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Validation of a contextualized assessment of smoking behaviour in students

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ABSTRACT

Aims The aim of this study was to validate an audio simulation of culture-specific social contexts associated with smoking to provide a medium for researchers to investigate social–contextual influences on tobacco use in the laboratory. **Methods** Eighty-one students (34.6% men; $n = 28$) listened to five audio simulations of peer social contexts where offers to smoke tobacco were made [Smoking Simulated Intoxication Digital Elicitation (S-SIDE)]. For each social scenario, participants answered questions about their willingness to accept the offer to smoke and completed measures of smoking cognitions and tobacco use. Thirty days later, participants completed online assessments of smoking behaviour. **Results** Willingness to accept smoking offers in the S-SIDE procedure was related to smoking at both time-points (T1: $r_{(81)} = 0.37$, $P < 0.001$;T2: $r_{(81)} = 0.36$, $P = 0.001$). Performance on the simulation improved prediction of smoking at 1 month follow-up over and above smoking expectancies, $F_{(2,74)} = 4.27$, $P = 0.02$; $R^2 = 0.21$; $\Delta R^2 = 0.09$, as well as other indices of smoking willingness, $F_{(2,75)} = 4.22$, $P = 0.02$; $R^2 = 0.22$: $\Delta R^2 = 0.09$, while neither expectancies nor willingness was related to smoking above and beyond the simulation. **Conclusions** Social context plays an important role in smoking-related decision-making and simulated social contexts have potential for the study of context-related decision-making in addiction.

Keywords Audio simulation, cigarette smoking, social context, students, validation, willingness.

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INTRODUCTION

A major public health concern among young adults is cigarette smoking. In the Netherlands, 26.3% of the total population after the age of 15 smokes sometimes and 19.5% are daily smokers. Young adults have the highest smoking rates; among 20–24-year-olds, 39.1% smoke sometimes and 23.6% are daily smokers [1]. University students who see themselves as social smokers often do not identify as ‘smokers’ and may not acknowledge their risk for tobacco dependence [2]. Such students often see smoking as a social activity rather than a sign of dependent behaviour [3]. Majchrzak and colleagues [2] found that college students believe they will stop smoking after graduation; however, research indicates that this is often not the case [4]. Moran and colleagues [3] used a cross-sectional survey to investigate the social smoking among US college students and found that occasional smokers had fewer quit attempts in the past year and were not planning to quit.

While many factors can influence the onset and progression of smoking, social contextual influences, including peer smoking and peer approval, have an important role [5,6]. Most studies investigating tobacco use contexts use retrospective assessments focusing on life-style and demographic factors [7], a strategy criticized within the smoking literature [8]. The static nature of these assessments limits our ability to understand in-the-moment decision-making of participants and how specific contexts may impact decision-making differentially [9]. In a recent review, Dimoff & Sayette [10] argued convincingly that the smoking literature would benefit from the systematic examination of social context, using laboratory techniques that have shown promise in the study of alcohol and other substance use behaviours as well as the investigation of cognitive constructs that operate within social contexts. Imitation paradigms, where confederates model use behaviour in the laboratory, can help to determine which conditions facilitate social influences on use behaviour and for whom [4,11–13], but require specialized laboratories and are often limited to single contexts. As an alternative, simulation paradigms provide standardized, replicable social contexts where individual substance use can be assessed in multiple settings without specialized equipment.

Smoking Simulated Intoxication Digital Elicitation (S-SIDE) methodology affords the opportunity to assess the role of social context on smoking behaviour systematically using replicable contexts that can be held constant across participants [14]. Based on Davison's early work in the 1980s and 1990s using simulated situations [15], participants indicate their behavioural willingness to accept offers of alcohol (and marijuana [16]) in response to simulated social contexts. Behavioural willingness is a construct capturing openness to engage in a behaviour given the opportunity to do so [17], and is considered the final pathway to non-deliberative decision-making in the prototype willingness model [18]. Each simulation is based on contextual information provided from the existent literature, survey-based data collections and focus groups from the target population. In US samples, the SIDE methodology was shown to relate to current alcohol and marijuana use patterns, alcohol expectancies and motives, and demonstrated predictive validity during 8 months in a study of alcohol use in college students [14]. As such, we modified the contexts for the examination of tobacco smoking to fit Dutch undergraduate contexts.

Our primary aim was to validate the S-SIDE. We expected the S-SIDE to demonstrate convergent and discriminant validity with other cognitive constructs based on past research using similar methods [14,16]. We focused upon expectancies for smoking or the if–then associations between behaviour and its outcomes held in memory [19,20] and general willingness to engage in smoking behaviour assessed via traditional self-report [21,22]. We anticipated that increased behavioural willingness for smoking on the S-SIDE would be related to more positive expectancies related to smoking (negative and positive reinforcement, appetite–weight control) and lower negative associations (negative consequences) as assessed by the Shortened Smoking Consequences Questionnaire (S-SCQ; [23]). We also expected behavioural willingness to smoke on the S-SIDE to correspond with indices of general willingness using other methods.

To determine concurrent and predictive validity of the S-SIDE, we assessed the association between behavioural willingness to smoke on the simulation with self-reported smoking at baseline and 30-day follow-up. We anticipated that willingness to smoke on the S-SIDE would be associated positively with concurrent and future smoking. We also expected the S-SIDE to demonstrate incremental validity above and beyond the smoking-related cognitions described above in relation to current and future smoking.

METHOD

S-SIDE development: script development

Based on the literature and gathering of local information, the context for five different scenes were determined (drinking at a terrace after an examination, a birthday party at someone's home, watching football in the pub, having dinner at a friend's house and visiting a music festival) and scripts drafted by a professional scriptwriter. As per Anderson and colleagues' previous simulations, control offers (food) are provided in addition to targets (smoking) to assess general tendencies towards behavioural willingness (i.e. specificity of responding). Focus groups were conducted to evaluate and improve the scenes.

Focus groups

The ethical committee of the University of Amsterdam (UvA), the Netherlands approved all focus groups and study procedures. Seventeen Dutch undergraduate smokers [at least one cigarette/month; 29.4% men (n = 5); mean_{age} = 21.5 years; standard deviation (SD) = 1.81; age 19–25 years] from the UvA participated in one of two focus groups for research credit in February 2014.

The focus groups consisted of three parts. In part 1, students discussed when they smoked tobacco, why they smoked and what they smoked and answered similar questions about snack foods (control offer content). In part 2, students listened to preliminary scripts read by the focus group facilitator. Students rated the realism of each scene, the frequency of being in such a scene and how much they would drink or use in the scene independently on a nine-point rating scale and then discussed what they thought should be changed per scene. In part 3, focus group members individually scored 11 potential actor's voices on believability and attractiveness on a nine-point scale.

Focus group data were analysed using basic thematic coding, matching the protocol used in Anderson *et al.* [14], and was then used to modify the scripts for realism. Preliminary scripts were evaluated as quite realistic (mean = 6.8, SD = 1.0), relatively common for students (mean = 3.2, SD = 2.8) and elicited use interest (mean = 6.0, SD = 0.9). Voice actors with the highest average scores were selected for the audio simulations.

Audio simulation production

The audio simulations were recorded and edited at the UvA. Each simulated situation contains dialogue between actors as well as background noise and sound effects to foster realism (e.g. clinking glasses, music, etc.). In every scene, four offers are made to the participant (two smoking; two food) followed by a beep, allowing participants the opportunity to indicate how willing they were to accept the offer (see Behavioural willingness below). Audio editing was conducted in Soundtrack Pro. Eprime version 2.0 software [24] presented the willingness scale for the offers in between the audio fragments.

Validation of the audio simulation

UvA students were recruited on-line and via flyers on campus. The included participants smoked at least one cigarette in the past month; 20 students indicated not having smoked any cigarettes during the past 2 weeks and were excluded from analyses. A total of 81 students [34.6% men (n = 28); mean_{age} = 22.8 years; SD = 6.48; range: 16–57] completed the study from May to June 2014. Ninety-one per cent of the sample spoke Dutch as their first language.

Design and procedure

Time 1

After providing written consent, students answered demographic questions regarding their age, gender and first language. Next, they were asked to put on headphones in soundproof cubicles, instructed to close their eyes and visualize themselves in the situations presented to the best of their ability. The five audio simulations (~ 2 minutes each) were then presented in randomized order on a Dell computer. Every 20–30 seconds, actors offered a smoke (target) or food (control) in the simulation, followed by the cue to respond to the behavioural willingness measure. After receiving a response, the audio simulation continued automatically. After completing the S-SIDE, participants answered the set of measures described below as well as an Implicit Association Test (not included within this investigation). The order of administration was not counterbalanced due to concerns about priming smoking before administration of the simulation, consistent with Anderson and colleagues' past work [14]. After completing all study procedures, students were credited with 1 class credit or €10.

Measures

Smoking behaviour. Tobacco dependence at baseline was assessed with the modified Fagerström Test (mFTQ; [25]; ∝ = 0.83; range = 0–5.67). The time-line follow-back (TLFB) procedure [26,27] asked how much participants had smoked on each day for the past 2 weeks (mean = 3.19, SD = 4.63; range = 0–20.00). One month later, participants received an e-mail with a link to a secure survey site to complete a TLFB for the previous 2 weeks (mean = 2.96, SD = 4.52; range = 0–20.0).

Behavioural willingness on S-SIDE. During the audio simulations, participants indicated their behavioural willingness to accept each smoking or control/food offer (BW smoke versus BW control) on a 1 (not at all willing) to 7 (very willing) scale. Responses were averaged within each scene (scene-level) and throughout scenes (total S-SIDE score). BW smoke was internally consistent throughout offers (∝ = 0.85; mean = 4.01, SD = 1.37; range = 1.0–6.8); however, BW control was less stable throughout offer types (∝ = 0.65; mean = 5.17, SD = 0.96; range = 3.1–7.0).

Self-reported willingness to smoke was assessed by describing a scenario in which participants were asked to imagine themselves 'spending an evening with friends. When you enter the room, everyone is chatting with each other, drinking alcohol, and smoking. You had already decided not to smoke this evening. When you sit down, someone offers you a cigarette' [21]. Participants indicated whether they would: accept the cigarette (mean = 3.24, SD = 1.67; range = 1–6), say 'no thanks' and decline the offer (mean = 4.54, SD = 1.70; range = 1–7) or leave the situation (mean = 1.62, SD = 1.33; range = 1–7) on a seven-point scale ranging from 'certainly not' to 'certainly'.

Smoking expectancies. The short Smoking Consequences Questionnaire (S-SCQ [23]) consists of 21 items (scaled 0: completely unlikely to 9: completely likely), assessing four expectancy categories: negative consequences (i.e. awareness of the risks of smoking; four items; ∝ = 0.79; mean = 7.64; SD = 1.31; range = 2.50–9.00), positive reinforcement (e.g. I enjoy the taste sensations while smoking; five items; ∝ = 0.89; mean = 5.00; SD = 1.64; range = 0–8.00), negative reinforcement (e.g. cigarettes help me deal with anger; seven items; ∝ = 0.90; mean = 3.66; SD = 1.97; range = 0–7.86) and appetite–weight control (e.g. smoking helps me control my weight; five items; ∝ = 0.90; mean = 2.42; SD = 1.94; range = 0–8.00).

ANALYSES

Analyses were conducted in Stata version 14.0 (Stata Corp, LLC, College Station, TX, USA). All variables were examined for deviations from non-normality before analysis. To address the concurrent and predictive validity of the S-SIDE, we used Pearson's correlation coefficients and paired t-tests to examine relations between BW smoke, BW control and T1 and T2 smoking behaviour as well to examine demographic differences on the BW indices. Moderation and incremental validity were assessed using regression. Given the very high correlations between T1 and T2 smoking, we did not include baseline smoking within regression analyses with T2 outcomes. Gender and age were also excluded as they were unrelated to smoking at T2. In step 1 of the hierarchical regressions, we entered the expectancy scales; in step 2, BW smoke and BW control. In the second regression, the order was flipped. Holm–Bonferroni [28] corrections controlled family-wise error rates for omnibus tests within sets of analyses; this is a stepwise rejection procedure used to retain power in detecting effects [28].

RESULTS

At baseline, participants reported smoking 44.68 cigarettes on average during the past 2 weeks (SD = 64.86) and low levels of tobacco dependence on the mFTQ (mean = 1.42, SD = 1.34). Smoking patterns were consistent between T1 and T2, mean = 41.41, SD = 63.34; $t_{(80)} = 1.63$, $P = 0.107$; $r = 0.96$, $P < 0.001$, and were not associated with gender, T1: $t_{(79)} = 0.86$, $P = 0.393$; T2: $t_{(79)} = 0.91$, $P = 0.364$ or age, T1: $r = -0.03$, $P = 0.756$; T2: $r = 0.03$, $P = 0.798$.

Participants accepted more control, mean = 5.17, SD = 0.96, than smoking offers, mean = 4.01, SD = 1.37, throughout scenes, $t_{(80)} = -6.45$, $P < 0.001$. Table 1 provides descriptive statistics for BW smoke and BW control during the five scenes. With repeated-measures analysis of variance (ANOVA), we compared scores on BW smoke and BW control per context. BW smoke differed between scenes, Wilk's lambda = 0.68, $F_{(4,77)} = 8.95$, $P < 0.001$, multivariate $\eta^2 = 0.32$ and BW control, Wilk's lambda = 0.54, $F_{(4,77)} = 16.59$, $P < 0.001$, multivariate $\eta^2 = 0.46$. No gender differences were found for BW smoke, $t_{(79)} = 0.56$, $P = 0.575$ or BW control, $t_{(79)} = -0.08$, $P = 0.936$, overall or by individual scene, BW smoke: $ts = -0.28$ ($P = 0.780$) to 1.80 ($P = 0.075$); BW control: $ts = -1.05$ ($P = 0.298$) to 0.52 ($P = 0.604$). Older participants demonstrated less BW smoke than younger participants, $r = -0.37$, $P = 0.007$, particularly within the birthday party, $r = -0.42$, $P < 0.001$ and music festival scenes, $r = -0.39$, $P < 0.001$. Age was not associated significantly with overall BW control, $r = -0.23$, $P = 0.042$ or at the scene level, $rs = -0.06$ ($P = 0.568$) to -0.27 ($P = 0.016$).

Validation of BW smoke and BW control

BW smoke was associated with higher average smoking at both time-points (Table 2), with BW smoke in dinner-party and terrace scenes seemingly driving the effects. BW control was not associated significantly with smoking indices, at T1, $r = -0.07$, $P = 0.520$ or T2, $r = -0.13$, $P = 0.264$ or at the scene level, $rs = -0.19$ ($P = 0.099$) to 0.37 ($P < 0.001$), suggesting discriminant validity for the measure in terms of smoking patterns. We tested whether BW smoke and average smoking levels varied as a function of tobacco dependence *post hoc*; moderation was not supported at either time-point, T1: $B = 0.07$, SE = 0.24, $\beta = 0.13$, $P = 0.760$, $F_{(3,72)} = 23.75$, $P < 0.001$, $R^2 = 0.50$; T2: $B = 0.11$, SE = 0.24, $\beta = 0.19$, $P = 0.643$, $F_{(3,72)} = 22.95$, $P < 0.001$, $R^2 = 0.49$.

In Table 3, we present associations between BW on the S-SIDE and other cognitive variables. None of the expectancies correlated significantly with BW smoke using the Holm–Bonferroni-corrected *P*-values; however, expectancies for positive reinforcement approached significance at $P = 0.006$, suggesting a positive association with BW smoke. Expectancies for appetite and weight control were associated negatively with BW control. Self-reported willingness to smoke, even when intending to abstain, was associated positively with BW smoke, while self-reported abstinence (saying 'no' or leaving the room) was not related significantly to BW smoke or control (Table 3).

Only negative reinforcement on the S-SCQ related to smoking at T2 in step 1 of the hierarchical regressions (Table 4). In step 2, BW smoke was associated with average smoking at T2, over and above the contribution of expectancies. When the sets were flipped, BW S-SIDE accounted for 15% of the variance in average smoking at T2, $F_{(2,78)} = 7.06$, $P = 0.002$, with BW smoke driving the effect, $B = 1.23$, SE = 0.35, $\beta = 0.38$, $P = 0.001$. The inclusion of the set of expectancies in step 2 did not improve the prediction of TLFB at T2, $F_{(4,74)} = 1.41$; $R^2 = 0.21$; $\Delta R^2 = 0.06$, $P = 0.240$, supporting the incremental utility of the S-SIDE.

Using the same strategy, the smoking willingness items as a set accounted for 13% of the variance in average smoking at T2, $F_{(3,77)} = 3.75$, $P = 0.014$. Including BW smoke and BW control in step 2 accounted for an additional 9% of variance, $F_{(2,75)} = 4.22$, $P = 0.02$. When flipped, the addition of the smoking willingness items in step 2 did not predict smoking behaviour significantly beyond BW indices entered at step 1, $F_{(3,75)} = 1.99$, $P = 0.122$.

Table 1 Descriptive statistics for behavioural willingness (BW) to accept a smoke offer and to accept control offers across scenes ($n = 81$).

Variables	*Terrace mean (SD)*	*Pub mean (SD)*	*Birthday mean (SD)*	*Dinner party mean (SD)*	*Music festival mean (SD)*
BW smoke	3.96 (1.93)[a]	3.85 (1.82)[a]	4.64[a] (1.64)	3.43[a] (1.78)	4.17 (1.68)
BW control	4.94 (1.81)[a]	4.65 (1.61)[a]	5.37 (1.47)[a]	6.06 (1.06)[a]	4.80 (1.41)[a]

[a]Statistically significant differences of post-hoc tests at P < 0.001. BW smoke = behavioural willingness to smoke, Smoking Simulated Intoxication Digital Elicitation (S-SIDE); BW control = behavioural willingness, food (S-SIDE). Scaling for BW ratings were 1–7. Shared superscripts indicate statistically significant differences of *post-hoc* tests at $P < 0.001$. SD = standard deviation.

Table 2 Associations between behavioural willingness (BW) to smoke (per scene and overall) and smoking behaviours (n = 81).

	BW smoke					
	Terrace	*Pub*	*Birthday party*	*Dinner party*	*Music festival*	*Overall*
TLFB T1	0.31[a]	0.15	0.26	0.42[a]	0.30[a]	0.37[a]
P-value	0.006	0.196	0.018	< 0.001	0.007	< 0.001
TLFB T2	0.31[a]	0.13	0.25	0.42[a]	0.28	0.36[a]
P-value	0.004	0.248	0.023	< 0.001	0.011	0.001

Pearson's correlation coefficients reported in table. Time-line follow-back (TLFB) T1 = TLFB at baseline; TLFB T2 = TLFB at 1 month follow-up; BW smoke = behavioural willingness to smoke, Smoking Simulated Intoxication Digital Elicitation (S-SIDE). [a]Statistical significance as determined by Holm (1979)-corrected *P*.

Table 3 Convergent and discriminant validation of the S-SIDE: associations with smoking behaviours and smoking-related cognitions (n = 81).

Variable	*BW smoke*	*BW control*
Self-reported willingness to smoke 1	0.37[a]	0.01
P-value	< 0.001	0.947
Self-reported willingness to smoke 2	−0.26	−0.03
P-value	0.018	0.798
Self-reported willingness to smoke 3	0.06	−0.02
P-value	0.584	0.858
S-SCQ negative consequences	−0.02	0.01
P-value	0.850	0.903
S-SCQ negative reinforcement	0.20	−0.21
P-value	0.077	0.059
S-SCQ positive reinforcement	0.30	0.02
P-value	0.006	0.862
S-SCQ appetite/weight control	0.04	−0.35[a]
P-value	0.735	0.002

Pearson's correlations reported in table; Self-reported Willingness to Smoke item 1 = I would accept the smoke offer, item 2 = I would say 'no, thank you', item 3 = I would leave the room); S-SCQ: Short-Smoking Consequences Questionnaire; BW smoke = behavioural willingness to smoke, Smoking Simulated Intoxication Digital Elicitation (S-SIDE); BW control = behavioural willingness food, S-SIDE. [a]Statistical significance was determined by Holm (1979)-corrected *P*.

Table 4 Hierarchical regression model of general willingness (self-report) to smoke a cigarette and the behavioural willingness (BW) obtained with the S-SIDE smoke (incremental validity).

Variable	*B*	*SE*	*β*	*P*
Step 1	$F_{(4,76)} = 2.65$, $P = 0.040$; $R^2 = 0.12$			
S-SCQ negative consequences	−0.09	0.39	−0.03	0.810
S-SCQ negative reinforcement	0.86	0.29	0.37	0.004
S-SCQ positive reinforcement	0.32	0.30	0.12	0.297
S-SCQ Appetite/ weight control	−0.23	0.29	−0.10	0.430
Step 2	$F_{(2,74)} = 4.27$, $P = 0.018$; $R^2 = 0.21$; $\Delta R^2 = 0.09$			
BW smoke	1.04	0.37	0.32	0.007
BW control	−0.61	0.52	−0.13	0.244

S-SCQ: Short-Smoking Consequences Questionnaire; BW smoke = behavioural willingness to smoke, Smoking Simulated Intoxication Digital Elicitation (S-SIDE); BW control = behavioural willingness food S-SIDE. SE = standard error.

DISCUSSION

We extended the SIDE simulation paradigm of Anderson and colleagues [14] to the study of smoking behaviour and created a culturally specific version for use in Dutch students. We found evidence of convergent and discriminant validity for the S-SIDE. As expected, BW smoke on the S-SIDE evidenced moderate associations with smoking behaviour at baseline and follow-up; in addition, BW control was unrelated to smoking behaviour, suggesting discriminant validity between willingness ratings. BW smoke on the S-SIDE was associated with willingness to accept a cigarette offer assessed via a written vignette developed by Spijkerman and colleagues [21], despite cues for abstinence in the written vignette. Surprisingly, BW on the S-SIDE was not associated with expectancies, relations supported in previous simulation work [14,15]. The S-SIDE demonstrated incremental validity when examining associations with smoking behaviour during 1 month follow-up, above and beyond smoking expectancies and smoking willingness assessed via written vignette. The inverse was not found. Overall, the findings suggest that the S-SIDE provides unique explanatory information that may be useful in future studies examining the effects of social contexts on smoking.

We found differences in the magnitude of the association between BW smoke and smoking behaviour at the scene level, indicating that some scenes might capture habitual smoking behaviour more effectively than others. Particular to the dinner-party scene, leaving a small, intimate dinner-party to smoke a cigarette may map well onto level of use (i.e. heavier smokers might be more willing to leave a party for this reason than lighter smokers). Openended elicitation strategies employed with other SIDE procedures [14,15] could be applied in future studies to explore such processes further. Interestingly, there was a robust negative association between expectancies for appetite and weight control from smoking and accepting food offers on the S-SIDE. This supports the notion that the simulation is modelling salient information about social contexts and eating behaviour that are germane to individuals with concerns about weight. The SIDE methodology also allows for in-the-moment assessment of behavioural willingness without exposing participants to agents in the laboratory when it may be unethical or illegal to do so (e.g. underage use). As work with adolescents supports the importance of behavioural willingness, one's openness to engaging in a risk behaviour over behavioural intentions, or goals developed through reasoning in predicting behaviour [29,30], future work with samples across a broader age range, similar to this study, should test the relative importance of behavioural intention versus behavioural willingness as complementary aspects of the prototype willingness model [31].

While the validation information provided here is promising, it is preliminary. More work is needed to validate this measure fully. Given the very high association between self-reported smoking at both assessments, we could not predict smoking at follow-up controlling for baseline use, as conducted during 8 months in Anderson *et al*. [14]. Future work should include follow-up periods of greater length to assess the S-SIDE's ability to predict changes in smoking behaviour. While *post-hoc* power estimates suggested a reasonable level of power for detecting bivariate relations (0.79), our ability to make more nuanced evaluations of interaction effects was somewhat limited. As such, the S-SIDE should be tested in larger samples of students throughout the Netherlands.

The availability of this simulation paradigm to assess smoking willingness opens the doors to research on proximal influences on smoking behaviour. For example, experimental studies could evaluate the impact on emotional priming (sadness, anxiety) or social exclusion on simulation performance. Clearer understanding of smoking-related decision-making in social contexts may also provide avenues for further developing targeted prevention and intervention strategies for university students. Given promising work by Ladd and colleagues in applying the SIDE methodology to the investigation of client language as a mechanism of change in therapy [32], future studies with the S-SIDE could translate such techniques to the intervention context. One can imagine adapting simulations, such as the S-SIDE, for prevention and intervention work allowing practitioners the opportunity to deconstruct the social influences on smoking with clients to embed cognitive restructuring and behavioural retraining in simulated contexts. Regarding the public health concerns regarding smoking and other tobacco use, further validation and expansion of such simulation paradigms may have utility in our scientific and intervention practices.

Declaration of interests

None.

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