95% Confidence interval	
					Lower	Upper
Intercept	14.79	14.47	1.02	0.31	-13.88	43.46
Age	0.50	0.16	3.05***	0.00	0.17	0.82
Gender	4.78	3.24	1.47	0.14	-1.64	11.19
White	0.45	3.15	0.14	0.89	-5.79	6.70
Schizophrenia or schizoaffective disorder	8.64	3.38	2.55**	0.01	1.94	15.35
Colorado Symptom Index	0.08	0.16	0.49	0.63	-0.23	0.38
BACS total z -score	-3.11	1.32	-2.35*	0.02	-5.73	-0.49
WRAT Sentence Comprehension (raw)	-0.04	0.17	-0.23	0.82	-0.38	0.30
Number of cigarettes smoked per day	0.04	0.14	0.30	0.76	-0.24	0.33
Audio (text to speech)	0.36	3.60	0.10	0.92	-6.78	7.50
Computer experience	-2.79	1.99	-1.40	0.16	-6.73	1.15
Stage of change	0.02	1.42	0.02	0.99	-2.79	2.83

Note. The R -squared for this model is .29; β = beta coefficient; SE β = standard error of the beta coefficient; WRAT = Wide Range Achievement Test; BACS = Brief Assessment of Cognition for Schizophrenia.

* $p < .05$. ** $p < .01$. *** $p \leq .001$.

for smoking cessation (assessed immediately after intervention completion) predicted engagement in cessation behaviors over the next 2 months.

DISCUSSION

Among this group of people with serious mental illness who smoke, those with lower education, older age, diagnoses of psychotic disorders, and greater cognitive impairment spent more time using the system. At the same time, education, diagnosis, symptoms, cognitive functioning, and other characteristics did not relate to cessation behaviors, indicating that

people with greater levels of symptomatology and cognitive impairments may respond as well to the intervention as their less symptomatic, less cognitively impaired counterparts. The system also appeared to be effective for men and women of varying ages, races, and ethnicities.

As with prior research, our results suggest that delivering simple information via audio and visual text at the 5th-grade reading level helps program users compensate for cognitive impairments and poorer reading and comprehension skills, such that engagement into treatment is not negatively impacted. Generalizability of the compensatory features of the decision support system findings are enhanced by the fact that the educational disadvantages and cognitive impairments of

TABLE 4
Predictors of Time Spent in Decision Support Section ($N = 122$)

Covariates	β	SE β	t	p	95% Confidence Interval	
					Lower	Upper
Intercept	15.24	16.56	0.92	0.36	-17.59	48.06
Age	0.90	0.19	4.8***	0.00	0.53	1.27
Gender	-6.22	3.71	-1.68	0.10	-13.57	1.12
White	-2.25	3.61	-0.62	0.53	-9.41	4.91
Schizophrenia or schizoaffective disorder	7.93	3.88	2.05*	0.04	0.25	15.61
Colorado Symptom Index	0.27	0.18	1.51	0.14	-0.08	0.62
BACS total z -score	-0.54	1.51	-0.36	0.72	-3.55	2.46
WRAT Sentence Comprehension (raw)	-0.38	0.20	-1.93	0.06	-0.77	0.01
Number of cigarettes smoked per day	-0.05	0.17	-0.29	0.77	-0.38	0.28
Audio (text to speech)	4.80	4.12	1.16	0.25	-3.38	12.97
Computer experience	0.74	2.28	0.32	0.75	-3.78	5.25
Stage of change	-4.05	1.62	-2.5	0.01	-7.27	-0.84

Note. The R -squared for this model is .30; β = beta coefficient; SE β = standard error of the beta coefficient; WRAT = Wide Range Achievement Test; BACS = Brief Assessment of Cognition for Schizophrenia.

* $p < .05$. *** $p \leq .001$.

participants are consistent with those with serious mental illness in other treatment studies using cognitive technologies (McGurk, Mueser, DeRosa, & Wolfe, 2009; McGurk, Mueser, & Pascaris, 2005). Although this research does not establish whether the audio functionality was a key feature leading to improved comprehension, it was a popular function of the system, especially with those having greater reading and comprehension difficulties, indicating the acceptability of these user functions to persons with compromised academic and cognitive capacities.

One way that web-delivered interventions can be tailored is by matching characteristics of users to people shown in the program. Research on the impact of matching clinician to patients based on race, age, and gender has been mixed (Farsimadana, Draghi-Lorenz, & Ellis, 2007; Sterling, Gottheil, Weinstein, & Serota, 2001). Our results showed that smokers with serious mental illness tended to chose a host that matched their age, but results on racial and ethnic matching were mixed. These findings support the use of this type of feature in educational programs. However, whether the capacity to have a program host who was similar to the user in age and race/ethnicity improved the efficacy of the program is not clear from our findings.

On average, participants spent an hour and a half using the system. On the one hand, an advantage to technologically delivered interventions is that the participant can proceed at his or her own pace. On the other hand, people with serious mental illness often lack the resources to purchase technologies or are dependent on mental health centers to provide access to them. Personal access to these technologies is increasing as costs decrease and access is expected to expand further over the next decade. With the limited number of smoking cessation initiatives being offered to this population, technology-delivered interventions may be the least expensive method to expand

treatment engagement, exceeding the impact of efforts to train clinicians.

We found that participants' stage of change for quitting smoking immediately following the intervention was the only factor that related to smoking cessation behaviors and use of cessation treatment. This offers confirmation of various models of health behavior change in which intention or desire to change predicts actual health behavior change (Ajzen, 1991; Bandura, 1989; Holland & Skinner, 1961; Kanfer, 1975; J. O. Prochaska & DiClemente, 1984; Rosenstock, 1966). Our intervention was designed to assist smokers in various stages of change by offering motivational enhancement for those in earlier stages as well as treatment decision support for those in later stages. Although somewhat controversial (Riemsma et al., 2003; West, 2005), this study supports the need for interventions that are tailored for the user's stage of change (Sutton et al., 2003).

The high feasibility of the decision support system demonstrated in this study may have been contributed to by the monetary compensation, albeit modest (\$15), provided to participants. Strengths of the study include the relatively large sample size, the careful characterization of the study group, and the low rate of attrition at the 2-month follow-up. Replication of this work among other samples of people with serious mental illness is needed to validate these findings. Further, a randomized control trial is needed to support a causal relationship between the system and participants' cessation behaviors.

Smokers with serious mental illness and poor reading comprehension, cognitive deficits, and varying levels of symptoms may have compensated by taking more time using this intervention, which has been designed to be used flexibly. Their cessation outcomes and quit behaviors were favorable across levels of impairments. The various opportunities for tailoring contained within this program may account for these positive

TABLE 5
Predictors of Smoking Cessation Engagement Behaviors ($N = 119$)

Covariates	β	SE β	t	p	95% Confidence Interval	
					Lower	Upper
Intercept	-0.05	1.13	-0.05	0.96	-2.27	2.16
Age	0.02	0.01	1.06	0.29	-0.01	0.04
Gender	-0.05	0.25	-0.21	0.83	-0.54	0.43
White	0.11	0.26	0.43	0.67	-0.39	0.61
Schizophrenia or schizoaffective disorder	0.27	0.28	0.96	0.34	-0.28	0.81
Colorado Symptom Index	-0.01	0.01	-1.13	0.26	-0.04	0.01
BACS total z-score	-0.01	0.11	-0.14	0.89	-0.22	0.19
WRAT Sentence Comprehension (raw)	0.00	0.01	-0.21	0.84	-0.03	0.02
Number of cigarettes smoked per day	-0.01	0.01	-0.61	0.54	-0.03	0.02
Computer experience	0.11	0.16	0.66	0.51	-0.21	0.42
Stage of change	-0.41	0.11	-3.67***	0.00	-0.63	-0.19
Total minutes spent using the EDSS	0.01	0.00	1.14	0.26	0.00	0.01

Note. This is a negative binomial regression where β = beta coefficient and SE β = standard error of the beta coefficient. WRAT = Wide Range Achievement Test; BACS = Brief Assessment of Cognition for Schizophrenia; EDSS = Electronic Decision Support System.

* $p < .05$. ** $p < .01$. *** $p \leq .001$.

results. Further work is needed to replicate these findings, assess whether our intervention produces outcomes similar to those of other groups of disadvantaged smokers, and further explore which aspects of the program are most important for its usability and efficacy.

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