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How do text-messaging smoking cessation interventions confer benefit? A multiple mediation analysis of Text2Quit

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Abstract

Aims—To determine the degree to which the observed benefit of Text2Quit was accounted for by psychosocial mechanisms derived from its quit smoking messaging versus from the use of extra-programmatic smoking cessation treatments and services.

Design—Prospective, multiple mediation model of a randomized controlled trial (RCT).

Setting—USA nationwide.

Participants—409 adult daily smokers. Participants were on average 35 years of age, predominantly female (68%), White (79%), lacked a college degree (70%), had medium nicotine dependence (average FTND score of 5.2), and more than half (62%) had made a previous quit attempt.

Intervention—Adult daily smokers browsing the web for smoking cessation support (n=409; recruited 5/19/2011–7/10/2012) were randomized to receive smoking cessation support via Text2Quit versus a smoking cessation material.

Measurements—Mediators (i.e., changes in psychosocial constructs of health behavior change, use of extra-programmatic treatment) were assessed at 1-month using single-item measures, and outcome (i.e., self-reported 7-day point prevalence abstinence) at 6-month follow-up.

Findings—Mediators accounted for 35% of the effect of Text2Quit on smoking cessation. Only psychosocial mechanisms had complete mediational paths, with increases in self-efficacy ($b=0.10$ [0.06–0.15]), quitting know-how ($b=0.07$ [0.03–0.11]), and the sense that someone cared ($b=0.06$ [0.01–0.11]) partially explaining the conferred benefit of Text2Quit. Use of outside resources,

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Conflict of interest statement:

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including treatments explicitly promoted by Text2Quit (i.e., medication ($b=0.001$ [$-0.01-0.01$]), quitline ($b=-0.002$ [$-0.01-0.04$])) and treatments and resources not promoted by Text2Quit (i.e., online forums ($b=0.01$ [$-0.01-0.04$]), self-help materials ($b=-0.01$ [$-0.04-0.02$])) did not have complete mediational paths. An interaction effect existed for medication use that suggested that for participants not using medication, Text2Quit conferred substantial benefit, but not for participants using medication.

Conclusions—Text-messaging programs for smoking cessation appear primarily to confer benefit by promoting improvements in the psychosocial processes related to quitting rather than through the use of extra-programmatic smoking cessation treatments and services.

Keywords

Smoking cessation; text-messaging; mobile health; mhealth; mediation; mechanisms of change

Introduction

A growing body of evidence indicates that text-messaging programs on mobile phones can help people modify health behaviors.^{1–4} Evidence is particularly strong for smoking cessation, where a recent Cochrane Review indicated that text-messaging smoking cessation programs increased long-term quit rates by 67% (relative risk = 1.67, 95% CI [1.46, 1.90]).⁴ In line with this accumulating empirical evidence, mobile treatments for smoking cessation are being added as recommended treatments to clinical practice guidelines for smoking cessation.⁵ Globally, text-messaging programs for smoking cessation have emerged as an important tool in tobacco control efforts.⁶ Text-messaging programs for smoking cessation have been found to be cost-effective⁷ and scalable at a national level. Indeed, current initiatives by the World Health Organization (WHO) such as “Be He@lthy, Be Mobile” are aimed at disseminating text-messaging programs globally. To date, the WHO has helped establish national text-messaging programs for smoking cessation in several countries, including Costa Rica, Tunisia and India.⁶

These early successes and strides towards dissemination notwithstanding, a knowledge gap exists regarding the mechanism by which text-messaging programs for smoking cessation confer their benefit. Such knowledge is critically important for two reasons. First, knowing how text-messaging smoking cessation programs work will help guide efforts to optimize existing programs. Second, given current efforts to promote the global dissemination of such programs, an understanding of the mechanisms of action would aid in selecting appropriate target countries for implementation. For example, if the primary mechanism by which these programs are found to work is through the promotion of the use of extra-programmatic services, then countries with weak infrastructures for tobacco treatment services would not be places where such programs would be expected to succeed.

To date, research on text-messaging programs for smoking cessation has primarily focused on assessing their efficacy. In terms of mechanisms, research has been limited to descriptive accounts of the potentially underlying mechanisms of change. Based on these descriptions, we know that the majority of text-messaging programs for smoking cessation that have been studied have consisted of a series of automated and interactive text messages timed around a

person's chosen quit date that guide the person through the process of smoking cessation. Messages generally provide advice and tips about quitting smoking, as well as referrals to smoking cessation services outside of the text messaging program. While messages are aimed at guiding the user through the quitting process, it is unclear what mechanism is responsible for the observed effects.⁸

Content analyses of the effective program Txt2Stop² have shown that the vast majority of text messages focus on psychosocial processes, that is, constructs that capture the interplay between psychological and social factors (e.g., the confidence to abstain from smoking in a social situation, the experience of feeling social support for one's quit attempt). Specifically, results indicated that 97% of the 899 Txt2Stop text-messages sought to promote self-regulation (i.e., by promoting behavioral substitution or self-reward, etc.) and/or to enhance motivation (24%).⁹ By contrast, only 2% of Text2Stop text-messages directly promoted the use of extra-programmatic, evidence-based treatments for smoking cessation such as nicotine replacement therapy (NRT), getting help from a clinician, or calling a quitline. This content balance in Txt2Stop suggests that this program was largely designed to focus on psychosocial mechanisms of behavior change, in line with theoretical models of smoking cessation^{10,11} and health behavior change.¹² Nonetheless, as such programs are disseminated globally, it becomes important to examine the actual mechanisms by which text-messaging programs for smoking cessation confer benefit.

To fill this gap, this study examines the ways in which an effective text-messaging program for smoking cessation, Text2Quit, was able to help participants quit smoking.¹ Specifically, we sought to determine the degree to which the observed benefit of the program was accounted for by changes in psychosocial variables that resulted from the program's quit smoking messaging or by the program's referral to extra-programmatic smoking cessation treatments and services. Specifically, our aim was to use a multiple mediation approach to determine the relative contribution of *a priori* theorized mechanisms of change in explaining the conferred benefit of Text2Quit on smoking cessation.

Methods

Participants

Participants were adult daily smokers (n=409), who were browsing the internet in search of quitting smoking support (5/19/2011–7/10/2012). Potential participants were included in the study if they were 18+ years or age, smoked 5 or more cigarettes per day, had a U.S. mailing address, e-mail address, and a cell phone with unlimited short messaging service, were interested in quitting smoking in the next month, and were not pregnant. The study was approved by the George Washington University IRB. All participants provided informed consent.

The sample used in this paper (analyzed 3/18/2015–1/15/2016) represents a subsample of the randomized trial participants¹, who completed a 1-month follow-up online survey (81% of the original n=503), and thus provided information on variables believed to explain treatment effects. Compared to the original sample, participants included in this subsample were more likely to be in the control group ($\chi^2(1)=6.79$, $p<0.01$, 86% vs. 77%), more likely

to have a higher education ($\chi^2(1)=4.27$, $p=0.04$, 88% vs. 79%), and less likely to be nicotine dependent ($\chi^2(1)=6.69$, $p<0.01$, average FTND scores of 5.2 ± 2.4 and 6.0 ± 1.9 vs., respectively, for having 1-month data vs. not).

Participants were on average 35 years of age, predominantly female (68%), White (79%), lacked a college degree (70%), had medium nicotine dependence (average FTND score of 5.2), and more than half (62%) had made a previous quit attempt. Participants randomized to the intervention vs. control groups were similar in terms of nicotine dependence, past year quit attempts, and most demographics (i.e., age, sex, race), but differed in the level of education, such that participants randomized to the Text2Quit condition were more likely to have completed a college or higher education degree than participants randomized to the control conditions ($\chi^2(4)=10.2$, $p=0.04$; see Table 1). This imbalance was also observed in the full sample.¹

Procedure

Participants were randomly assigned to one of two conditions: the intervention group, who were enrolled in the text-messaging program Text2Quit, and a control condition, in which participants received a link to Smokefree.gov prior to the launch of its text-messaging program SmokefreeTXT, and a link to the online brochure “Clearing the Air” after the launch of SmokefreeTXT. Participants completed a baseline and follow-up surveys at 1, 3 and 6-months post-enrollment, primarily by phone, though an online option was added later.

The Text2Quit program consists primarily of a series of automated, bidirectional text messages (i.e., users can both receive and send messages; messages sent by users result in tailored, automated responses). Messages are tailored based on first name, quit-date, top three reasons for quitting, money saved by quitting, and use of quit-smoking medications. E-mails and a web portal are offered as supportive features. The text messages are timed around a user’s quit day and provide advice on quitting smoking. Messages are based on Social Cognitive Theory^{13,14} within the framework of a biobehavioral model. Messages are aimed at improving self-efficacy for quitting, describing outcome expectations from quitting, increasing perceived social support for quitting, modeling effective quitting strategies and coping skills, and increasing behavioral capability for quitting. In terms of the taxonomy used to describe Text2Stop², the 90 core messages every Text2Quit user received predominantly focused on psychosocial constructs, where messages focused primarily on enhancing motivation to stay abstinent (37%) and maximizing self-regulatory skills (24%)¹⁵. Only six core messages promoted the use of extra-programmatic smoking cessation aids, with one core message providing advice to use medication, which triggered the subsequent receipt of additional follow-up messages (28 messages) to help guide medication use if endorsed by the user. Additionally, “MEDS” was a keyword that users could text at any time to receive this logic-branched feedback on medication use. Messages were developed to be consistent with the U.S. Public Health Service Clinical Practice Guidelines¹⁶, which recommend calling a quitline and considering the use of approved quit-smoking medications. Thus, intended treatment mechanisms were two-fold: (1) changes in psychosocial variables that were directly impacted by the intervention, and (2) facilitation of and linkage to outside resources to further support smoking cessation. The targeted

psychosocial constructs were self-efficacy, motivation, social support, and know-how. The linkage to outside resources focused on the utilization of quitlines and medication use. To encourage the use of quitlines, all participants received SMS messages about quitlines. To facilitate the use of medication, all participants received SMS messages educating them about medication options. Those interested in using medication also received SMS reminders to use the chosen medication and tips about use. For more detail, please see Abroms et al..¹

Measures

Smoking Status—In this study, we examined self-reported 7-day point prevalence abstinence at 6-month follow-up to examine mechanisms accounting for abstinence. While the RCT included biochemical verification of smoking status, we focused on self-reported abstinence in our analyses, because biochemical confirmation is not recommended by the SRNT Subcommittee on Biochemical Verification¹⁷ for population-based studies with limited (or in our case, no) face-to-face contact, and because self-reported smoking is a standard method for assessing the efficacy of low-intensity interventions.^{18,19} In line with the previously reported RCT outcomes¹, and the common standard for outcome criteria in smoking cessation trials²⁰, we presumed participants that were lost to follow-up (18%) to be smoking. Smoking cessation rates were similar in this subsample compared to the total randomized sample, with 38% (Text2Quit) vs. 22% (Control) reporting 7-day abstinence in this subsample compared to 32% vs. 21% reporting 6-month 7-day abstinence in the full sample.

Psychosocial mechanisms targeted directly by the intervention—At the 1-month follow-up, participants were presented with four Likert-scale items to describe the impact of the program (treatment or control) on them. These items addressed self-efficacy, motivation, social support, and know-how. Specifically, the items were: “The program ... gave me confidence that I can quit smoking”, “... made me think that it was worthwhile for me to quit”, “...made me feel that someone cared if I quit”, and “...made me feel that I knew the right steps to take to quit”. Response options ranged from “1=completely disagree” to “5=completely agree”. There was also an option to indicate “not applicable/don’t know”, which was used by n=40 (10% of the sample per item), which we recoded as “3=neither agree nor disagree”.

Outside resources—At the 1-month follow-up, participants were asked about the smoking cessation support they had used since enrolling in the study. The response options that were specifically queried were: “a stop-smoking clinic or class”, “a telephone help/quit line”, “one-on-one counseling from a health professional (doctor, nurse, etc.)”, “self-help materials, books or videos”, “online quit smoking community”, “acupuncture, hypnosis or other alternative therapy”, “quit smoking medication(s) (e.g. nicotine replacement therapy (NRT) patch, gum, lozenge; Zyban; Chantix)”. Of these outside resources, only the use of a quitline and medications were encouraged by the treatment.

Baseline Characteristics—The baseline survey captured demographic information (i.e., age, gender, race, education), nicotine dependence via the Fagerström Test for Nicotine

Dependence (FTND)²¹, and whether or not participants had made a 24-hr quit attempt during the past year.

Analytic Strategy

To test for a treatment difference on theorized mechanisms of change, we used t-tests for continuous outcomes, and logistic regression for binary outcomes. To test the relative importance of the *a priori* theorized mechanisms of change underlying the Text2Quit benefit, we used a multiple mediation model²² (Figure 1). In this model, we did not include significant interaction terms between treatment condition and mediator, because inclusion of these terms changes the meaning of the “b” path (i.e., mediator to outcome path)²³. Thus, to maintain ease of interpretation while providing information about such moderating effects, we conducted univariate post-hoc tests using logistic regressions to determine the presence of interaction effects, and provide descriptive information about the directionality of such effects. To avoid temporal confounding²⁴, we employed a fully lagged mediational design. We examined the impact of randomized group assignment (baseline) on mediators at 1-month follow-up, and smoking outcomes at 6-month follow-up. We controlled for demographic variables and the baseline levels of nicotine dependence and previous quit attempts. To this end, we used a structural equation modeling (SEM) approach using SAS 9.4 PROC CALIS. This procedure uses the product-of-coefficients approach^{25,26}, where we constructed 95% confidence intervals using the Monte Carlo Method for Assessing Mediation²⁷, as implemented by the interactive tool created by Preacher and Hayes²⁸.

Data Preparation—Because most of our variables of interest were categorical, we used polychoric correlations for the multiple mediational analysis. To this end, we created a categorical age variable (i.e., by categorizing values in 5-year intervals, < 20 years of age, and 70 years of age), and reduced the number of racial categories to three (i.e., White, African American, Other) and the number of education categories to two (i.e., college or higher vs. less). We examined the resulting polychoric correlation matrix for multicollinearity, and noted that all four psychosocial variables were highly correlated with each other (average $r=0.70$). To avoid multicollinearity in our multiple mediational model, we conducted one multiple mediation model for each of the highly correlated psychosocial variables, where the respective psychosocial variable was specified as a mediator alongside the variables characterizing the use of outside resources, as denoted in Figure 1. We also noted a high correlation among the variables assessing the use of in-person therapies (average $r=-0.87$). Because the use of this type of smoking cessation support was low in this sample (i.e., < 5%), we excluded these variables from the mediation model. The correlation among the remaining outside resource variables ranged from $r=-0.02$ (between NRT and online forums) to $r=0.36$ (between Quitline and online forums).

Results

Univariate Group Differences on Potential Mechanisms of Change

On average, participants in the control condition fell somewhat short of agreeing (i.e., less than “4=agree”) that the program increased their self-efficacy, motivation, perceived social support or know-how (Table 2). Participants assigned to the Text2Quit intervention felt more

positively ($p<0.01$), coming close to agreeing on average (i.e., average rating of 3.9) that the program improved their self-efficacy, and exceeding “agreement” for indices of motivation, social support and know-how.

The majority of participants used one or more smoking cessation resources in addition to their assigned treatment (64%). Compared with the control group, participants assigned to Text2Quit did not differ in their utilization of outside resources, except that Text2Quit users tended to have a higher uptake of medication, though not statistically significantly when tested univariately ($p=0.10$). Note that utilization of the other Text2Quit-recommended smoking cessation resource, use of quitlines, did not appear to differ between treatment groups (10% vs. 12%, respectively, in the Control vs. Text2Quit groups). The most commonly used resources in addition to the assigned treatment were the use of quit smoking medication (33%), followed by self-help materials (23%), and online quit smoking communities (18%).

Multiple Mediation Effects

In the multiple mediation model using “gave me confidence” as the psychosocial mediator, there was a significant effect of randomized group assignment on smoking abstinence, where the abstinence rate was higher in the Text2Quit group. Of the total effect, 35% was accounted for by the five mediators. Less of the effect was explained in the alternative models using the other psychosocial variables as mediators, with 24% explained by the model using “right steps”, 22% using “cared”, and 9% using “worthwhile”. Formal tests of mediation showed that “gave me confidence” ($b=0.10$ [0.06–0.15]), “right steps” ($b=0.07$ [0.03–0.11]), and “cared” ($b=0.06$ [0.01–0.11]) all were significant mediators of the effect of randomization to Text2Quit on smoking abstinence. “Worthwhile” was not ($b=0.02$ [–0.01–0.06]). None of the outside resource variables were significant mediators.

In the model using “gave me confidence” as the psychosocial mediator, standardized path estimates (Table 3) show that, while controlling for baseline covariates, randomization to Text2Quit was associated with higher endorsement that the program “gave confidence” at the 1-month follow-up ($\beta=0.46$, $p<0.01$). Less impact occurred on outside smoking cessation resources, where only the effect of Text2Quit on smoking medication was significant ($\beta=0.12$, $p=0.01$). This impact of Text2Quit on the uptake of smoking medication was weaker than its impact on self-efficacy, as indicated by the different magnitudes of the standardized path estimates ($\beta=0.46$ vs. $\beta=0.12$). These estimates were consistent with those observed in the mediational models using the other psychosocial mediators, where estimates of the impact of Text2Quit on outside resources were identical, and estimates of the impact on the other psychosocial variables were comparable (i.e., $\beta=0.50$ for “cared”, $\beta=0.46$ for “right steps”, and $\beta=0.37$ for “worthwhile”).

In the model using “gave me confidence” as the psychosocial mediator (Table 3), higher endorsement that the program “gave confidence” at the 1-month follow-up significantly predicted 7-day point prevalence abstinence at 6-month follow-up ($\beta=0.22$, $p<0.01$). Utilization of outside resources specifically encouraged by Text2Quit (i.e., use of medication and/or quitline) were not related to smoking abstinence. Other outside resources, which were not targeted by Text2Quit, did predict smoking abstinence, but with mixed results.

Participating in an online quit smoking community was positively related to smoking abstinence at 6-month follow-up ($\beta=0.28$, $p<0.01$). By contrast, utilizing self-help materials, books or videos was negatively related to smoking abstinence ($\beta=-0.28$, $p<0.01$) outcomes. Results regarding the impact of outside resources on smoking abstinence were consistent across mediational models using the other psychosocial mediators. Regarding the other psychosocial variables, these alternative models indicated that “right steps” ($\beta=0.15$, $p<0.01$) and “cared” ($\beta=0.12$, $p<0.01$) also were significant predictors of abstinence, while “Worthwhile” was not.

Interaction Effects of Mediators and Randomized Group Assignment

Significant interaction effects were present for three of the tested mediators: “worthwhile” ($b=0.60$, $\chi^2=4.85$, $p=0.03$), “right steps” ($b=0.65$, $\chi^2=5.19$, $p=0.02$), and “use of medications” ($b=-1.06$, $\chi^2=5.24$, $p=0.02$). Table 4 provides a descriptive summary of abstinence rates by treatment group and mediator to better conceptualize these significant interaction effects. For this table, we dichotomized the psychosocial variables, but we used their original scoring in the logistic regression models. Table 4 shows that in the case of the psychosocial mediators, the effects of perceiving quitting as worthwhile and knowing the right steps to quit on 6-month smoking abstinence were stronger in the Text2Quit group than in the control group. For “use of medication”, the interaction effect was a bit more complicated. Among participants who did not choose to use medication, the abstinence rate was substantially higher in participants randomized to Text2Quit. Among participants who chose to use medications, abstinence rates were similar in both treatment groups.

Discussion

This secondary data analysis of the RCT data of an effective text-messaging smoking cessation program shows that Text2Quit¹ works primarily through psychosocial processes, namely by increasing smokers’ confidence in their ability to quit smoking, giving smokers the feeling that someone cared if they quit, and ensuring that smokers knew the right steps to take. Increasing smokers’ confidence in their ability to quit was the best mediator. This finding is in line with research on telephone counseling and cellphone interventions that have highlighted the importance of self-efficacy in achieving abstinence^{29–31}. It extends existing evidence by showing that self-efficacy plays a key role in text-messaging interventions, and that utilization of outside resources was not important as a mediational pathway, with the possible exception of the use of medications. Our mediational model only tested main effects of the mediators, and in these models, the use of medication was not a significant mediator of 6-month smoking abstinence, even though Text2Quit appeared to increase the uptake of medication use, as was intended. When taking into account an interaction effect, however, our post-hoc analyses indicated that the positive impact of Text2Quit on smoking abstinence was larger in participants not using smoking cessation medications, suggesting that Text2Quit and use of medications have comparable but not additive effects.

This more conditional effect of medication use notwithstanding, our findings demonstrate that text-messaging programs are not merely tools that connect smokers to existing

treatments, but rather that text-messaging programs can function as independently efficacious treatments to support smoking cessation in and of themselves by virtue of bringing about psychosocial changes. As such, this finding supports the use of text-messaging programs in areas and countries that have relatively weak infrastructures for tobacco treatment services.

Intriguingly, our results further suggest that text-messaging programs do not undermine the use of other smoking cessation resources, as evidenced by the fact that utilization of outside resources did not differ by treatment group. In fact, our data suggest that text-messaging programs may perhaps work synergistically with other treatments. In our sample, most participants used at least one other resource to help them quit smoking. After controlling for the effect of increases in confidence to quit smoking, we found that other resources still played a role in enhancing smoking abstinence (e.g., receiving social support via online forums appeared to help). This finding leads us to believe that having multiple tools available to smokers is beneficial, not just to get the right fit for the right person, but to offer multiple ways to support unique individuals in a multi-faceted way.

The clear result of psychosocial processes playing a key role in conferring the benefit of Text2Quit notwithstanding, much of the variance remains unexplained, similar to other studies of treatment mechanisms underlying smoking cessation^{29–33}. With 65% of the effect still unaccounted for, there are still other ways in which text-messaging confers benefit. Identifying such additional pathways will help further enhance existing text-messaging programs. For example, Text2Quit users oftentimes commented in qualitative write-in answers that they thought the program helped them because it simply reminded them to stay on track. This effect may not be captured by increases in the measured psychosocial processes, but clearly was relevant enough to users to point it out proactively. Other mechanisms likely exist that deserve further scrutiny.

Limitations

This secondary data analysis relied on self-report of smoking cessation as its primary outcome, which has limitations in terms of validity and reliability. Randomization was not fully effective, where participants in the Text2Quit group reported higher levels of education. Relatedly, it is also important to keep in mind that the subsample used for this paper differed from the total randomized sample (higher education, less nicotine dependence, more likely to be in the control group). While we accounted for these factors analytically, this sampling bias diminishes the generalizability of our results. The use of single-item measures to assess our main constructs of interest may also be seen as a limitation, as traditionally, multiple-item, well-validated measures have been used to assess psychosocial constructs. We are ambivalent as to whether or not the use of these single-item measures constitutes a limitation. For one, the goal of the items was to assess changes in these constructs that participants attributed to their participation in their assigned smoking cessation program. Both the focus on change and the attribution of this change to the assigned smoking cessation program are issues that existing, validated measures do not address. Thus, the use of these items provided unique data that directly addressed the underlying research question. Whether or not a single item could do this task justice in a reliable manner is up to debate.

We find the concern about using single-item measures allayed by findings that some single-item measures have, in fact, been shown to have superior predictive validity to full-length, validated scales (e.g., self-efficacy predicting substance use)³⁴, but certainly, the single-item measures used in this study have not been rigorously evaluated in this manner.

Conclusion

Text2Quit appears to confer its benefit primarily through increases in smokers' confidence in their ability to quit smoking. Increases in the use of extra-programmatic smoking cessation treatments and services, including services specifically promoted by Text2Quit (i.e., quitline, medication) did not account for its benefit. Further development and refinement of text-messaging smoking cessation programs should focus on enhancing impact on psychosocial constructs relevant in health behavior change, and explore additional ways in which these programs support smoking cessation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Multiple Mediation Model
Multiple mediation model used to contrast Text2Quit vs. control on mechanisms of change

Table 1

Demographics and smoking-cessation-relevant indices (n=409)

	Control (n=207)		Text2Quit (n=202)		p
	%/mean	(SD)	%/mean	(SD)	
Demographics					
Age	35.7	(10.7)	35.7	(10.7)	0.99
Sex (% female)	64.9		71.3		0.17
Race					0.58
White	77.8		80.2		
African American	12.1		8.9		
Other	10.1		10.9		
Education (% college degree or higher)					0.04*
Some high school	5.8		2.5		
High school graduate	18.4		10.9		
Some college/technical school	46.9		55.5		
College graduate	19.8		24.8		
Graduate school	9.2		6.4		
Smoking-cessation-relevant indices					
Nicotine dependence (FTND)	5.2	(2.4)	5.2	(2.3)	0.97
Made past year quit attempt (24 hrs)	61.4		62.4		0.83

Table 2

Descriptive Information on Potential Mechanisms of Change, as reported at 1-month follow-up

	Control (n=207)		Text2Quit (n=202)		p
	%/mean	(SD)	%/mean	(SD)	
<u>Accomplished within the smoking cessation material (in mean (SD))</u>					
Gave me confidence that I can quit smoking	3.3	0.9	3.9	0.9	<.01**
Made me think that it was worthwhile for me to quit	3.8	1.0	4.3	0.8	<.01**
Made me feel that someone cared if I quit	3.4	1.0	4.2	0.9	<.01**
Made me feel that I knew the right steps to take to quit	3.4	0.9	4.1	0.8	<.01**
<u>Outside resource encouraged by the smoking cessation material</u>					
Quit smoking medication(s)	29.5		37.1		0.10
Telephone help/quit line	10.1		11.9		0.57
<u>Other outside resource used by participants</u>					
Stop-smoking clinic or class	3.4		3.0		0.81
One-on-one counseling from a health professional	3.9		2.0		0.26
Acupuncture, hypnosis, or alternative therapy	3.4		3.5		0.96
Self-help materials, books, or videos	23.7		22.3		0.74
Online quit smoking community	18.8		17.8		0.79

Note:

**
p < 0.01

Table 3

Standardized path parameter estimates of the multiple mediator model contrasting Text2Quit vs. control on mechanisms of change (n=409)

Type of Path		β	SE	<i>t</i>
Path				
<i>Direct effect: Text2Quit (vs. control) predicting 7-day abstinence</i>				
Text2Quit	→ (6-mo) 7-day Abstinence	0.20	0.05	4.17**
<i>Mediational paths: Text2Quit (vs. Control) predicting mediators</i>				
<u>Accomplished within the smoking cessation material</u>				
Text2Quit	→ (1-mo) "Gave me confidence"	0.46	0.04	11.66**
<u>Outside resource encouraged by the smoking cessation material</u>				
Text2Quit	→ (1-mo) Medication	0.12	0.05	2.56*
Text2Quit	→ (1-mo) Quitline	0.04	0.05	0.87
<u>Other outside resource used by participants</u>				
Text2Quit	→ (1-mo) Self-help materials	-0.05	0.05	-0.99
Text2Quit	→ (1-mo) Online forum	-0.03	0.05	-0.65
<i>Mediational paths: Mediators predicting 7-day abstinence</i>				
<u>Accomplished within the smoking cessation material</u>				
(1-mo) "Gave me confidence"	→ (6-mo) 7-day Abstinence	0.22	0.05	4.72**
<u>Outside resource encouraged by the smoking cessation material</u>				
(1-mo) Medication	→ (6-mo) 7-day Abstinence	0.01	0.04	0.15
(1-mo) Quitline	→ (6-mo) 7-day Abstinence	-0.05	0.04	-1.10
<u>Other outside resource used by participants</u>				
(1-mo) Self-help materials	→ (6-mo) 7-day Abstinence	-0.28	0.04	-6.62**
(1-mo) Online forum	→ (6-mo) 7-day Abstinence	0.28	0.04	6.50**

Note: using z-value cut-offs for the *, where 1.96 = 0.05 and 2.58 = 0.01; baseline covariates were included in the model (see Figure 1), but are not shown

Table 4

6-Month abstinence rates by treatment group and 1-month mediator

Type of Mediator	Not Endorsed/Used (in %)		Endorsed/Used (in %)		Difference of the difference	p of interaction term
	Control	Text2Quit	Control	Text2Quit		
Psychosocial						
Gave me confidence that I can quit smoking	17.5	24.0	28.4	42.8	7.8	0.23
Made me think that it was worthwhile for me to quit	22.2	22.2	21.4	40.6	19.1	0.03*
Made me feel that someone cared if I quit	19.7	27.0	24.4	40.6	8.8	0.17
Made me feel that I knew the right steps to take to quit	19.3	18.4	24.7	42.7	18.8	0.02*
Outside Resource						
Quit smoking medication(s)	17.8	40.9	31.2	33.3	-21.0	0.02*
Telephone help/quit line	22.0	36.0	19.1	54.2	21.2	0.20
Self-help materials, books, or videos	25.3	39.5	10.2	33.3	9.0	0.18
Online quit smoking community	20.8	33.7	25.6	58.3	19.8	0.18

Note: For the ease of this table, responses to the single-item psychosocial mediators measures were dichotomized, where “completely disagree”, “disagree” and “neither agree nor disagree” responses were coded as “not endorsed” and “agree” and “completely agree” were coded as “endorsed”.

[†] Logistic regression models were run for each mediator, where ABSTINENCE = GROUP MEDIATOR GROUP*MEDIATOR; the p-values for the GROUP*MEDIATOR term is provided here