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Smoke into Sound: A pilot randomised controlled trial of a music cravings management program for chronic smokers attempting to quit

Genevieve A. Dingle and Nicholas A. Carter
School of Psychology, The University of Queensland, Brisbane, Queensland, Australia

Abstract
Chronic smokers display greater cravings and higher dependence on nicotine than smokers who successfully quit, which indicates a need for novel interventions that address cravings. Smoke into Sound is an online interactive program that uses personalised music-listening to assist participants to manage emotional states and cravings that act as cues for their smoking. This study describes a pilot randomised trial of Smoke into Sound (MUSIC) in comparison to current best practice cognitive behaviour therapy programs delivered online and by telephone (CBTE) or by telephone only (CBTT). Participants were 55 chronic smokers aged 18 to 66 years (45% females) who completed an online questionnaire before being randomly assigned to one of the three conditions: MUSIC, CBTE or CBTT. The 38 participants remaining 6 weeks later completed a post-program online questionnaire to assess smoking status; craving strength; self-efficacy for cessation; and confidence in regulating emotions without smoking. Almost half (45%) of the sample had stopped smoking at the post-program assessment, with similar proportions of participants in each condition no longer smoking. Participants in the MUSIC and CBTE conditions had greater reductions in craving strength and improvements in emotion regulation than those in the CBTT. The findings indicate that chronic smokers responded equally well to the music emotion regulation strategies as to the CBT strategies for smoking cessation. Smoke into Sound is the first program to our knowledge that applies music psychology theory to an intervention for addictive behaviour.

Keywords
craving, health, intervention, music-listening, smoking

Cigarette smoking is the leading cause of preventable death, causing nearly 6 million deaths each year worldwide, and decreasing life expectancy by an average of 10 years (Centers for Disease Control and Prevention, 2015). Smoking harms nearly every organ of the body and carries a heavy burden of disease and disability. Widespread anti-smoking public health campaigns have successfully reduced the prevalence of smoking in Australia over the past 25 years,

Corresponding author:
Genevieve Dingle, School of Psychology, The University of Queensland, Brisbane, St Lucia, Queensland 4072, Australia.
Email: dingle@psy.uq.edu.au

leaving a smaller population of chronic smokers who haven't responded to current smoking cessation approaches. It seems that those who *could* quit, have quit – and those still smoking find quitting most difficult (Chaiton, Cohen, & Frank, 2008; Chassin, Presson, Sherman, & Kim, 2003). Smokers who fail to quit after multiple attempts display a higher dependence on nicotine, greater cravings, and greater perceived challenges in quitting, than do smokers who made fewer attempts (Fagerstrom & Schneider, 1989; Hughes, 2011; Ip et al., 2012). This indicates a need for new ways of addressing cravings for chronic smokers attempting to cease (Shiffman, Brockwell, Pillitteri, & Gitchell, 2008a).

Cravings have been described as affectively-charged cognitive events in which an object or activity associated with pleasure or relief is in focal attention. The Elaborated Intrusion theory of desire (EI; Kavanagh, Andrade, & May, 2005; May, Kavanagh, & Andrade, 2015) maintains that intrusive thoughts become conscious craving through elaboration, a process in which vivid multisensory images of the intrusive craving target are explicitly generated, maintained, and manipulated in working memory, leading to cravings (Baddeley & Andrade, 2000; Rosen & Engle, 1997). Even when unelaborated, intrusive thoughts produce unconscious decisional biases which prompt automatic behaviour towards obtaining the reward (Kahneman & Tversky, 1982; Zajonc, 1980). However, the more an intrusive thought is elaborated, the more salient the reward becomes. In smokers' everyday experience: thinking about cigarettes only makes the thought of smoking more urgent, and the fact that one is *not* currently smoking more disappointing.

Smoking and physiological withdrawal

According to EI theory, intrusive thoughts have four triggers: physiological withdrawal; external cues; cognitions; and negative affect (Kavanagh et al., 2005; May et al., 2015). Taking physiology first: smoking was once thought to be motivated purely by withdrawal-induced cravings. Nicotine acts directly on central nervous system nicotinic acetylcholine receptors. It is linked to dopamine release in the nigrostriatal region; the mesolimbic dopamine system being central to nicotine's reinforcing effects (Benowitz, 1996; Corrigall, Coen, & Adamson, 1994). Nicotine passes through the brain within 20 seconds of smoke inhalation, rapidly facilitating neuronal firing and release of dopamine in the ventral tegmental area (VTA), creating a pleasant stimulating effect (Benowitz, 1996; Corrigall et al., 1994). To restore "normal" homeostatic neurochemistry, unpleasant opponent processes activate to counter these pleasurable nicotinic effects (Solomon & Corbit, 1973). Opponent processes, which persist after the effects of nicotine subside, manifest as withdrawal symptoms, including irritability, anxiety, and impaired concentration (Hughes & Hatsukami, 1986). During withdrawal, smokers may have intrusive thoughts of the behaviour that relieves withdrawal (smoking), which may develop into cigarette-craving if elaborated.

Nicotine replacement pharmacotherapies (e.g., nicotine patches) are designed to preclude withdrawal symptoms. A Cochrane review summarised that nicotine replacement aids smoking cessation by relieving or preventing withdrawal and providing dopaminergic pleasure in the same VTA and *Nucleus Accumbens* regions as smoke-delivered nicotine (Benowitz, 2009; Cahill, Stevens, Perera, & Lancaster, 2013). But the physiological withdrawal account fails to explain why nicotine replacement therapies only improve the chance of cessation by around 10% (Baillie, Mattick, & Hall, 1995). Furthermore, the physiological account doesn't explain why many people are infrequent smokers, apparently unaffected by withdrawal yet unable to permanently quit (Shiffman, Dunbar, Tindle, & Ferguson, 2015). Clearly there are other, psychological factors involved.

Cognitive behavioural model of smoking

The cognitive behavioural model of smoking posits that due to pairing with nicotine delivery, many stimuli become persistent triggers for intrusive smoking thoughts. These stimuli include internal cues (e.g., thinking about relaxing) and external cues (e.g., smoking paraphernalia). Stimuli associated with smoking become conditional stimuli, which evoke neural representations of smoking as a rewarding behaviour (Kelley & Berridge, 2002). Nicotinic release of dopamine into the *Nucleus Accumbens* amplifies associative learning between smoking and accompanying stimuli, making these representations increasingly prominent and well-learned (Balfour, 2004). Thus, nicotine facilitates easy learning of links between everyday objects (e.g., a lighter) and sensations (e.g., stress), with pathological, intrusive smoking thoughts.

The EI process and related smoking-behaviour can, however, be terminated by other cognitions, competing tasks or incentives, or barriers to executing smoking behaviour (Bandura, 1999). Consequently, teaching smokers coping skills to manage intrusive thoughts and elaborated cravings boasts the most success as a cognitive behavioural therapy (CBT) (Shiffman, 1984; West, 2009). Coping refers to behavioural or cognitive problem-solving techniques, which smokers use to avoid external cues, for instance, hiding ashtrays and avoiding smoking areas; change smoking-associated thoughts before they trigger intrusive desire thoughts, for example, reframing "I want to relax, I need a cigarette" to "I want to relax, I need a cup of tea"; or tolerate conscious cravings if intrusive thoughts are elaborated, for example, engaging in self-talk or distracting oneself for the duration of the craving (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Ferguson & Shiffman, 2009).

A series of Cochrane reviews found CBT approaches effective in one-on-one, telephone, and internet delivery contexts (Civljak, Stead, Hartmann-Boyce, Sheikh, & Car, 2013; Lancaster & Stead, 2005; Stead, Hartmann-Boyce, Perera, & Lancaster, 2013). Combining cognitive-behavioural support with pharmacotherapy increases cessation rates by 70%–100%. This represents a clinically significant improvement upon the cessation rates achieved from pharmacotherapy only or brief advice only (Stead, Koilpillai, Fanshawe, & Lancaster, 2016).

Smoking and negative emotions

Despite their relative effectiveness, nicotine replacement and cognitive-behavioural coping approaches don't do enough to address the affective (emotional) aspects of smoking. Substance use is frequently maintained or reinstated by negative affect (Gross, 2007; Kassel, 2010). Difficulties in regulating negative emotional states along with attempts to avoid experiencing them are linked to substance use disorders (F. A. Baker, Gleadhill, & Dingle, 2007; Dingle, Kelly, Flynn, & Baker, 2015; Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). Negative reinforcement models posit that addictive behaviour is driven by attempts to avoid or dampen such difficult feelings (T. B. Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; McCarthy, Curtin, Piper, & Baker, 2010; Otto, Safren, & Pollack, 2004). Of smokers who receive treatment, 75% relapse within 6 months, due to an inability to tolerate the negative affect associated with quitting – especially if they rely on smoking to regulate emotions (Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; Hajek et al., 2013).

Negative affect generates smoking-related cognitions independent of physiological deficits. For example, because smoking relieves withdrawal-induced anxiety by increasing nicotine concentrations, people may generalise their smoking response when experiencing anxiety in social and performance contexts. Thus, negative affect can produce intrusive thoughts of smoking as a source of relief when *any* displeasure is experienced. Furthermore, negative affect impairs

cognitive-behavioural coping. People feeling low are consciously less able to resist cravings, and unconsciously biased towards well-learned, previously-rewarded behaviours, like smoking (T. B. Baker et al., 2004; Kavanagh, 1992; Marlatt & Gordon, 1985). When experiencing negative affect, people have more difficulty avoiding habitual external cues or reframing smoking-related cognitions, so they are more likely to expose themselves to intrusive thought triggers "*I'm so stressed out – I really need a smoke*" and external cues, for example, going into a shop that sells cigarettes on the way home. For chronic smokers who fail to quit after multiple attempts, emotion regulation strategies may be the key to their cessation.

Emotion regulation and the role of music-listening

Emotion regulation can be conceptualised as the ability to modify emotion in flexible and adaptive ways in response to the social context (Campos, Walle, Dahl & Mainet, 2011). Music-listening is ranked among the most effective everyday emotion regulation strategies (Thayer, Newman, & McClain, 1994). For example, a survey of 1602 Australians found that 80% of respondents used music for stress-management – the fourth most-common strategy overall, and the number one strategy for youths (Casey & Lian, 2014). Indeed, research on music as emotion regulation formed a recent special issue in this journal (see *Musicae Scientiae*, volume 20, March 2016). People find music rewarding: it can be used to meet people's need for pleasure and positive sensation-seeking (Laukka & Juslin, 2004; Nater, Krebs, & Ehlert, 2005; Saarikallio, 2011) and to enhance their wellbeing (Papinczak, Dingle, Stoyanov, Hides, & Zelenko, 2015). Music can also induce or alleviate negative emotions including sadness (Garrido & Schubert, 2013; Peltola & Eerola, 2015) and anger (Sharman & Dingle, 2015). Indeed, its emotional effects are among the most common motives for music-listening (Swaminathan & Schellenberg, 2015). In experience-sampling and day-reconstruction studies, participants reported music influenced their feelings: while listening to music, positive emotions were more common, negative emotions less common, and stress was reduced (Juslin, Liljeström, Västfjäll, Barradas, & Silva, 2008; Västfjäll, Juslin, & Hartig, 2012). Similarly, in a series of diary studies, van Goethem and Sloboda (2011) showed that (1) music promotes broader affect regulation strategies like distraction, introspection, and active coping; (2) music plays a clear role in creating happiness and relaxation; and (3) music is an effective way of regulating emotions using a range of underlying mechanisms. Thus, findings of both laboratory studies and field studies indicate that music-listening may be a useful method of managing emotions and craving during smoking cessation.

Music and cravings management

There are three main pathways through which music-listening could assist with cravings management: affective, physiological and behavioural. Although music can serve as an auditory cue for substance use (Fachner, 2010; Short & Dingle, 2016), music interventions have been found to assist people to reduce cravings in hospital drug and alcohol treatment settings (Silverman, 2011, 2016) and in residential rehabilitation settings (Dingle et al., 2015). Music interventions have been shown to promote the experiencing of both positive and negative emotions during drug and alcohol treatment, and participants report that music allows them to experience emotions without the need for substance use (F. A. Baker, Gleadhill, & Dingle, 2007; F. A. Baker, Dingle, & Gleadhill, 2011). Smokers could use music to discharge negative affect, reducing the chance of engaging in smoking behaviour via numerous pathways of the EI model of craving (Figure 1). First, if smokers listen to pleasant music, negative

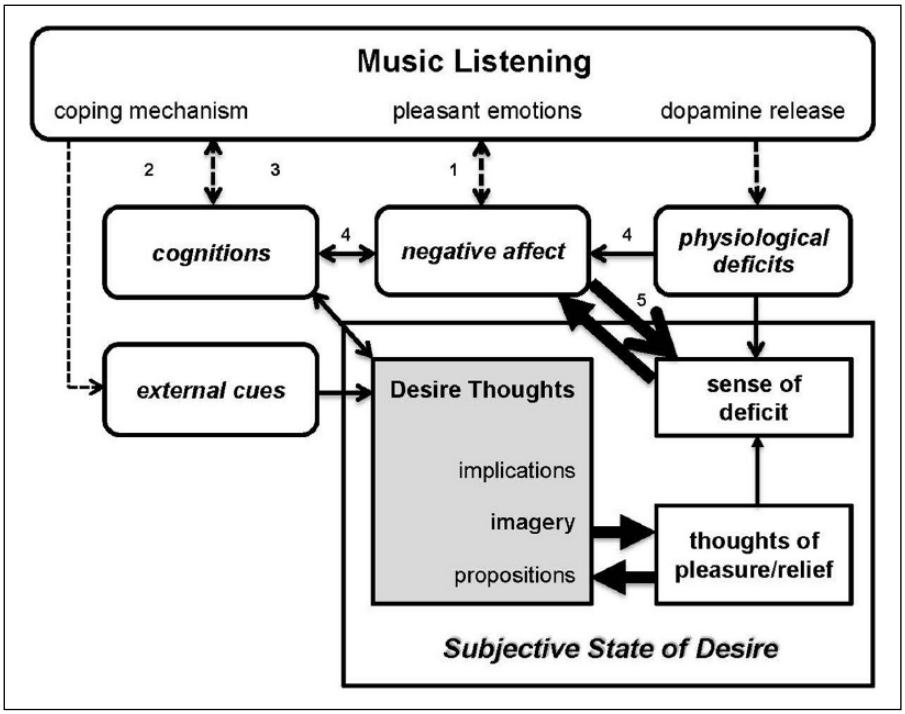

Figure 1. Proposed effect of music on components of the Elaborated Intrusion Theory of Desire for Smoking. Dotted arrows denote the theoretical influence of music on triggers for intrusive "desire thoughts", faded arrows denote implicit processes that may be disrupted by music-listening. Numbers refer to pathways by which music-listening could reduce smoking behaviour.

affective triggers for intrusive smoking thoughts would be negated via induction of pleasant emotions, reducing the chance of triggering intrusive thoughts directly or via affect-related cognitions (Papinczak, et al., 2015; Saarikallio & Erkkilä, 2007). Importantly, music-listening may support self-efficacy for performing cognitive-behavioural coping – a process that will be measured in the current study in terms of confidence managing emotions without smoking. Several studies have found cigarette cravings are better managed when positive affect is enhanced (Shmueli & Prochaska, 2012; Tice, Baumeister, Shmueli, & Muraven, 2007), moderating engagement in cognitive coping strategies (Garland et al., 2010; Schlauch, Gwynn-Shapiro, Stasiewicz, Molnar, & Lang, 2013). This notion is consistent with broaden-and-build theory of positive affect, which asserts that positive affective states can broaden individuals' cognitive capacity in such a way to broaden one's repertoire of coping options (Fredrickson, 2001). More broadly, this would be consistent with the findings that music enhances self-efficacy in other health and behaviour change programs, such as exercise (Clark, Baker, & Taylor, 2016; Karageorghis & Priest, 2012) due to its motivational qualities. Third, if smokers associate music with affective relief, smoking-related cognition may begin triggering music-listening thoughts instead. Fourth, alleviating negative affect would reduce the likelihood of intrusive thoughts triggered by other sources being elaborated. Fifth, elaborated craving intensity would be reduced, as there would be one fewer dimension of deprivation made salient if negative affect is discharged.

In addition to these affective benefits, music-listening may aid smoking cessation by providing an alternative source of dopaminergic reward. Positron emission tomography imaging studies found that brain responses to enjoyable music correlated with activity in brain regions associated with reward and emotion (Blood & Zatorre, 2001; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011). Functional and connectivity analyses showed responses to pleasant music along dopaminergic NAcc and VTA pathways, which are implicated in reward processing and activation via addictive drugs like nicotine (Berridge & Robinson, 2003; Menon & Levitin, 2005). As listening to one's favourite music modulates dopaminergic activity along the same reward pathways as nicotine, it could fulfil part of the same physiological function as smoking cessation pharmacotherapy (Benowitz, 2009; Cahill et al., 2013).

A third pathway is behavioural; the act of findings and listening to music on one's personal listening device or phone could serve as an alternative behavioural response to cravings and help smokers to tolerate cravings until they pass (Ferguson & Shiffman, 2009; Saarikallio & Erkkilä, 2007; Salovey, Bedell, Detweiler, & Mayer, 1999). This could work via distraction by altering smoking cognitions – for instance, songs which inspire perseverance, or provide distraction with non-smoking thoughts. Research has long noted the smoking-cessation benefits of having a greater number of coping strategies available, with no difference in effectiveness between various cognitive and behavioural strategies (Fiore et al., 2008; Perri, Richards, & Schultheis, 1977; Shiffman, 1984).

The current study

This study aimed to test the effectiveness of a new web-based program using personalised music-listening, called Smoke into Sound. The interactive website incorporated psychoeducation about smoking and its triggers, particularly emotional states and cravings, in a series of short video clips. Participants watched the videos detailing how to use music-listening as an emotion-regulatory strategy and completed interactive tasks online. Further detail about the program content is presented in Table 2 and described in the Methods section. Chronic smokers seeking assistance from Quitline were randomly assigned to one of three conditions: the Smoke into Sound program (hereafter referred to as the MUSIC condition); or current best practice cognitive behaviour therapy strategies delivered in a comparable interactive website with video clips along with telephone assistance from Quitline (CBTE) or delivered by telephone only (CBTT). The telephone-assisted cognitive behaviour therapy intervention was essentially treatment as usual from the Quitline service. Outcomes were measured by online survey after 6 weeks. There were three hypotheses, as follows:

H1. Although all three programs were expected to be effective, only the MUSIC program contained specific strategies for emotion regulation, and therefore a higher proportion of participants in the MUSIC condition were expected to quit than participants in the CBTE and CBTT conditions.

H2. The MUSIC condition was expected to be more effective at reducing cravings than the CBTE or CBTT conditions.

H3. In accordance with the EI model and the importance of negative affect in smoking behaviour, improvements in quitting likelihood was expected to be mediated by ability to manage emotions without smoking.

Method

Design

A 3 (conditions: MUSIC vs CBTE vs CBTT) × 2 (Time: Baseline T1 vs 6-weeks post-baseline T2) mixed design was used. Assignment to intervention program condition was random and double-blinded. Dependent variables were: smoking status; craving strength; confidence to quit smoking; and managing emotions without smoking. Other variables were included as potential covariates. All materials were presented to participants online using Qualtrics™, hosted on the University of Queensland's School of Psychology website.

Participants

Participants were 55 smokers aged 18 to 66 years (M = 40.61, SD = 10.99) from across Queensland who were seeking workplace-sponsored smoking-cessation treatment telephone-delivered by Quitline. As shown in Table 1, less than half of the sample were female (45%), there was a range of education levels, and a majority (82%) were in full-time employment. Participants had previously attempted to quit on average five times. They were recruited for this pilot between June and August 2015, with the T2 follow-ups completed by 1 October. The time between T1 and T2 data collection was designed to be 42 days, and was in fact M = 44.21, SD = 14.51, based on when the participants accessed study materials. To be eligible for recruitment, clients had to be aged 18 years or over, and report being a current smoker. If recruitment criteria were met, tele-counsellors read clients a script inviting clients to hear about a study examining web-based support and other factors that affect quitting. If clients consented, their information was passed on to the researchers for potential recruitment. Study participation was voluntary, and compensated with a $20 gift voucher upon completion of the T2 questionnaire. Ethics approval was obtained from The University of Queensland (clearance number: 15-PSYCH-4-70-TS) and Queensland Health (2015; approval number: HREC/15/QPCH/99), and all participants digitally indicated informed consent at study commencement.

According to G*Power, an a priori power calculation for a 3 × 2 repeated measures ANOVA testing a within and between interaction, with an assumed medium effect size of f = 0.25, 1-ß = 0.80 and α = .05 will require 42 participants. In the current study, we had N = 38 valid cases, which meant that the results could reach an a priori power of 1-ß = 0.76.

Materials

Intervention programs. Novel programs developed for this project were interactive psychoeducational websites for the MUSIC and CBTE conditions. Each program consisted of six psychoeducational videos totalling 20 minutes in length, followed by interactive components (see Table 2 for program website contents). Each video featured one of the authors explaining concepts and strategies, overlaying animations illustrating those concepts hand-drawn on a whiteboard. Video features were filmed on a 5.0 megapixel iPad, and edited with Adobe Premiere. A pilot with 22 participants showed that the series of music videos were equally as engaging as the series of CBTE videos.

Smoke into Sound (MUSIC). This program taught participants to identify which emotions were triggers for their smoking, and how music can be used as a substitute for the emotion regulating effect of smoking. The participants were introduced to a two-dimensional model of emotion

Table 1. Demographic features of participants at baseline, according to intervention group.

Demographic variable	MUSIC	CBTE	CBTT	Total
	(n = 19)	(n = 18)	(n = 18)	(N = 55)
Age	40.37 (*9.64*)	40.72 (*11.02*)	41.39 (*12.73*)	40.61 (*10.99*)
Gender (female)	7 (37%)	12 (67%)	6 (32%)	25 (45%)
Indigenous status (Aboriginal)	0 (0%)	2 (11%)	0 (0%)	2 (4%)
Receiving mental health treatment	1 (5%)	5 (28%)	2 (11%)	8 (14%)
Receiving physical health treatment	2 (11%)	5 (28%)	2 (11%)	9 (16%)
Educational attainment				
Primary only	0 (0%)	1 (6%)	0 (0%)	1 (2%)
Some secondary	6 (32%)	1 (6%)	5 (26%)	12 (21%)
Completed secondary	3 (16%)	5 (28%)	5 (26%)	13 (23%)
Some tertiary	5 (26%)	7 (39%)	3 (16%)	15 (27%)
Completed tertiary	5 (26%)	4 (22%)	6 (32%)	15 (27%)
Employment status				
Full-time	14 (74%)	16 (89%)	16 (84%)	46 (82%)
Part-time	2 (11%)	0 (0%)	2 (11%)	4 (7%)
Unable to work	1 (5%)	1 (6%)	0 (0%)	2 (4%)
Home duties	0 (0%)	1 (6%)	0 (0%)	1 (2%)
Home duties and part time	1 (5%)	0 (0%)	0 (0%)	1 (2%)
Student and part time	0 (0%)	0 (0%)	1 (5%)	1 (2%)
Retired	1 (5%)	0 (0%)	0 (0%)	1 (2%)
Smoking history				
Cohabiting with other smokers	9 (47%)	10 (56%)	7 (39%)	26 (46%)
Age of smoking initiation (years)	16.16 (*4.27*)	16.06 (*6.21*)	16.35 (*6.40*)	16.46 (*5.70*)
Age of regular smoking (years)	17.42 (*3.08*)	16.78 (*5.43*)	18.00 (*4.02*)	17.64 (*4.40*)
Years spent regularly smoking	22.94 (*11.18*)	23.94 (*12.40*)	22.35 (*15.08*)	22.96 (*12.70*)
Number of previous quit attempts	3.16 (*1.61*)	7.28 (*7.37*)	4.82 (*4.57*)	4.96 (*5.18*)
Longest quit in last 5 years				
Have not quit in last 5 years	3 (16%)	0 (0%)	1 (5%)	4 (7%)
< 1 day	2 (11%)	1 (6%)	0 (0%)	3 (5%)
1–6 days	5 (26%)	3 (17%)	4 (21%)	12 (21%)
1–4 weeks	0 (0%)	4 (22%)	4 (21%)	8 (14%)
1–3 months	1 (5%)	4 (22%)	3 (16%)	8 (14%)
3–6 months	3 (16%)	0 (0%)	0 (0%)	3 (5%)
6–12 months	3 (16%)	2 (11%)	4 (21%)	9 (16%)
> 12 months	2 (11%)	4 (22%)	3 (16%)	9 (16%)

Note. Data are displayed as Number (%) or Mean (*Standard Deviation*).

in which emotions are defined by a positive-negative valence axis, and a high-low energy arousal axis (Eerola & Vuoskoski, 2011; Russell, 1980). They were taught to identify their current and desired emotional state on these two dimensions and then to select music that would assist them in reaching their desired emotional state. This method of psychoeducation has been used to effectively convey emotion regulation, and is associated with enhancements in managing emotions using music and possessing a of adaptive emotion regulation strategies (Dingle,

Table 2. Program website contents and elements by intervention program condition.

Website element	MUSIC condition contents: emotion regulation via music-listening	CBTE condition contents: cognitive-behavioural strategies to quit smoking
Video 1	Background information normalising the difficulty of quitting smoking, and smoking cues which make it difficult. Background research suggesting how music may provide an additional strategy to help smokers quit.	Background information normalising the difficulty of quitting smoking, and smoking cues which make it difficult. Information about automatic thoughts, and how changing cognitions with self-talk can be used to cope with cravings.
Interactive component 1	Selecting the emotional cue most associated with smoking from a list.	Writing an automatic smoking thought and a self-talk example to cope with it.
Video 2	Explanation of the two-dimensional valence-arousal model of emotions.	Information about removing the reward of smoking by changing smoking environment.
Interactive component 2	Clicking where previously-selected emotional cue lies on valence/arousal chart.	Writing ideas for how to remove the reward from smoking, in a free-response text box.
Video 3	Smoking to change feelings, and how the feeling changes in terms of valence/arousal.	Automatic smoking habits, and changing them by replacing smoking's function.
Interactive component 3	Indicating how emotional smoking cue changes in valence/arousal after smoking, by selecting "increases/decreases/stays the same" from dropdown boxes.	Writing a situation in which smoking is performed habitually, in a free-response text box; writing a non-smoking replacement habit, in a free-response text box.
Video 4	Asking participants to consider what music would match the target, post-smoking emotion, followed by explanation that personally-meaningful music works best.	Asking participants to consider what benefits they expect to get from smoking, and what non-smoking coping strategies would provide the same benefits as smoking.
Interactive component 4	Writing the features of their chosen music important in changing emotions, in a free-response text box.	Choosing a feeling linked to smoking from a dropdown box; writing the expected benefit of smoking; writing a coping strategy that would provide the same expected benefit.
Video 5	Strategies for listening to music in various locations/situations, instead of smoking.	Importance of clarifying reasons for quitting, quit support, and smoke-free areas.
Interactive component 5	Writing ideas for how music-listening could be used to change feelings when an emotional cue induces smoking urges, in a free-response text box.	Writing main reasons for quitting; writing who will be a source of social support; writing plans for creating smoke-free areas.
Video 6	Creating a "quitting playlist".	Incorporating strategies into a "quit plan".
Interactive component 6	Writing the first three songs and artists to be added to the quitting playlist.	Writing three main smoking triggers; writing coping strategies for those triggers.

Hodges, & Kunde, 2016). Participants were also encouraged to type in *how* they would use music to overcome cravings and emotional triggers – for example, developing a "quit" playlist on their phone for easy access during the day. These participants also received usual treatment from Quitline.

Online Cognitive-behavioural program (CBTE). This program contained a series of video clips about coping strategies taken from the Queensland Quitline publication *Quit Because You Can*, which are typically covered in the content of the Quitline cessation program itself. Participants were asked to identify their three main triggers for smoking and to develop strategies focused on changing cognitions about the benefits of smoking and the need to smoke; changing behaviours that lead to smoking; and reducing the contingent reward of smoking behaviours. These participants also received usual treatment from Quitline.

Telephone Cognitive-behavioural program (CBTT). The content of this program was the same as for the CBTE program, however, these participants received telephone assistance only without access to a psychoeducational website, which is the usual treatment from Quitline. Participants were provided with a static website containing contact details for various smoking support agencies, and this information was also provided to participants in the MUSIC and CBTE conditions at the end of their website.

Measures

Demographic data. Basic details, including smoking history, were collected to control for differences due to demographic influences.

Smoking status. Smoking status was assessed dichotomously at T2 by the standard item: "Are you currently smoking?" Participants who responded *No* were asked to indicate their smoke-free duration; those who responded *Yes* were asked to indicate their T2 nicotine dependence (see in what follows). This item was not directly assessed at baseline, as being a current smoker was a condition of study participation.

Nicotine dependence. Nicotine dependence, a strong predictor of ability to quit smoking (Fagerstrom & Schneider, 1989; Hughes, 2011; Ip et al., 2012), was assessed using the Fagerstrom Test for Nicotine Dependence, a 6-item multiple-choice questionnaire (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). Four items assess smoking habits (e.g., How soon after you wake up do you have your first smoke?); two assess perceived difficulties (e.g., Do you find it difficult to not smoke in places where it is forbidden?). Higher scores indicate higher nicotine dependence, with validity with other measures reflecting dependence, including withdrawal symptom severity, biochemical measures of smoke exposure, and response to pharmacotherapy (Fagerstrom & Schneider, 1989; Payne, Smith, McCracken, McSherry, & Antony, 1994).

Craving strength. Craving strength was assessed using the Craving Experience Questionnaire (May et al., 2014), a 10-item questionnaire scored on an 11-point scale from 0 (*not at all*) to 10 (*extremely*). Three items assess craving intensity (e.g., When you have quit in the past . . . how much did you want to smoke?), four assess craving imagery (e.g., When you have quit in the past . . . how much did you picture smoking?), and three assess craving intrusiveness (e.g., When you have quit in the past . . . how intrusive were thoughts about smoking?). At baseline, prior to participants' current quit attempt, past-tense wording was used to establish strength of cravings the last time participants tried quitting (e.g., When you have quit in the past, how much did you want to smoke?). At 6 weeks post-baseline, the wording was changed to reflect the present tense of the current attempt (e.g., How much do you want to smoke?). Higher sums of item scores indicate greater craving strength, as validated with other measures of substance use compulsion (May et al., 2014).

Self-efficacy. Self-efficacy for quitting was assessed using self-report questions scored on 11-point scales from 0 (*not at all*) to 10 (*extremely*) which Quitline uses to assess client progress: "How important is it for you to become a non-smoker?"; "How confident are you that you can quit smoking right now?"; and "How determined are you to quit smoking for good?". Higher scores indicate greater self-efficacy.

Managing emotions without smoking. A measure with five items scored on an 11-point scale from 0 (*not at all*) to 10 (*extremely*) assessed participant confidence in managing the following emotions without smoking (e.g., How confident are you managing . . . without smoking?): stress or anxiety; feeling good; boredom; feeling sad or depressed; and relaxing. The battery was included as separate items based on the self-efficacy items, and the most common affective smoking triggers (Fidler & West, 2009; McEwen, West, & McRobbie, 2008; McKennell, 1970). However, high intercorrelations and excellent internal consistencies between items led to their combination, as they were included to assess a single construct. Higher scores, taken as the average of all items, indicate greater capacity to manage emotional triggers without smoking.

Pharmacotherapies. Pharmacotherapy products improve cessation outcomes, so their use was measured as a covariate (Cahill et al., 2013). Products used to aid cessation were assessed by the standard question, "Select any physical products you are using to assist your quitting." Responses consisted of: *nicotine patches*; *oral nicotine replacement*; *Champix (varenicline tartrate)*; *Zyban (bupropion)*; *other (please specify)*.

Alcohol misuse. To control for its influence, alcohol misuse was assessed using the Alcohol Use Disorders Identification Test – Consumption, a three-item self-report questionnaire. Higher scores indicate greater alcohol misuse, as validated with other accepted measures (Meneses-Gaya et al., 2010).

Procedure

The procedure for the trial is shown in Figure 2. After consenting, participants created a participation code, and were taken to the baseline questionnaire. Following questionnaire completion, participants were randomised to an intervention program condition, and provided the respective website. Blind randomisation was carried out within the Qualtrics'™ random-number service assigning each participant, with equal probability, to a condition website, the moment he/she completed the baseline questionnaire. Participants were blinded to their condition: each participant was told he/she would be given a support website at the questionnaire's conclusion, without reference to the content of that website; and both the MUSIC and CBTE websites referred to content therein as "new quitting strategies". Researchers included the second author and four postgraduate clinical psychology interns (all supervised by the first author). These researchers and the Quitline treatment providers were also blinded to condition assignment, since it occurred anonymously online, and the study was not discussed during Quitline treatment contacts. One week later, participants were telephoned by one of the researchers, to remind them of the baseline questionnaire, and provide troubleshooting had it not been accessed. Six weeks after initial telephone contact, participants were telephoned one final time to remind them of the 6-week post-baseline questionnaire, which was emailed to them at that time. After the T2 questionnaire completion, participants were provided a summary of the study's aims, access to all treatment conditions, and a $20 gift voucher.

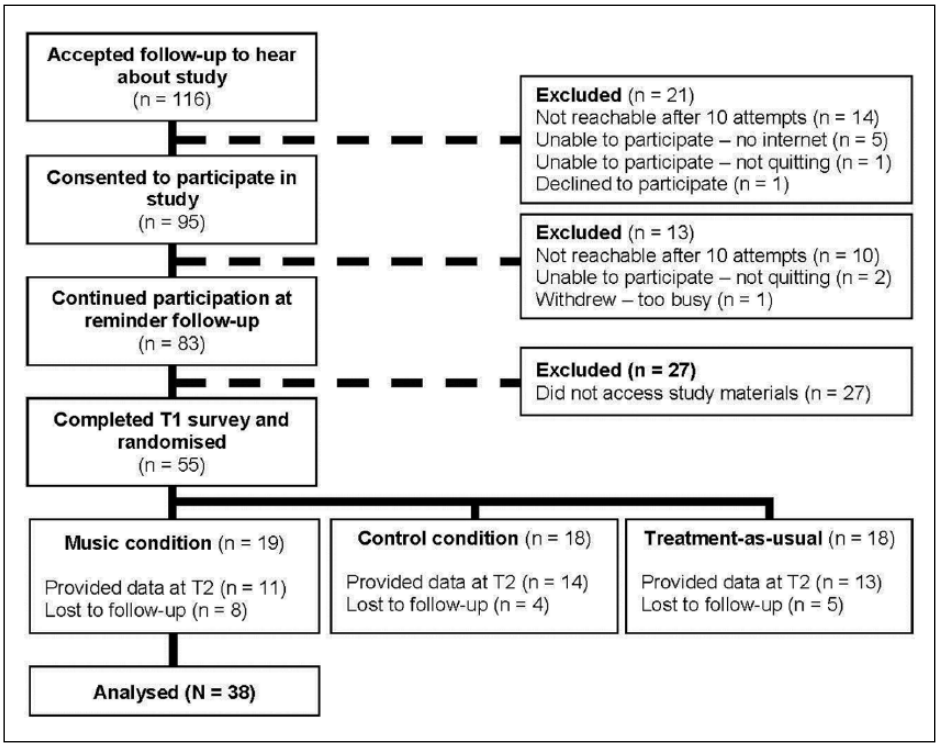

Figure 2. CONSORT flowchart of study participants, point of random condition assignment, and dropouts at each stage of the internet-based study.

Results

Preliminary analyses

Data screening. Six participants were missing some data at T1. Data appeared missing completely at random (MCAR), $\chi^2(253, N = 55) = 220.75$, $p = .929$, and there were no systematic baseline differences between participants missing data or not. Therefore, missing T1 data were substituted using Expectation Maximisation. Demographics for the full sample and the three conditions are displayed in Table 1 and smoking related variables for the full sample and each intervention group are presented in Table 3. As can be seen, means are similar (within one standard deviation of the total sample means) for the three conditions, indicating that randomisation created equivalent groups. As 17 participants (31%) did not access the T2 survey, values on the T1 variables were examined for systematic differences in T2 completion. There was only one significant association between T2 response and any variables: all 9 participants who reported currently receiving physical health treatment responded at T2, $\chi^2(1, N = 55) = 4.81$, $p = .044$. This demographic measure, however, was unrelated to other variables, so the difference is unlikely to bias any findings.

Losses to follow-up appeared random and independent of other manipulated or measured variables. Furthermore, attrition was no different to Quitline's 38% rate, $Z = 1.08$, $p = .280$. Besides physical health treatment, participants who provided T2 data were representative of all study participants. Participants who provided no T2 data were deleted from the dataset list-wise

Table 3. Dependent and explanatory variables at baseline (T1), according to intervention group.

Variable	Total	MUSIC	CBTE	CBTT
	(*N* = 55)	(*n* = 19)	(*n* = 18)	(*n* = 18)
Dependent variables				
Fagerstrom test for nicotine dependence	4.92 (*2.29*)	4.89 (*2.54*)	5.14 (*1.93*)	4.74 (*2.45*)
Craving experience questionnaire	48.25 (*21.64*)	57.00 (*20.21*)	41.27 (*22.59*)	46.10 (*20.17*)
Self-efficacy				
Importance of quitting	9.50 (*1.06*)	9.53 (*0.90*)	9.56 (*1.15*)	9.42 (*1.17*)
Confidence in quitting	6.41 (*2.26*)	6.53 (*2.57*)	6.67 (*2.00*)	6.05 (*2.25*)
Determination to quit	8.66 (*1.79*)	8.68 (*2.19*)	8.83 (*1.34*)	8.47 (*1.81*)
Confidence Managing Emotions without smoking	6.59 (*2.18*)	6.66 (*2.57*)	6.63 (*1.46*)	6.47 (*2.44*)
Other explanatory variables				
Alcohol use disorders identification test	5.41 (*2.90*)	5.54 (*3.04*)	4.39 (*2.30*)	6.23 (*3.11*)
Pharmacotherapy used				
Patch nicotine replacement	31 (55%)	5 (26%)	4 (22%)	2 (11%)
Oral nicotine replacement	11 (20%)	1 (5%)	0 (0%)	2 (11%)
Patches and oral nicotine	3 (5%)	12 (63%)	11 (61%)	8 (44%)
Champix	1 (2%)	0 (0%)	0 (0%)	1 (6%)
None	10 (18%)	1 (5%)	3 (17%)	6 (33%)

Note. Data are displayed as Number (%) or Mean (*Standard Deviation*).

to allow complete-case analysis for main analyses. Remaining data were screened for T2 missing values prior to main analyses: data missing from 11 of 38 participants and 10 of 26 variables appeared MCAR, $\chi^2(293, N = 38) = 262.15$, $p = .902$, and was substituted using Expectation Maximisation.

Descriptives and bivariate relationships. T1 and T2 means and standard deviations for continuous dependent variables from the complete-case sample are displayed in Table 4. No outcome had a significant bivariate relationship with any categorical variable.

Group differences in quitting likelihood. One-way between-participants ANCOVAs examined whether intervention program condition predicted T2 scores, controlling for covariates, since mean differences may have been qualified by systematic variations on other measures. Note that pharmacotherapy use was not included as a covariate in any models because it had insufficient variability to be a useful categorical predictor for this sample. Over the course of this study, 45% of chronic smokers quit, with similar proportions of quitters in each condition. Because smoking status was a dichotomous measure repeated within participants over time, McNemar's chi-squared test was used as the appropriate statistic for a change in proportion of smokers. As displayed in Figure 3, the exact test revealed the proportion of smokers at T2 was significantly reduced from T1 for the total sample ($p < .001$), CBTE ($p = .031$), and CBTT ($p = .031$) groups. The reduction in the MUSIC group was only marginally significant ($p = .063$) due to the overly-conservative Yates correction SPSS uses in the computation, and the

Table 4. Dependent variables at T1 and T2 for the complete-case sample, according to intervention group.

Dependent variable	Total ($N = 38$)		MUSIC ($n = 11$)		CBTE ($n = 14$)		CBTT ($n = 13$)	
	T1	T2	T1	T2	T1	T2	T1	T2
Proportion of Smokers	38 (100%)	21 (55%)	11 (100%)	6 (55%)	14 (100%)	8 (57%)	13 (100%)	7 (54%)
Smoke-free duration (days)[a]	–	28.24 (*22.03*)	–	35.60 (*24.77*)	–	25.17 (*14.65*)	–	25.17 (*27.77*)
Fagerstrom Test for Nicotine Dependence[b]	5.70 (*2.58*)	3.26 (*2.45*)	5.83 (*3.76*)	4.33 (*3.27*)	4.95 (*1.87*)	2.31 (*2.01*)	6.43 (*2.23*)	3.43 (*1.99*)
Craving experience questionnaire	49.79 (*21.73*)	25.00 (*19.30*)	62.82 (*13.38*)	23.83 (*18.97*)	41.10 (*23.11*)	20.44 (*21.31*)	48.13 (*21.93*)	30.87 (*17.16*)
Self-efficacy								
Importance of quitting	9.61 (*0.97*)	9.53 (*1.03*)	9.64 (*0.92*)	9.27 (*1.27*)	9.71 (*0.83*)	9.93 (*0.27*)	9.46 (*1.20*)	9.31 (*1.25*)
Confidence in quitting	6.32 (*2.08*)	6.84 (*2.50*)	6.36 (*2.46*)	6.00 (*3.29*)	6.93 (*1.38*)	8.21 (*1.21*)	5.62 (*2.29*)	6.08 (*2.33*)
Confidence Managing Emotions without smoking	6.62 (*2.14*)	7.47 (*2.44*)	6.87 (*2.63*)	7.49 (*2.65*)	6.76 (*1.13*)	8.37 (*2.11*)	6.26 (*2.59*)	6.49 (*2.38*)

Note. Data are displayed as Mean (*Standard Deviation*) or Number (%). Means and standard deviations displayed above are observed. Further analyses use estimates based on 5000 bootstrapped resamples, as explained in the *Main Analyses* subsection.

[a]Calculated from the subsample of non-smoking participants at T2.

[b]Calculated from the sample of participants still smoking at T2.

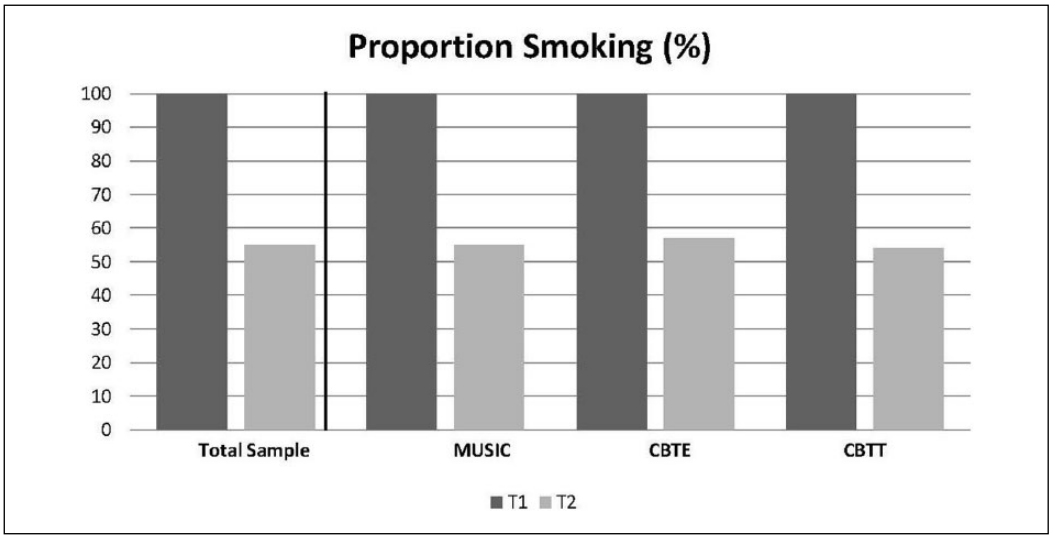

Figure 3. Proportion of the sample currently smoking at T1 and T2 shown for the full sample and for the three smoking program conditions

smaller group sample size (Sokal & Rohlf, 2012). Although the proportions within each condition were comparable (Figure 3), hypothesis 1, that the MUSIC condition would yield a higher proportion of people quitting than the CBTE and CBTT conditions, was not supported. There were no between-groups differences in smoke-free duration or T2 nicotine dependence for participants who had or had not quit, respectively; but those still smoking displayed significantly lower T2 nicotine dependence across all groups.

Craving strength. As Figure 4 shows, craving strength scores decreased over time for the MUSIC and CBTE conditions, but not for the CBTT. The highly significant decrease for the MUSIC condition is especially noteworthy, given its small sample size. Hypothesis 2, that the MUSIC condition would be more effective at reducing cravings than the CBTE or CBTT conditions was therefore partially supported.

Contrary to this hypothesis however, the main effect of intervention program condition on T2 craving strength became non-significant ($p = .465$, $\eta_p^2 = .04$) after controlling for T1 Confidence Managing Emotions Without Smoking as a covariate ($p = .013$, $\eta_p^2 = .17$). Table 5 shows that, based on 5,000 bootstrapped resamples, T1 Confidence Managing Emotions significantly predicted T2 craving scores, such that every unit increase in T1 Confidence Managing Emotions was associated with a 3.61-unit decrease in T2 craving strength. Although coefficients for both the MUSIC and CBTE conditions suggested that being in either group could reduce T2 craving strength, neither was significant as the CIs contained 0.

Confidence in quitting smoking. Differences over time in Confidence in Quitting Smoking were non-significant for the full sample and each condition, as seen in Table 6. Interestingly, a main effect of intervention program ($p = .031$, $\eta_p^2 = .19$) on T2 Confidence in Quitting was revealed after controlling for T1 Confidence Managing Emotions ($p = .028$, $\eta_p^2 = .14$) and T1 nicotine dependence ($p = .016$, $\eta_p^2 = .16$) as covariates. Table 7 displays that all covariates significantly predicted T2 Confidence in Quitting scores, such that a unit increase in T1 Confidence Managing Emotions and T1 nicotine dependence scores was associated with a 0.38-unit increase, and

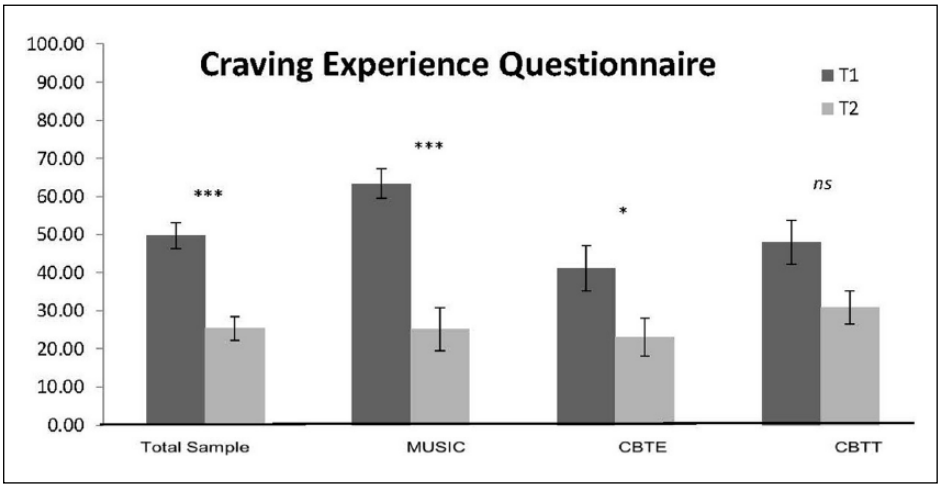

Figure 4. Mean scores on the Craving Experience Questionnaire from T1 and T2 for the total sample, and for the three smoking program conditions (*p < .013; **p < .01; ***p < .001 for differences between T1 and T2).

Table 5. ANCOVA results for T2 Craving Experience Questionnaire scores and intervention group condition, with T1 Confidence Managing Emotions Without Smoking as a covariate.

Predictor	F	p	η_p^2	Bootstrap estimates		
				B	SE	95% CI
T1 managing emotions	6.79	.013	.17	−3.61*	1.59	[−6.79, −0.66]
Intervention program condition	0.78	.465	.04	–	–	–
MUSIC	–	–	–	−4.85	6.39	[−16.71, 5.58]
CBTE	–	–	–	−8.65	7.39	[−21.46, 5.81]

Note. B = the unstandardized regression coefficient; SE = the estimated standard error of the coefficient, based on 5,000 bootstrap resamples. *p < .05 based on 5,000 bootstrap resamples.

a 0.36-unit decrease, respectively, in T2 Confidence in Quitting, based on bootstrapped resamples. Planned contrasts found no difference in T2 Confidence in Quitting between MUSIC and CBTT conditions, p = .34, 95% CI [−2.10, 0.74]. However, being in the CBTE condition was significantly associated with a 2.06-unit increase in T2 Confidence in Quitting compared to the CBTT condition, p = .015, 95% CI [0.43, 3.69].

Mediation of Confidence Managing Emotions without smoking. To test whether changes in managing emotions without smoking affected other measures of quitting likelihood over time, repeated-measures mediation analysis was executed for each other outcome, using the MEMORE *SPSS* macro (Montoya & Hayes, 2016). Mediation was tested using estimates based on 10,000 bootstrapped resamples, to estimate indirect effect sizes and increase power (Preacher & Hayes, 2004). Contrary to hypothesis 3, there was no significant mediation

Table 6. Bootstrapped *t* test results for differences in outcome measures from T1 to T2.

Dependent variable	Total ($N = 38$)		MUSIC ($n = 11$)		CBTE ($n = 14$)		CBTT ($n = 13$)	
	ΔMean (*SD*)	98.7% CI	ΔMean (*SD*)	98.7% CI	ΔMean (*SD*)	98.7% CI	ΔMean (*SD*)	98.7% CI
Fagerstrom test for nicotine dependence[a]	−2.45** (2.01)	[−3.63, −1.46]	−1.50* (*1.26*)	[−2.50, −0.67]	−2.68** (*2.21*)	[−5.34, −0.58]	−3.00** (*1.90*)	[−4.86, −1.57]
Craving experience questionnaire	−24.79*** (*27.07*)	[−36.38, −13.29]	−38.99*** (*24.66*)	[−55.02, −22.47]	−20.19* (*24.73*)	[−34.27, −5.77]	−17.70 (*24.75*)	[−34.77, 5.24]
Self-efficacy								
Importance of quitting	−0.08 (*0.96*)	[−0.45, 0.26]	−0.36 (*0.82*)	[−1.18, −0.09]	0.21 (*0.85*)	[−0.21, 0.86]	−0.15 (*1.03*)	[−0.69, 0.38]
Confidence in quitting	0.53 (*2.30*)	[−0.45, 1.45]	−0.36 (*2.39*)	[−2.64, 1.27]	1.29 (*1.77*)	[−0.07, 2.71]	0.46 (*2.58*)	[−1.23, 1.92]
Confidence Managing Emotions without smoking	0.85* (*2.09*)	[0.03, 1.68]	0.62 (*1.51*)	[−0.60, 2.14]	1.61 (*2.11*)	[0.08, 2.95]	0.23 (*2.25*)	[−1.56, 2.11]

Note. ΔMean = $M_{T2} - M_{T1}$; *SD* = estimated standard deviation, taken by multiplying the bootstrapped *SE* by stimated standard deviation, taken by multiplying the bootstrapped ociated with a 2.06-unit increase in, 000 bootstrapped resamples.

[a]Calculated from the sample of participants still smoking at T2.

*$p < .013$ *or* the 98.7% CI did not contain 0; **$p < .01$; ***$p < .001$.

Table 7. ANCOVA results for T2 confidence in quitting smoking scores and intervention group condition, with T1 Confidence Managing Emotions Without Smoking and T1 nicotine dependence as covariates.

Predictor	*F*	*p*	η_p^2	Bootstrap estimates		
				B	*SE*	95% CI
T1 Confidence Managing Emotions	5.28	.028	.14	0.38*	0.17	[0.06, 0.70]
T1 Nicotine dependence	6.44	.016	.16	−0.36*	0.14	[−0.58, −0.02]
Intervention program condition	3.87	.031	.19	–	–	–
MUSIC	–	–	–	−0.52	1.04	[−2.54, 1.45]
CBTE	–	–	–	2.06*	0.76	[0.43, 3.69]

Note. *B* = the unstandardized regression coefficient; *SE* = the estimated standard error of the coefficient, based on 5,000 bootstrap resamples.
*$p < .05$, based on 5,000 bootstrap resamples.

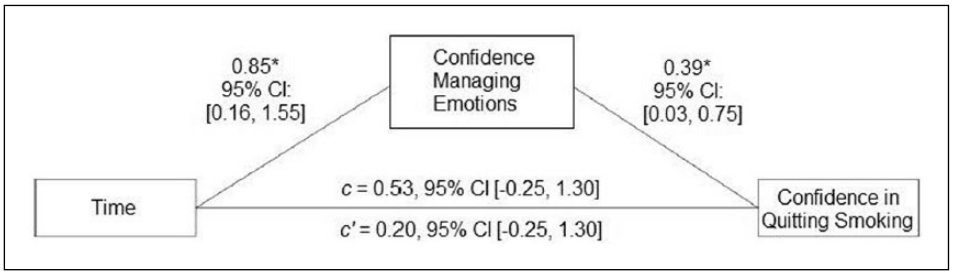

Figure 5. Mediation model showing Confidence Managing Emotions Without Smoking mediates the change over time in confidence in quitting smoking. Numbers shown are unstandardized regression coefficients.

of Confidence Managing Emotions Without Smoking for either smoking status or craving strength. However, it did mediate the relationship between Time and Confidence in Quitting Smoking (see Figure 5). When Confidence Managing Emotions and Time were entered as simultaneous predictors for Confidence in Quitting, Confidence Managing Emotions emerged as a significant predictor in both models, but Time did not. Bootstrapping revealed bias-corrected indirect effects of Confidence Managing Emotions on Confidence in Quitting of 0.33, 95% CI (0.00, 0.79). Therefore, changes in Confidence Managing Emotions Without Smoking significantly mediated changes in Confidence in Quitting Smoking, and hypothesis 3 was therefore partially supported.

Discussion

Using a randomised controlled design, this pilot study investigated whether Smoke into Sound – a novel interactive psychoeducation web program using music-listening to assist smokers to manage their cravings and emotions – was effective in helping smokers to quit. We adopted the EI model of craving as a theoretical framework for the study (Kavanagh et al., 2005; May et al., 2015), and hypothesised that due to the strategies in the MUSIC condition designed to target emotions and cravings, a higher proportion of smokers would quit in this condition compared

to the CBT conditions. This hypothesis was not supported as a similar proportion of participants in each condition quit during the study period. That is not to say that the MUSIC program was unsuccessful however – indeed, almost half of these chronic smokers had ceased to smoke at the 6-week survey in all three programs. These figures are comparable to the 42% 6-week point-prevalence abstinence for Australian Quitline clients (Germain, Letcher, & Fairthorne, 2004). Reductions in craving strength were consistent with previous studies of smokers receiving pharmacotherapy and cognitive-behavioural treatment (Stead & Lancaster, 2012a, 2012b; Stead et al., 2012). Our findings demonstrate that the online MUSIC program in conjunction with telephone-delivered treatment as usual was equally effective as current best practice CBT-based interventions. The general lack of differential effects between conditions suggests that either there were non-specific therapeutic effects (such as gaining access to a targeted intervention that has face validity) accounting for the response rates, or that any differences between the conditions in terms of their mechanisms of action were unable to be detected in the smoking status or nicotine dependence outcome measures.

Examining the mechanisms of action more closely, the second hypothesis that the MUSIC condition would specifically address craving experiences was supported. The largest and most significant decrease in cravings was in the MUSIC condition, even though it had the smallest sample size and thus least chance of attaining statistical significance by chance. The CBTE condition had the next largest decrease, with a non-significant change for CBTT. The fact that these between condition effects became non-significant after entering T1 Confidence in Managing Emotions without smoking further emphasises the EI model pathways. That is, the MUSIC condition was helpful in addressing internal triggers for cravings but only for participants who were not already confident in managing their emotions without smoking at T1. Both the MUSIC and CBTE conditions were associated with greater improvements in confidence in managing emotions without smoking than the CBTT, with no difference between website conditions (Brandon, 1994). It is likely that the websites provided adaptive emotion-regulation strategies through different processes. The MUSIC condition participants may have felt more confident managing emotions through their music psychoeducation as intended; and CBTE condition improvements might be related to coping strategies for internal triggers among these participants.

Hypothesis 3, that quitting measures would be mediated by confidence in managing emotions without smoking, was supported for confidence in quitting but not for smoking status and nicotine dependence. Increases in the self-efficacy measures over time were associated with improved confidence managing emotions as hypothesised, in line with greater capacity to regulate emotions without smoking being linked to quitting ability (Brown et al., 2005; Kassel, Stroud, & Paronis, 2003; Weinberger, McKee, & George, 2010). The CBTE website could be responsible for improvements in confidence managing emotions and, through this construct, increase self-efficacy for quitting. But, given that the MUSIC condition was associated only with improvements in managing emotions (which it was designed for) and not self-efficacy, the reverse seems more likely: elements of the CBTE website may have increased general self-efficacy, which in turn could have improved specific confidence in regulating emotions (with a strong, significant observed correlation between confidence quitting and confidence managing emotions without smoking).

Implications

The present findings have theoretical implications for both smoking addiction and music psychology. Firstly, consistent with EI, there was a positive relationship between smokers'

confidence in regulating emotions without smoking, and general self-efficacy for quitting. This relationship highlights the theorised link between affect and cognitions in relation to smoking, and the role of cognitive-behavioural coping: ability to manage emotional cues increases cognitive coping (Kavanagh, 1992); and/or cognitive-behavioural coping reduces exposure to elaborated desires that would prompt affective triggers (Bandura, 1999). Also consistent with EI was the relationship between self-efficacy and quitting, indicating that the belief one can quit may translate to better coping with elaborated desires or cravings (Shiffman, 1982; Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996).

The effect of music psychoeducation on craving strength and confidence in regulating emotions is exciting, especially if affect, self-efficacy, and quitting are interrelated. These findings suggest that emotion regulation via music-listening may apply not only to everyday negative affect (Dingle & Fay, 2016; Dingle et al., 2016; Saarikallio, 2011), but also to affectively-charged elaborated desires and cravings (Kavanagh et al., 2005). Music-listening shows promise for benefitting those vulnerable subpopulations who cannot quit, and researchers could further investigate its effectiveness within such cohorts. Music-listening may also have applications in other areas related to impulse control deficits without having to be used as a fully-fledged therapy: it could be a strategy taught and used to deal with the strong affective pull of intense compulsions or desires. Within smoking cessation, if findings can be replicated, pathways through which music influences smoking outcomes can be examined further – is it emotion regulation as intended (Saarikallio, 2011; Thayer et al., 1994)? Alternatively, music-listening may exert its effects via the dopamine release emulating nicotinic effects (Menon & Levitin, 2005; Salimpoor et al., 2011), or music may simply offer another useful coping strategy (Fiore et al., 2008).

The practical implications of these findings are substantial. A 20-minute web-based program seemed to influence quitting outcomes 6 weeks later, equally and on some measures better than that of Queensland's best-practice smoking cessation treatment (CBTT). Immediately, Queensland Quitline could transform in-print content to an interactive online format for a potential boost to self-efficacy and cravings management, which are related to better overall cessation outcomes. If the links between music-listening psychoeducation, confidence managing emotions, and craving strength are substantiated, smoking cessation practitioners could recommend personalised music-listening as a cessation strategy. Practitioners could coach clients in how to use music-listening as affective relief, or even suggest that clients download and use a musical mood management app such as *Music eScape* (Hides, et al., 2015). This is an accessible method using existing resources, since 89% of Australians own a smartphone (Mackay, 2014). Thus, music-listening could benefit disadvantaged populations at minimal cost, given that they are likely to already own a delivery device. Music-listening could also be rolled into extant smoking cessation apps, linking to one's personal music library. Even if effect sizes of these emotion regulation strategies are small: even an increase of 1% of smokers quitting with 1% increased success would save 140 lives, and $3.41 million for our economy – potentially at no additional cost thanks to the ubiquity of smartphones (Australian Bureau of Statistics, 2015; Collins & Lapsley, 2004).

Limitations and future directions

The major limitation of this pilot was the small sample size, which resulted in insufficient power in the longitudinal analyses. That some relationships were observed anyway makes them all the more meaningful, for *this* sample. Nevertheless, we must be cautious in making any

population inferences based on these data drawn from 38 participants. Recruitment through Quitline was chosen because, as the State's primary smoking-cessation service, it provided the best way to recruit smokers ready to quit, who would benefit most from novel intervention programs. Large samples, however, are essential for randomised controlled trials which compare treatment conditions. Unfortunately, the recruitment period negotiated with Queensland Health fell during a change in Queensland Government, such that workplace smoking cessation contracts were not yet renewed and hence client recruitment was restricted. The scope of this project was too small to extend the recruitment period and increase the sample, and clearly a replication with a large sample is required. Another limitation of the study was the follow-up limited to 6 weeks. Individual variability in abstinence length and time-to-quit is high, so the study's timeframe may not have captured treatment effects (Borland, Partos, Yong, Cummings, & Hyland, 2012; Shiffman et al., 1996). Conversely, observed cessation-rates may be inflated given the self-report point-prevalence assessment of smoking status. Six weeks is insufficient to ensure behaviour change: a more robust predictor of long-term quitting is 30-day continued abstinence measured at 12 months (Mantler, Irwin, & Morrow, 2012). Future studies should take this design factor into account.

An issue to be considered in future research is whether there are individual differences in response to music related interventions. Other research shows that some people are highly sensitive to the emotional effects of music whereas others are less so (Loxton, Mitchell, Dingle, & Sharman, 2016; Mas-Herrero, Marco-Pellares, Lorenzo-Seva, Zatorre, & Rodriguez-Fornells, 2013), and this factor may well moderate their response to a music-listening intervention such as Smoke into Sound. Future studies should examine typical music-listening behaviours in participants, along with individual difference factors such as sensitivity to music, and reward sensitivity, which has been shown to underlie both substance misuse and music engagement (Loxton et al., 2016).

Conclusion

EI theory suggests an essential component of smoking addiction, negative affect, is neglected by current best practice treatments. Addressing it could improve cessation rates among people struggling to quit, and the powerful emotion-regulatory properties of music could fulfil that function. Findings from this pilot show that an online music-listening program in conjunction with telephone assistance as usual helped almost a half of participants to quit, a proportion equivalent to best practice CBT programs. It also showed that participants in the MUSIC condition showed significant decreases in craving experiences. The findings of this study show the potential for chronic smokers to turn their smoke into sound.

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