Does the addition of a supportive chatbot promote user engagement with a smoking cessation app? An experimental study

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Background

- ~15% of adults in England are cigarette smokers; 30-40% make a quit attempt each year[1]
  - The majority are unaided
- The use of pharmacological and behavioural support can substantially improve the chances of quitting[2,3]
  - But specialist services are facing funding cuts and are relatively rarely used

[1] www.smokinginengland.info; [2] Stead et al. (2008), *Cochrane Database Syst Rev;*
[3] Lancaster et al. (2005), *Cochrane Database Syst Rev*

Background

- Rapid growth in internet access and personal smartphone ownership[1]
  - 77% of adults in the UK used a mobile device to access the internet in 2018
  - Promise of digital smoking cessation interventions (e.g. websites, apps)

[1] Office for National Statistics, 2018

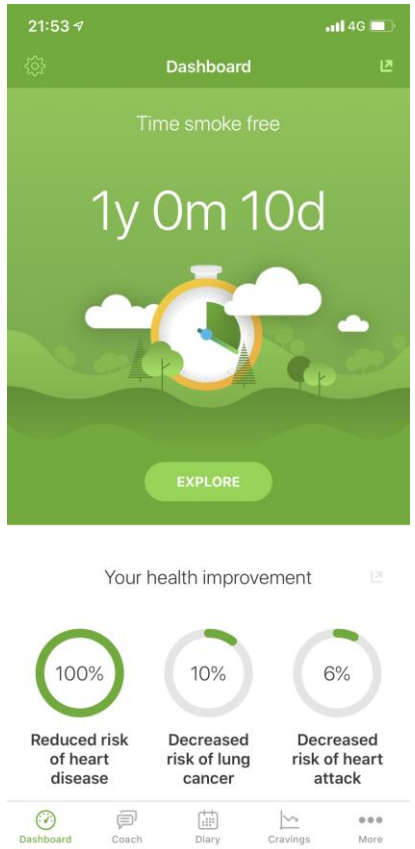
The ‘engagement crisis’

- Digital smoking cessation interventions can help smokers quit[1,2]
  - Effect sizes are small; high unexplained heterogeneity
  - User engagement tends to be low on average[3]
  - Problematic, as rates of engagement are associated with quit success[4,5]
- Identifying content and design features that promote engagement is a priority

[1] Taylor et al. (2017), *Cochrane Database Syst Rev*; [2] Whittaker et al. (2019), *Cochrane Database Syst Rev*;
[3] Kelders et al. (2012), *JMIR*; [4] Bricker et al. (2013), *Nicotine Tob Res;* [5] Buller et al. (2014), *Telemed J E Health*

The Smoke Free app

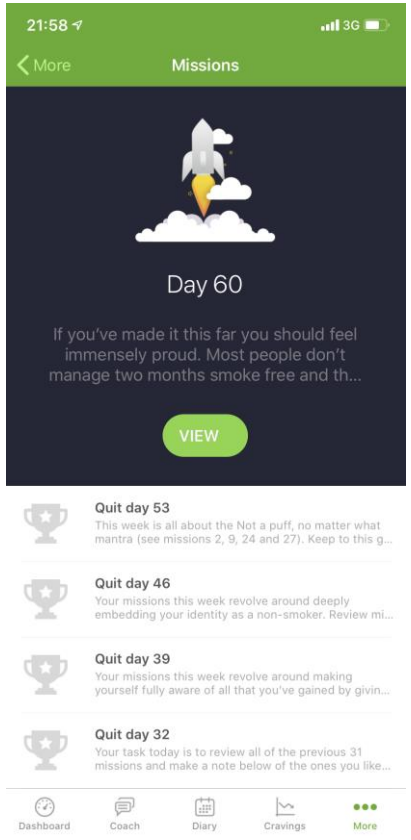
- Contains behaviour change techniques that research suggests are likely to improve the chances of quitting[1]
  - Goal setting
  - Self-monitoring
  - Feedback
  - Rewards

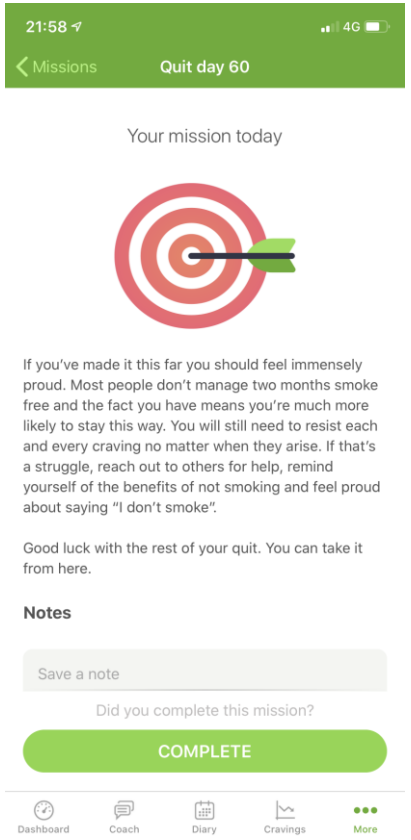


[1] Michie et al. (2011), *Addictive Behaviors*

The Smoke Free app

- Exists both as a free and a paid ('pro') version with additional content (i.e. daily 'missions') - $4.99
- Early evidence of effectiveness in an exploratory RCT[1]; full RCT is currently underway[2]
- Popular with ~3,000 new, global downloads/day
- Acts as a useful test bed for identifying content and design features that promote engagement





[1] Crane et al. (2019), *F1000Research;* [2] Jackson et al. (2019), *Addiction*

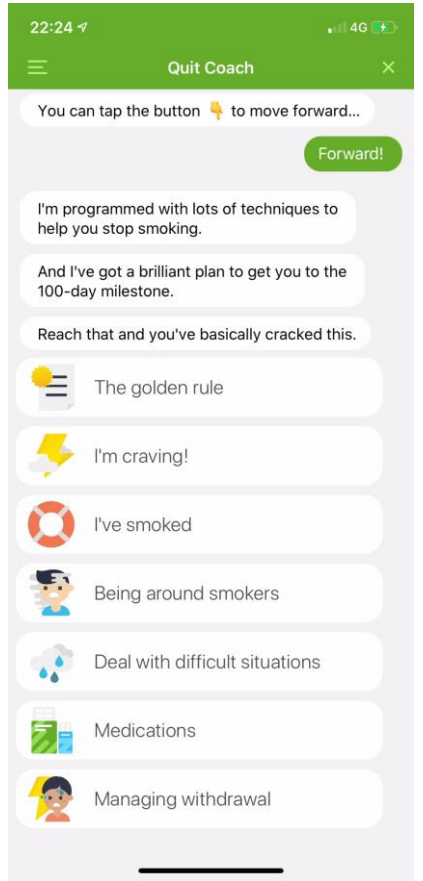
Chatbots

- Chatbots = computer programs that have two-way conversations with users via auditory, visual or textual media
- Hypothesised to influence user engagement via increased interactivity or 'supportive accountability'[1]
- Smokers hold positive attitudes towards and engage frequently with chatbots[2,3]; no experimental studies to-date
- Chatbot added to the 'pro' version of the Smoke Free app in 2018

[1] Mohr et al. (2011), *JMIR;* [2] Crutzen et al. (2011), *J Adolesc Health;*
[3] Masaki et al. (2019), *JMIR mHealth uHealth*

The Quit Coach

- Designed to check in with users twice per day by way of a notification
- Available for on-demand support as and when needed
- Informed by the UK Stop Smoking Services' standard programme
- Designed to appear knowledgeable with a friendly tone of voice



The present study

Research questions

In smokers who purchase the ‘pro’ version of the Smoke Free app…

- Do smokers who are randomly offered the addition of a supportive chatbot **engage more frequently** compared with smokers who are offered the standard ‘pro’ version of the app?
- Do smokers who are randomly offered the addition of a supportive chatbot have greater odds of **self-reported abstinence** at a 1-month follow-up?

Methods

Study design

- Experimental study with smokers randomised to the intervention and control arms in a planned, unequal ratio of 1:4
- Analysis plan pre-registered on the Open Science Framework (https://osf.io/q4kje)
- Recruitment completed at the point our analysis plan was registered

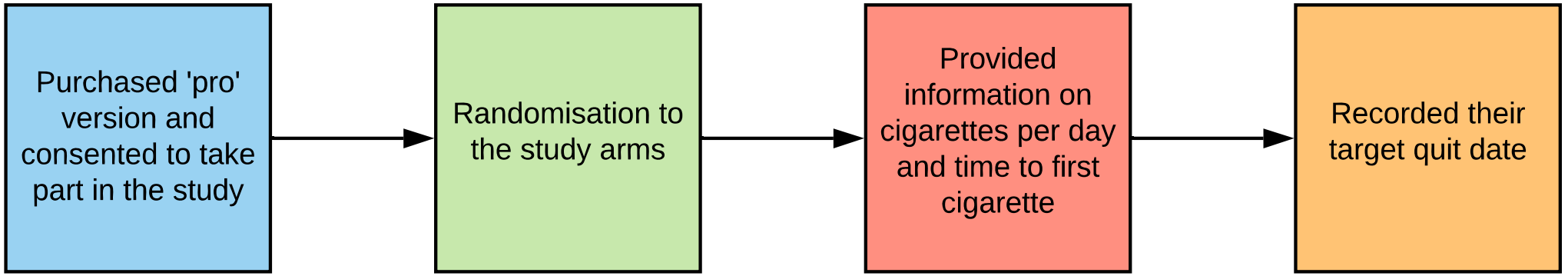
Methods

Eligibility criteria

- iPhone user
- Purchased the ‘pro’ version of the Smoke Free app between 1 September 2018 and 18 December 2018
- Had phone set to English language
- Aged 18+ years
- Daily or non-daily smoker
- Set a quit date <2 days before and <14 days after their date of registration

Methods

Measures and procedure



Primary outcome: Frequency of engagement between date of registration and the 1-month follow-up survey

Secondary outcome: Self-reported quit success at the 1-month follow-up survey

Methods

Data analysis

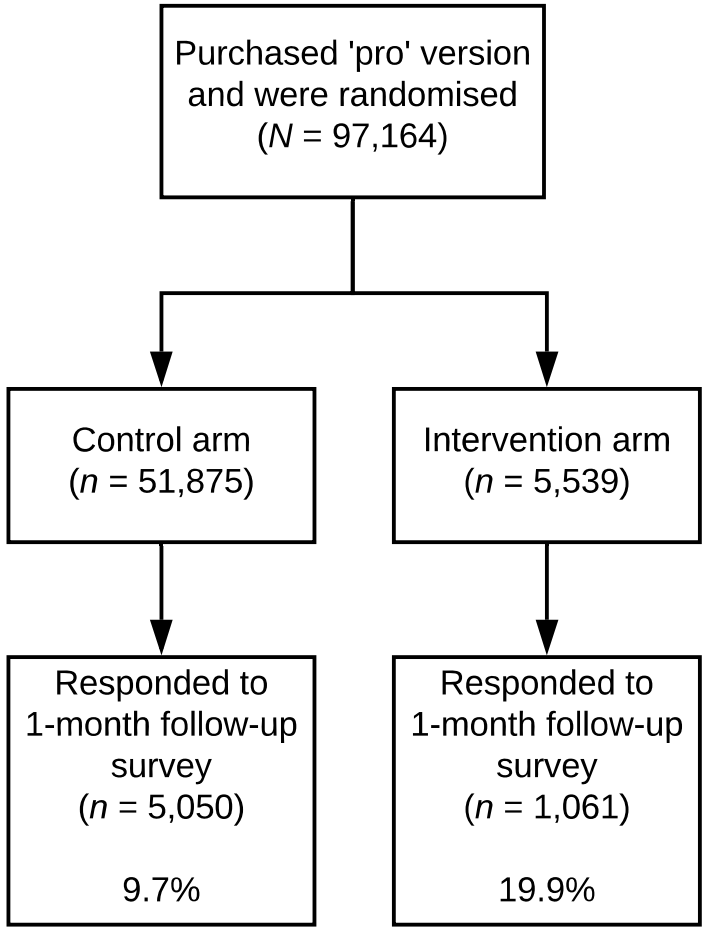
- Group differences in the frequency of engagement were assessed using negative binomial regression analyses, with and without adjustment for cigarettes per day (CPD) and time to first cigarette (TTFC)
- Group differences in quit success at the 1-month follow-up were assessed using logistic regression analyses, with and without adjustment for CPD and TTFC
  - Analysis was by intention-to-treat
  - Sensitivity analysis (follow-up only)

Results

Deviations from pre-specified analysis plan

- Due to a coding error, the 'frequency of engagement' variable did not have a temporal dimension embedded in the database
  - Not possible to derive the number of logins from the date of download until the 1-month follow-up
  - Instead, assessed the total number of logins tallied up until the date at which the data were downloaded from the database (29th March 2019)
  - Sensitivity analysis adjusting for number of weeks in the study

Results


Purchased 'pro' version and were randomised (N = 97,164)
Control arm (n = 51,875)
Intervention arm (n = 5,539)
Responded to 1-month follow-up survey (n = 5,050)
9.7%
Responded to 1-month follow-up survey (n = 1,061)
19.9%

Results

Sample characteristics

	Control (n = 51,875)	Intervention (n = 5,339)
Time to first cigarette, % (n)*		
<5 min	19.3 (9,999)	17.2 (917)
5-30 min	19.0 (9,880)	18.9 (1,009)
31-60 min	37.8 (19,605)	37.0 (1,973)
>60 min	23.6 (12,235)	26.5 (1,413)
Cigarettes per day, mean (SD)*	14.7 (8.9)	16.0 (11.4)

* $p < .001$

Results

Frequency of engagement

- Median 5 (IQR = 22) vs. 16 (65.5) logins
- IRR_{adj} = 2.01 (95% CI = 1.92-2.11), $p < .001$

Sensitivity analysis – mean number of logins/week

- IRR_{adj} = 2.02 (95% CI = 1.94-2.11), $p < .001$

Results

Quit success at the 1-month follow-up

- Intent-to-treat analysis:
  - 7.1% (3,704) vs. 15.8% (844)
  - OR_{adj} = 2.38 (95% CI = 2.19-2.58), $p < .001$
- Follow-up only analysis:
  - 73.3% vs. 79.5%
  - OR_{adj} = 1.36 (95% CI = 1.16-1.61), $p < .001$)

Discussion

Strengths

- First study to quantify the added effect of a chatbot on user engagement and quit success within a smoking cessation app
- Large sample of >55,000 smokers
  - Useful test bed for advancing our understanding of what intervention components work, for whom and why

Discussion

Limitations

- The 1:4 randomisation ratio was not consistently applied – coding error?
- Baseline differences between groups in CPD and TTFC
- iPhone users only, who tend to be more affluent than Android users
- No data on age, sex and social grade
- No biochemical verification of quit success
- Substantial loss to follow-up – reduces confidence in results pertaining to quit success
- Sample drawn from users who are willing or able to pay for a smoking cessation app

Discussion

Avenues for future research

- Assumed additive effect of the chatbot on user engagement
  - But may have acted synergistically with other app components
  - Factorial trial required to elucidate this
- Mechanisms of action of the chatbot
  - 'Model of Supportive Accountability' – sense of accountability to a benevolent and trustworthy coach[1]
  - Qualitative study planned for 2019-20

[1] Mohr et al. (2011), *JMIR*

Conclusions

- The addition of a supportive chatbot to an existing smoking cessation app more than doubled user engagement
- In view of very low follow-up rates, there is low quality evidence that the addition also increased self-reported quitting at a 1-month follow-up

Thank you for listening.
Any questions?

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Perski, O., Crane, D., Beard, E., & Brown, J. (2019). Does the addition of a supportive chatbot promote user engagement with a smoking cessation app? An experimental study. *Digital Health, 5,* 1-13.