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4 Developing and Adapting a Text Messaging Intervention for Smoking Cessation from New Zealand for the United Kingdom

Caroline Free, London School of Hygiene and Tropical Medicine, University of London

Background

Tobacco use is a leading cause of preventable death, estimated to cause more than five million deaths each year worldwide (WHO, 2009). Around half of current smokers will be killed by their habit if they continue to smoke and 25 percent to 40 percent of smokers will die in middle age (Doll, Peto, Boreham, and Sutherland, 2004; Vollset, Tverdal and Gjessing, 2006). In the US and the UK over half of existing smokers report they would like to stop (Lader, 2009; McClave, Whitney, Thorne, Mariolis, Dube, and Engstrom, 2010).

Existing effective behavior change smoking cessation support interventions include group, one-on-one, and telephone counseling. These increase smoking cessation by pooled relative risk of 1.98, a 95 percent confidence interval of 1.60 to 2.46 for group counseling, pooled relative risk of 1.39, a 95 percent confidence interval of 1.24 to 1.57 for individual counseling, and pooled relative risk of 1.29, a 95 percent confidence interval of 1.20 to 1.38 for telephone advice (Lancaster and Stead, 2005a; Stead, Perera and Lancaster, 2006; ITU, 2010). However, many smokers cannot or do not want to use existing services. Additional effective interventions to support smoking cessation are urgently needed.

Mobile phone technology has the potential to provide personalized smoking cessation support. Motivational messages and behavior change tools used in face-to-face smoking cessation support can be modified for delivery via mobile phones with the content tailored to the age, sex, and ethnic group of the quitter (Rodgers, Corbett, Bramley, Riddell, Wills, Lin, and Jones, 2005; Free, Whittaker, Knight, Abramsky, Rodgers, and Roberts, 2009). In this way, support can be delivered wherever the person is located, without them having to attend services and can

be interactive, allowing quitters to obtain extra help when needed (Rodgers *et al.*, 2005; Free *et al.*, 2009).

Because of the widespread ownership of mobile phones, fully automated smoking cessation support can be delivered to large numbers of people at low cost. In 2009, more than two thirds of the world's population owned a mobile phone and 4.2 trillion text messages were sent (ITU, 2010). In the UK, there are about 120 mobile phone subscriptions per 100 population with ownership greater than 80 percent in all socio-economic groups (Ofcom, 2009).

The STOMP (Stop smoking with mobile phones) trial, conducted among 1,700 young smokers (at least sixteen years of age with a mean age of twenty-five years) throughout New Zealand, assessed the effectiveness of a text message-based smoking cessation intervention (Rodgers *et al.*, 2005). The STOMP intervention text message content was developed by a motivational interviewing trained counselor, Tim Corbett, and contains over 1,000 text messages. The trial results showed considerable promise, with over a twofold increase in self-reported quit rates at six weeks (28 per cent versus 13 per cent, relative risk 2.2, a 95 per cent confidence interval of 1.79 to 2.70, p-value of less than 0.0001). The results were consistent and separately significant across all major subgroups including those defined by age, sex, ethnicity, income level, and geographical location. Some limitations in the study, however, affected the validity of the results at six months. First, there was differential loss to follow-up at six months (79 per cent follow-up in the control group versus 69 per cent in the intervention group). This is likely to be due to the control group receiving a month of free text messaging in return for continuing to participate until the 26-week follow-up call, while the intervention group was not offered this. Second, only a small sample of self-reporting quitters was selected for biochemical validation through salivary cotinine testing.

The txt2stop intervention in the UK was modified and developed from the STOMP intervention and was evaluated in a randomized controlled trial with 5,800 participants (Free, Cairns, Whittaker, and Edwards, 2008; Free *et al.*, 2009). The txt2stop intervention is a complex intervention, as it contains a number of components providing information combined with a range of behavior change techniques. Participants are asked to set a quit date within fourteen days of randomization. There is frequent contact by text message (five messages per day) in the first five weeks after randomization and then messages reduce to three per week for six months. Specific features of the intervention include that: participants can opt to have a 'quit buddy' where participants with similar characteristics and quit dates are paired up so that they can text each other for support. Participants can also text the word 'crave' or 'lapse' at any time, and a text message (or series of text messages) is immediately delivered in response.

Existing guidance for the development and evaluation of complex interventions suggests that the key elements of the process include development, feasibility and piloting, evaluation, and implementation phases (Craig, Dieppe, Macintyre, Michie, Nazareth, and Petticrew, 2008). The developmental phase includes identifying an evidence base for the intervention and identifying or developing appropriate theory and modeling process and outcomes. Feasibility and piloting can involve testing procedures, estimating recruitment and retention, and determining sample sizes. Evaluation can involve evaluating effectiveness, understanding change processes, and assessing cost-effectiveness (Craig *et al.*, 2008).

I will report the work we completed in chronological order from the work completed prior to the txt2stop pilot trial through to the main trial.

Development

The work we completed prior to the main trial was twofold, first to modify the existing STOMP intervention for a UK population and second to generate new messages.

Modifying the existing text messages

To modify the existing content of the STOMP text message intervention for the UK, the STOMP messages were first reviewed by smoking cessation counselors employed by the QUIT smoking cessation charity working in the UK. Their views regarding the comprehensibility, suitability, and content of messages were sought. Suggestions for improvements in messages were incorporated and texts were modified. All text messages were subsequently assessed in a series of focus groups by sixty-two potential trial participants (smokers, ex-smokers, and smokers trying to quit).

All text messages were reviewed in at least two focus groups to assess their acceptability, comprehensibility, and participants' response to the messages (did they find them encouraging/discouraging, would they like to receive such messages, and would such messages help or hinder them if they were trying to quit). Where text messages were 'liked' in both groups they were retained. If a text message was 'disliked' by any member of either group, further questions were asked to explore what was 'disliked'. Participants and smoking cessation counselors were asked for their suggestions in improving the messages. Any messages that were altered were subsequently tested in at least two further focus groups. The process was repeated until the message was considered comprehensible and acceptable in at least two groups. Where messages were not rendered acceptable and comprehensible they were discarded.

Feedback from the focus groups was extremely positive regarding both the concept of txt2stop and the text message content. Four main types of modification

were made: changes to words, for example reflecting different terms or text abbreviations used in the UK, changes to culturally specific references, for example to music and sports personalities, changes to the framing of text messages, for example to involve more 'suggestion' and less 'telling', and changes or removal of some texts, such as texts which participants found 'too American' or 'patronizing'. Changes to framing and removal of some messages were completed based not only on participants' feedback but also on the theoretical basis of our approach to generating new smoking cessation messages described later in the chapter.

Generating new messages

Existing guidance for the development of complex intervention suggests that intervention development be informed by theory and the existing evidence base (Craig *et al.*, 2008); however, it remains unclear which theories would result in the most effective interventions. While the existing evidence base shows that group, individual, and telephone counseling are effective in increasing smoking cessation, there was no clear evidence demonstrating which components of these interventions are most important or necessary to increase smoking cessation (Stead, Lancaster and Perera, 2003a; Lancaster and Stead, 2005a; Stead and Lancaster, 2005a). Thus in the absence of clear evidence regarding which theory should be used, we examined and drew on a range of theories to develop the txt2stop intervention. These included psychological behavioral theories and behavior change techniques and approaches, social theory (and contextual data), and theories regarding therapeutic relationships (doctor–patient relationships). As there was no clear evidence about which elements of face-to-face smoking cessation counseling are most effective, we worked with practicing smoking cessation counselors modifying the approaches they used for delivery by text message. We describe how each theory and our work with smoking cessation counselors generated specific types of messages.

Psychological theories of health behavior and behavior change

There are a wide range of psychological theories of health behavior and health behavior change. These include social cognition models (such as the theory of planned behavior), as well as dynamic theories of behavior changing (such as stages of change and spontaneous processing models). In addition, the discipline of psychology provides a wide array of techniques and approaches used in psychological interventions to change behavior (such as the techniques use in motivational interviewing).

Social cognition models

Social cognition models aim to describe the factors influencing behavior. The theory of planned behavior (Ajzen, 1985), for example, suggests that the proximal determinants of behavior are the intentions to engage in the behavior and perceptions of control over the behavior. Intentions represent a person's motivation in the sense of her or his conscious plan or decision to exert effort to perform the behavior. Intention is determined by three sets of factors: beliefs about the behavior, which is a product of beliefs about outcomes and the evaluation of the outcome. Secondly, subjective norms are the person's belief about whether significant others think he or she should engage in the behavior, which is function of normative beliefs. This is operationalized as 'does the individual's referent think the person should perform the behavior' and the motivation to comply with the referents expectation. The third determinant is perceived behavioral control, which is the perception of ease or difficulty of the behavior. Judgments of perceived behavioral control are influenced by beliefs concerning whether one has access to the necessary opportunities and resources to perform the behavior successfully. This includes internal control factors, information, personal deficiencies, skills, abilities, emotions, and external control factors such as opportunities, dependence on others, and barriers.

While such theories may inform our understanding of behavior in isolation, social cognitive psychological theories of behavior (such as the theory of planned behavior) were too removed from the specific beliefs and motivations influencing smoking to directly inform the content of messages. Such theories could lead researchers to generate text messages aiming to influence beliefs about outcomes such as the health benefits of the behavior they are promoting but require contextual data which may be socially or culturally specific to inform researchers regarding smokers' beliefs and motivations regarding their behavior. A further limitation of such models in informing which messages should be developed is that such theories are theories of behavior not theories of behavior change. Thus while the importance of motivation for example is emphasized, the theories do not tell you how to increase motivation. As such, they describe the factors influencing behavior but do not necessarily provide a clear mechanism for influencing these factors or the behavior itself. Social cognition theories are based on subjective expected utility theory and deliberative reasoning processes (for example weighing up the pros and cons of behavior). The limitations of such approaches in understanding behavior have been outlined; for example, Fishbein and Fazio have described the importance of the salience and accessibility of attitudes (Fishbein and Ajzen, 1975; Fazio, 1990). A further limitation of such theories is that they are static and do not take into account changes over time.

Dynamic theories of behavior

Dynamic theories of behavior acknowledge that both motivation and behavior vary at different times and some theories acknowledge that changes may occur over short time periods in the same individual. The stages of change model (Prochaska and DiClemente, 1984) describe smokers going through precontemplation (not even thinking about quitting) and contemplation phases (thinking about quitting) prior to being ready to quit and then maintaining quitting or relapsing. However, this theory was of limited use for informing the content of our intervention, as eligibility criterion for the trial was that all participants were willing to make a quit attempt in the next month and were currently daily smokers. Thus our intervention was not designed for smokers at precontemplation or contemplation phases described by the stages of change model, but specifically only included smokers ready to attempt a change.

Salience of attitudes and spontaneous processing models

Fishbein and others focus on the salience of attitudes in informing behavior (Fishbein and Ajzen, 1975). Fishbein claims that any person may possess a large number of beliefs but that at any one time only some of these are likely to be salient. It is the salient beliefs that determine attitude to the behavior and behavior. This view is supported by evidence from cognitive psychology which suggests that people have poor information processing ability and therefore are unlikely to consider all their beliefs. With this modification of decision making, it becomes important to identify beliefs salient to the individual.

Fazio goes further in his theory of 'spontaneous processing models' (Fazio, 1990). He argues that people only make decisions weighing up the pros and cons of a behavior when they have both the opportunity and motivation to do so. He states that social cognitive variables will predict behavior according to these models when these conditions are met. In this theory, not all social behavior is deliberative or reasoned but is more spontaneous in nature. Thus he describes two means of decision making. The first is conscious decision making in which an individual analyzes the costs and benefits of a particular behavior and deliberately reflects on the attitudes relevant to the behavioral decision. The second means of decision making is a spontaneous reaction to one's perception of the immediate situation. In such a model, the individual may not have actively considered the relevant attitudes and/or not be aware of the influence of attitude. The attitudes may influence how the person interprets the event that is occurring. An attitude will be automatically triggered from memory following the presentation of relevant cues. The likelihood of activation is determined by the accessibility of the attitudes, which in turn is a function of how strongly the attitude is linked to the behavior

and how the person evaluates the attitude. Once activated the attitude shapes the perception in an automatic attitude congruent fashion, i.e. if a positive attitude is activated this leads person to notice positive qualities of the attitude object. This automatic process of selective perception will therefore shape the individual's definition of the event and thus determine behavior. Furthermore, recent activation or priming of an attitude from memory is sufficient for that attitude to influence interpretations and priming can be subliminal (the individual need not consciously reflect on the attitude).

According to spontaneous processing models, participant's perceptions and hence response to a situation depend on whether the individual's attitudes are activated from memory. The situation provides cues but the key to behavior is the attitude accessibility.

Experimental work, conducted outside the health arena, supports key aspects of these theories namely that accessibility of relevant attitudes influences the strength of relationship between attitudes and behavior and that highly accessible attitudes can lead to selective perception (Fazio, 1990).

In relation to text message-based smoking cessation support, Fazio's spontaneous processing models and theories regarding the importance of salience of attitudes a text messaging smoking cessation intervention might provide insight into how the messages could work (Fazio, 1990). One potential advantage of text messaging interventions lies in their ability to reach participants wherever they are at any time, as mobile phones are generally always carried by participants (Rodgers *et al.*, 2005; Free *et al.*, 2009). In txt2stop, text messages are sent at intervals throughout the day and every day. Text messages could act to prime positive attitudes relating to quitting that are held by the smoker so that such attitudes are stronger and more accessible when cues for smoking occur. Thus the text messages sustain the salience and accessibility of quitting attitudes and motivations over smoking attitudes and motivations. So, when stimuli to smoking occur, it is the smokers' quitting attitudes that are retrieved from memory rather than their smoking attitudes.

A further potential advantage of text messaging interventions is that unlike face-to-face, telephone, or internet interventions where the participant has to have sufficient motivation to seek help and support, in text message-based interventions messages can be delivered which have not been specifically sought at that time. Thus messages could provide affirmation regarding the quit attempt, remind participant why they are quitting, and boost motivation to continue with the quit attempt at times when motivation for quitting is low or waning. These theories, relating to the potential mechanism of action of text messages, did not directly inform the precise content of messages. Based on these theories, it was important for messages to be positive, target smokers reasons for quitting and staying quit,

boost motivation and be delivered at intervals throughout waking hours (for example *Quitting smoking is the most important thing you can do to improve your health. Quit for you and protect those around you*).

Those generating messages were made aware of these practical implications of the theory, but were not necessarily aware of the psychological theory underpinning these requirements.

Techniques and approaches used in existing behavior change interventions

To develop text messages using behavior change techniques and approaches found in existing smoking cessation interventions, we also drew on the ethos and techniques used in motivational interviewing and the approaches used by existing telephone and face-to-face smoking cessation counselors. Many of such techniques and approaches are rooted in therapeutic psychology. Motivational interviewing uses a range of techniques face-to-face (Miller and Rollnick, 2002). Motivational interviewing is client-centered and the emphasis is on exploring the participant's motivations, choices, and empowerment. Some of the techniques used in motivational interviewing include exploring ambivalence about behavior change, decisional balance (pros and cons), reflective listening, resisting telling participants what they should do, understanding patient motivations, listening with empathy, and empowering participants to achieve their own objectives using open questions and summarizing. The automated txt2stop intervention was not capable of responding to individual motivations and responses in the way an MI counselor can in a one-on-one session. We did, however, incorporate some elements of motivational interviewing into the program. The STOMP and txt2stop interventions text messages asked participants about the pros and cons of quitting for them (decisional balance), for example *TXT2STOP: If u think quitting is v important, you're more likely to stay quit. List pros and cons of smoking*. Some messages asked participants their reasons for quitting (which many participants responded to by text message), for example *TXT2STOP: Why not write an action list of your reasons why you want to Quit. Use it as your inspiration*. In the pilot work, elements of text messages that were directive and telling participants what they should do were removed and replaced with options (choices). Messages were sent which affirmed both the decision to quit and provided congratulations regarding having quit (after the quit day), such as *Well done, 2 wks quit, don't weaken now, uv gone thru the worst – don't allow yrself to get addicted again!*

Messages showed empathy to participants for example acknowledging that quitting was hard but encouraging them to keep going, for example *Don't be too*

hard on yourself. Quitting smoking can make you feel angry or sad at things that normally would not bother you.

As existing evidence demonstrates that face-to-face and telephone counseling is effective in supporting quitting, we also drew on the knowledge and experience of trained smoking cessation counselors (Stead, Lancaster and Perera, 2003b; Lancaster and Stead, 2005b; Stead and Lancaster, 2005b). Smoking cessation counselors use a range of behavior change techniques, and experienced counselors can have expertise in the best ways of framing support and the kind of language that smokers respond to and understand. To date, it remains unclear which techniques are essential or more effective in supporting quitting, so smoking cessation counselors were asked to generate messages based on their experience (Stead *et al.*, 2003b; Lancaster and Stead, 2005b; Stead and Lancaster, 2005b). We included text messages covering any approach smoking cessation counselors described using that we could feasibly deliver by text message, given the restrictions imposed on us by the text messaging technology which had limited interactivity and personalization and only 160 characters for each text message. Smoking cessation counselors provide support and encourage smokers to use medications, so additional text messages were developed to encourage participants to use nicotine replacement therapy in addition to the txt2stop support. Some messages were developed based on theories that we generated with the counselors. For example, counselors commented that many smokers liked the information they gave about the benefits to smoker's body and health that would achieve by stopping smoking. We hypothesized that the ability to send text messages at specific times co-inciding with the time that the benefit would occur would be particularly motivating. For example, oxygen levels become normal eight hours after stopping smoking. The program was set up to send the following message to participant hours after stopping. *TXT2STOP: Health update! Well done, your oxygen levels are now normal. Check out your web page www.txt2stop.org to see how you're getting healthier.*

Contextual evidence

Contextual evidence regarding smokers' beliefs and motivations can be obtained from qualitative and cross-sectional quantitative research. Much of this research is routed in social theory, which emphasizes the sociocultural influences on behavior. Clearly, our text message-based intervention was directed to individual smokers, although it included interpersonal support, thus its ability to address broader social influences on behavior is extremely limited. However, qualitative research and cross-sectional surveys rely on data from individual smokers and provide considerable and detailed understanding of the beliefs, social norms, and motivations that

influence behavior. We provide one example of how we used such data. The QUIT smoking cessation charity had completed focus groups exploring smokers' beliefs regarding nicotine replacement therapy (NRT); smokers reported that they did not use NRT as they were concerned nicotine was as harmful as cigarettes. They had limited awareness of the other chemicals present in cigarette smoke that cause harm. For the pilot trial, we therefore developed text messages addressing these misconceptions, for example *TXT2STOP: Nicotine makes you want another cigarette but it's the 4,000 other chemicals in smoke that can kill you. Nicotine replacement therapy helps you quit and You will be twice as successful if you quit smoking and use an NRT product.*

Theory regarding doctor–patient relationships and interactions

In models of doctor–patient relationships and consultations engaging the patient and establishing rapport is the first step in a consultation (Pendleton, Scofield, Tate, and Havelock, 1984; Neighbour, 1987). In clinical settings, engaging the patient and establishing rapport is carried out through a number of techniques including the use of open-body language and taking a 'patient-centered' approach. Establishing 'engagement and rapport' in an automated text message intervention represented a particular challenge. All nonverbal cues are absent, and body language could not be used to make participants feel welcome to the program. In addition, the program has limited interactive content limiting its ability to adopt an individual approach. Thus, language and messages that were designed to be welcoming and developing a sense that the people behind the text messages were real people who were concerned about the smoker. *TXT2STOP: Don't try to quit smoking on an exam day or if you have a job interview – try to quit on a day that is stress free. Or TXT2STOP: If you have any questions about TXT2STOP, you can contact the team free from a landline call to 0800 xxxxxxxx.* (The research team if contacted were able to answer questions about the trial and did not offer smoking cessation advice). While it was not possible to fully individualize the intervention, both STOMP and txt2stop interventions were able to address issues that arise with smokers trying to quit such as concerns about weight gain and concerns about friends smoking.

Fine tuning new messages

Generating messages which were only 160 characters long was a particular challenge. Short messages mean that the most important element of the message had to be determined to fit into one text message or the messages had to be split into two components sent in separate messages at different times. In addition,

Figure 4.1 The process used to generate text messages for the txt2stop intervention

messages had to be framed and using language that was acceptable to people. Other challenges are related to the limitations of an automated program in responding to individuals. We used the same methodology to fine tune the content of new messages as we used to modify the messages in the existing STOMP program. All new messages were tested in at least two focus groups to assess their acceptability, comprehensibility, and participants' response to the messages. Messages were modified until at least two focus groups found them acceptable and comprehensible, or the messages were discarded (Figure 4.1).

Feasibility and piloting

The feasibility of delivering the txt2stop intervention and trial methods was assessed in a pilot trial with 200 participants. A full account of the pilot trial is reported elsewhere (Free *et al.*, 2009).

The pilot randomized controlled trial aimed to recruit and recruited successfully 200 participants. We recruited the target of 200 participants within seventeen days from the trial launch and had to close the trial to further recruitment. Our computer-based data collection and randomization systems worked efficiently, as did the interfaces between the web-based data collection system, the computer program generating texts, and the SMS company which sent the text messages to the participants. All text messages sent were received by the trial participants.

Using evidence-based methods for follow up, we achieved 98 percent complete short-term follow-up and 92 percent long-term follow-up. The short-term results

showed a doubling of self-reported quitting relative risk of 2.02, a 95 percent confidence interval of 1.08 to 3.76, and the effects at six months were consistent with a modest benefit in the point prevalence of biochemically validated smoking cessation with a relative risk of 1.28 and a 95 percent confidence interval of 0.46 to 3.53 (8.5 percent or 8/94 versus 6.7 percent or 6/90).

The process evaluation for the pilot trial

The qualitative statements made by the participants in the intervention group showed that participants value the intervention, for example *'It's a good effort from u guys thanks for stopping me'* and *'thank you very much for allowing me on the program and for helping me quit I'm sure my daughters would thank you if they understood'*. The text messages were described as *'very good'*, *'incredibly helpful'* and *'very motivating'*. In particular, participants' comments illustrate the quality of communication that can occur through text messages: *'I found myself talking myself out of having another cigarette when my buddy was the one craving one. I think this process helped even if it was reverse psychology'*. Some participants' comments illustrate how unique components of the intervention can help quitting: *'text crave was a good function especially when out'* or *'Every time I was craving a cigarette I'd get a text and it would stop me. They'd always arrive at the right time'*. Quit buddies were described as *'great'* and *'brilliant'*. Participants also suggested modifications to the program. Three participants wanted to reset their quit date. Three participants were disappointed with their quit buddy, who did not respond to their text messages. Others wanted to set their own start time for the messages. A number of participants commented that they did not want to receive messages in using texting abbreviations and several participants asked for more messages regarding the health benefits of quitting.

Process evaluation questionnaires were completed by 56 percent ($n = 57/102$) of the participants in the intervention group. Of these, 96 percent ($n = 54$) reported that the text messages in plain English were easy to understand and 61 percent ($n = 34$) thought the messages in text lingo were easy to understand. Fifty-six percent ($n = 31$) reported that it was useful being able to embargo times and 27 percent ($n = 15$) wanted to be able to embargo an additional time. The number of text messages received was: about right for 44 percent ($n = 25$) respondents, too few for 14 percent ($n = 8$) respondents, 5 percent ($n = 3$) were unsure and 37 percent ($n = 21$) of respondents thought it was too many. Nineteen percent ($n = 11$) liked using the text crave function and 21 percent ($n = 12$) liked having a 'QUIT buddy'. Sixty-eight percent ($n = 39$) would recommend the txt2stop program to a friend, 21 percent ($n = 12$) would not and 11 percent ($n = 6$) were unsure if they would recommend the program to a friend. Thirty-one percent ($n = 17$) of the

participants who completed a process evaluation questionnaire reported that they had successfully quit at six weeks. Sixty percent ($n = 34$) reported that the text messages using 'standard English' were useful in helping them quit, 34 percent ($n = 19$) reported that the text lingo messages were useful in helping them quit, 30 percent ($n = 12$) thought having a 'QUIT buddy' was useful in helping them quit and 32 percent ($n = 8$) reported that the text CRAVE option was useful in helping them quit.

Development

Based on the findings from the pilot trial and process evaluation, a number of changes and additions were made to the txt2stop intervention. The intervention was modified, so trial participants were able to reset their quit date, had greater flexibility regarding embargoing times that they did not want to receive messages, and could choose the start time for messages. Participants could opt to change their quit buddy. Additional messages regarding the health benefits of quitting were added. The pilot trial results demonstrated that many participants relapsed between four weeks and six months following their quit date, so further work focused on the development of messages to strengthen the intervention in supporting participants to cope with cravings and to avoid relapse. The existing evidence base regarding relapse prevention provides limited evidence regarding effective interventions (Hajek, Stead, West, Jarvis, and Lancaster, 2009). We therefore interviewed smoking cessation counselors regarding the steps they took in support people who lapsed and in trying to prevent relapse. Based on this messages were developed focusing on planning for dealing with cravings and temptation to smoke (for example *TXT2STOP: To make things easier for yourself, try having some distractions ready for cravings, and think up some personal strategies to help in stressful situations*). In addition, a new feature was added to the program where participants who had smoked a cigarette were advised to text LAPSE to the short code. In response, participants would receive a series of three messages in succession designed to reassure the participant that this did not need to be the end of their quit attempt, encourage the participants to think about why they had lapsed and make a plan of how to prevent this in the future and encourage them to restart their quit attempt, such as *T2S: Don't be too hard on yourself. If you've slipped, you haven't failed. Quitting is a process. You've managed to stop for a while and that's an incredible achievement. Keep going!*

Evaluation

The main trial conducted with 5,800 participants showed that the intervention more than doubled biochemically verified smoking cessation at six months (Free, Knight,

Robertson, Whittaker, Edwards, Zhou, Rodgers, Cairns, Kenward, and Roberts, 2011). In addition to the main trial, we conducted qualitative interviews with twenty-five participants and completed a process evaluation with 600 participants. Participants were also asked to provide feedback regarding the messages. Full account of the methods and results of these evaluations will be published elsewhere. Here, I will describe the key findings from the quantitative process evaluation and discuss the extent to which they support or refute the benefits of particular messages or the theories underpinning the messages.

In the process evaluation, a twenty-two item questionnaire was used and statistical significance was set at a p value of 0.002 using a bonferoni adjustment. Participants in the intervention group were statistically significantly more likely to report that they saved messages on their phone to re-read, that they were aware craving would get easier over time, and that the messages encouraged them to stay quit when I felt like smoking. In the intervention group 15 percent (n = 25) and in the control group 6 percent (n = 11) of participants reported 'yes' to the statement *'the text messages made me want to smoke'*.

The quantitative evidence from the process evaluations suggests that from participants' perspectives, the role of the messages in supporting motivation to stay quit is important. Participants in the intervention were more likely to be aware that cravings would get easier over time and to have written a list down of their reasons for quitting, but the process evaluation cannot tell us if these factors were causal in increasing quitting or the product of another causal pathway such as engagement in the intervention. Being aware that cravings get easier over time could also be an outcome of successful quitting. In feedback, participants also stated that messages about the benefits that their body and health were obtaining from quitting were especially motivating.

The findings from the process evaluation are consistent with the hypothesis that the intervention works predominantly by maintaining the salience and accessibility of 'quitting/ staying quit' attitudes to sustain motivation and quitting over time. The messages also appeared to prompt smoking in some participants, which suggests that the messages can increase the salience and accessibility of quitting or smoking attitudes and potentially cue behavior in opposing ways. Participant accounts are also in keeping with our theory that receiving messages regarding the benefits that their body was experiencing at the time this occurred after quitting was especially motivating.

Further work should explore the factors that influence the level of support experienced by participants and participants' experience of the interventions as a 'real person'. Further work is needed to identify why participants respond in different ways to the messages and which participants experience cravings for

smoking on receipt of messages. Following the development of the intervention, we coded the text message content using a typology of behavior change techniques (Michie, Free and West, submitted for publication). In the future, work developing new text messaging interventions could be informed by recent research describing behavior change techniques and their effectiveness, which was not published when we developed the txt2stop intervention (Michie, Hyder, Walia, and West, 2011; Michie, van Stralen and West, 2011). Future work on text messaging interventions for smoking cessation support should explore ways of improving the txt2stop intervention, potentially involving the use of a greater range of behavioral techniques, further tailoring of the intervention and fine-tuning the intervention based on participants' feedback.

Summary

The work we completed followed key processes outlined in existing guidance for the development and evaluation of complex interventions. We worked on theory, the existing evidence base, and the existing STOMP program to generate text messages, which were evaluated and modified using feedback from smoking cessation counselors and potential participants in focus groups. The messages were subsequently tested in a pilot trial. Feasibility of the trial process (recruitment, follow up) and delivery of the intervention were assessed in the pilot trial. Findings from the process evaluation for the pilot trial were used to further develop the intervention. The intervention was subsequently evaluated in a main trial. Thus we moved forward and backward between development, piloting, and evaluation phases to finalize the txt2stop intervention evaluated in the main trial. Plans for implementation have been initiated. A similar methodology could be used to develop other texting messaging interventions.

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