I do as I am: understanding and leveraging identity to promote smoking cessation and physical activity

Penfornis, K.M.

Chapter 5

My future-self has (not) quit smoking: An experimental study into the effect of a future-self intervention on smoking-related self-identity constructs

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Kristell M. Penfornis, Winifred A. Gebhardt, Ralph C.A. Rippe, Colette van Laar, Bas van den Putte, Eline Meijer
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ABSTRACT

Objectives: Envisioning one's (non)smoking future may make (un)desired future identities more accessible, salient and personally relevant and facilitate smoking cessation. The current study assessed whether a future-self intervention can weaken smoker self-identity and expected identity loss when quitting smoking, and strengthen quitter- and nonsmoker self-identity, while accounting for personal factors – socioeconomic position, nicotine dependence, consideration of future consequences and clarity of the envisioned future-self. Additionally, it examined the association between smoking-related identity and quitting intention and behavior.

Methods: This longitudinal online experimental study randomized 233 adult smokers to an intervention condition (where they completed a mental imagery, visual and verbal task about a future (non)smoking self), or to a passive control condition. Smoker-, quitter-, nonsmoker self-identity and identity loss were measured post-intervention and after one- and three-months. Quit intention and attempts were measured at baseline and after one month.

Results: There was a consistent increase in non-smoker self-identity, and decrease in smoker self-identity and identity loss over a period of six months for all participants, but no significant difference in smoking-related identity between the intervention and control group. While personal factors did not moderate the effect of the intervention, we found that smoking-related identity constructs do vary with nicotine dependence, consideration of future consequences and clarity of the envisioned future-self. Quitting behavior is primarily associated with non-smoker self-identity.

Conclusions: Although the future-self intervention did not significantly influence smoking-related identity or behavior, identity – in particular non-smoker self-identity – is important to consider in smoking cessation interventions. More research is needed to find effective operationalizations for identity-based interventions in the context of smoking.

The data that support the findings of this study are openly available at https://doi.org/10.34894/9GZFTX .

INTRODUCTION

Identity, self-perceptions of who we are, is an important determinant of (smoking) behavior. Identity theories [1–3] posit that people are more likely to act in line with their identity, and conversely, will try to avoid behaviors that conflict with or even threaten their identity. In a nutshell, identity acts as a guide for behavior, including smoking and quitting behaviors.

Identity theories distinguish between self- and group identity. Self-identity refers to self-perceptions of ourselves [2], and group-identity refers to self-perceptions of oneself derived from membership to social groups [2,4]. A growing body of evidence recognizes the motivational mechanisms of self- and group identity on smoking behaviors, yet effects have been found to be stronger for self-identity than for group identity [5]. This is why the current study focuses on self-identity. Both quantitative and qualitative studies have also found that smoking-related identity plays an important role in intention to quit (e.g., [5–8] and (successful) quit attempts [5,8–10], even after controlling for relevant variables (e.g., age, gender, heaviness of smoking). These relationships were found to be stronger for quitter self-identity (i.e., identifying as someone who quits smoking) and nonsmoker self-identity (i.e., identifying as someone who does not smoke) than for smoker self-identity (i.e., identifying as someone who smokes) [5,8,10]. Additionally, prior research shows that ex-smokers who maintain an attraction to smoking are more likely to relapse [11]. In sum, to quit successfully and durably, smokers need to perceive themselves more as nonsmokers or quitters and less as smokers [11–14]. In the current study, we tested the relationship between self-identity constructs and quit intention and attempts again. We expected that stronger quitter and nonsmoker self-identity would positively relate to intention to quit and new quit attempts, while stronger smoker self-identity and expected identity loss if quitting smoking (see below) would negatively relate to these outcomes (hypothesis (H)1). Taxonomies of Behavioral Change Techniques [15,16] recognize identity as a factor capable of influencing behavior, including smoking behaviors. To date, however, an effective operationalization of identity BCTs is still lacking. One interesting route to explore is that of possible/future selves. Possible selves theories [17,18] advance that current behavior is guided by perceptions of who one wants to become in the future (desired future-self) and who one fears they might become in the future (undesired future-self). Individuals are not only motivated to engage in behavior that fits and confirms current self-identities, they are also prone to behaving in ways that help them attain their desired future-self and avoid their undesired future-self [19–21]. In a nutshell, according to possible selves theories, future identities color and guide current identities, as individuals are likely to favor and invest in behaviors in the present that bring them closer to a desired identity in the future [18,22]. Hence, interventions which provide a nudge for future ideal self-views to become the new current self-views – or in other words nudge a shift in self-identity [12,23] – may be a promising way to operationalize identity BCTs and facilitate smoking cessation.

While a shift in smoking-related identity seems desirable for successful smoking cessation, adopting a new identity can be a challenge. One may feel that one is losing part of the self in the process. In a study examining narratives of post-partum smoking relapses, Bottorff and co-authors [24] found that women who had successfully quit smoking around the time of their pregnancy generally (re)lapsed after having given birth, because they felt they had lost a part of their freer, less inhibited, more relaxed selves by quitting smoking. Findings that identity loss can thwart successful quit attempts have been corroborated more recently in Vangeli and West [23] and Meijer et al. [12]. Additionally, Meijer et al. [12] highlighted that expecting to lose part of oneself when quitting (identity loss), can already be sufficient to thwart quit attempts. The main objective of the current study is to test the effect of envisioning one's (non)smoking future on smoking-related identity constructs, including identity loss.

Despite evidence that an identity shift from smoker to quitter or nonsmoker may facilitate smoking cessation, experimentally nudging change in smoking-related identity through an intervention has, to our knowledge, only been attempted by Meijer, Gebhardt and colleagues [25]. Employing one possible operationalization for a future-self intervention, their study assessed whether quitter self-identity can be strengthened by writing about a future-self as quitter. More specifically, participants in the intervention group were asked to write down all positive aspects associated with a mental image of themselves being in the process of quitting smoking. It was expected that by envisioning and writing about quitting in the future, an identity as quitter would more accessible, salient and personally relevant and may encourage a quit attempt. The future-self writing exercise was only marginally successful in strengthening quitter self-identity post-intervention – with no effect on smoking behaviors – compared to a control condition where participants did a similar future-self writing exercise on unrelated behavior (i.e., washing hands more frequently). Nevertheless, writing exercises about future-selves show potential in influencing smoking-related self-identity and behavior, because they have successfully been used to influence other (health) behaviors and outcomes (e.g., in the context of physical activity and overall wellbeing – [26–31]. For this reason, the current study tests the effect of a future-self intervention, operationalized differently, on smoking-related identity again. We expect a weaker smoker self-identity and identity loss, and stronger quitter self-identity and nonsmoker self-identity (see above) in the future-self intervention condition than in the control condition (H2).

Prior studies testing future-self writing exercises, such as the one in Murru and Ginis [28], had positive effects on health behavior up to eight weeks post-intervention, but most did not ascertain outcomes beyond that point. Thus, despite short-term success, it remains unknow what the effect – on identity and behavior – of future-self interventions are after several months. That is why the current study ascertains the effect of the future-self intervention directly post-intervention and after three and six months. We expect quitter

self-identity and nonsmoker self-identity to be especially strengthened, and smoker self-identity and identity loss especially weakened directly post-intervention (H3).

Meijer and colleagues [25] suggested several routes to improve future-self interventions. Achieving the desired future-self and avoiding the undesired future-self may well be facilitated by comparing future-selves with current selves in a so-called mental contrasting procedures [32,33]. This is why a first proposed improvement was to have participants envision both their desired (i.e., as sustained quitter) and undesired (i.e., as continued smoker) possible self. Second, to account for individual preferences in information processing [34], Meijer et al. recommended to include a visual task (i.e., finding images associated with the future-self) in addition to the verbal task (i.e., writing about the future-self) in the intervention. Finally, Meijer et al. suggested taking into account potential moderators of the effect of future-self writing task on smoking-related self-identity. Previous research proposes that both lower socioeconomic position (SEP) individuals and individuals with greater nicotine dependence generally see and keep seeing themselves more as smokers [9,10,35,36]. Moreover, findings suggest that smoker self-identity in lower compared to higher SEP individuals is more resistant to change [9], that lower SEP smokers have more difficulties envisioning themselves as nonsmokers [10], and that a shift towards nonsmoking is less likely for individuals with stronger dependence to nicotine [7,36,37]. Other interesting moderators are clarity of an envisioned future-self, which has been shown to be directly related to the likelihood of endorsing [38,39] or feeling connected to the future-self [40], and one's consideration of the future consequences of current behavior (see [29] – high levels of which have been found to facilitate the formation of future-selves [18,41]. In summary, prior evidence suggests that smoking-related identity varies based on personal factors, and, because of this, that such factors could moderate the effect of a future-self intervention. Yet, few studies have looked at the relation between personal factors and smoking-related identity, and none tested potential moderating effects of such factors in identity-related interventions. The current study sheds more light on the matter, and considers SEP, nicotine dependence, consideration of consequences and future-self clarity specifically. We anticipate corroborating that smokers with a higher SEP, lower nicotine dependence, and greater consideration of consequences and future-self clarity identify more with quitting and nonsmoking and less with smoking – at all times – than smokers with a lower SEP, greater nicotine dependence and lower consideration of consequences and future-self clarity (H4a). Consequently, we expect to find moderation effects for all four factors. More specifically, we foresee smokers with higher SEP, lower nicotine dependence, greater consideration of consequences and future-self clarity to have stronger quitter self-identity and nonsmoker self-identity, and weaker smoker self-identity and identity loss when exposed to a future-self intervention than when not exposed to such an intervention (H4b).

The Present Study

Extending previous work, the aim of the current study was to examine the effect - over time - of an online experimental future-self intervention on smoking-related self-identity and identity loss. More specifically, we attempted to strengthen desired self-identities (i.e., quitter self-identity, nonsmoker self-identity) and to weaken undesired self-identity (i.e., smoker self-identity) and identity loss by means of a mental imagery, verbal and visual task. It was inferred that by envisioning desired and undesired future-selves and consolidating these mental images through images and by writing about them, an identity as quitter or nonsmoker would become more accessible, salient and personally relevant than an identity as smoke and may guide behavior toward smoking cessation. The current study also examined the relation of SEP, nicotine dependence, consideration of future consequences and future-self clarity with smoking-related identity constructs, and their potential moderating role on the effects of the future-self intervention. Outcomes were measured directly after the future-self intervention in the experimental group, and after one and three months in both the experimental group and a passive control comparison group. Additionally, the present study examined the association between smoking-related self-identity and identity loss on the one hand and intention to quit and new quit attempts on the other.

METHODS

Participants and Design

This study employed a longitudinal online experimental design with a future-self intervention and waitlist control condition. Participants were recruited in the Netherlands and Dutch-speaking part of Belgium from July 2017 to October 2018. They were recruited through numerous media (e.g., previous research participation, social media such as LinkedIn or Facebook – full list in Supplement 1) to obtain a large and diverse group. Measurements were performed at baseline (T0), directly after the intervention (T1, experimental condition only), and after one (T2) and three months (T3). The intervention took place directly after T0. Based on previously found small to medium effect sizes [25,27,28], sample sizes were estimated to obtain statistical power at the recommended .80 level [42], with Cohen's d = .40, α = .05, and one-tailed testing. This yielded a minimum of 78 participants per condition at T3. The aim was to include 110 participants per condition to allow for attrition. In total, 262 people met inclusion criteria (i.e., aged 18 and over, daily smoking and intending to quit in the future), of which 233 completed the T0 survey and were randomly assigned to a condition. Of the randomized participants, 157 completed the T2 survey (67.38%,) and 151 the T3 survey (64.38%) (see Supplement 1 for attrition analyses). Supplement 1 includes an overview of the baseline sociodemographic profile of the participants. Significantly more women than men ($\chi^2(1) = 38.734$, $p < .001$), and more middle SEP than low or high SEP

smokers ($\chi^2(2) = 62.043$, $p < .001$) participated in this study. Two gift coupons of €100.- and six of €50.- were randomly distributed among participants having completed the T2 and T3 surveys.

Procedure

Surveys in Dutch were presented to participants using Qualtrics (www.qualtrics.com). Smokers interested in participating received an e-mail containing the link to the T0 survey.

Directly before the T0 survey, participants were informed about the study aim (i.e., investigating how smokers think about smoking, quitting, themselves and the future), the inclusion criteria (see above), that participation was voluntary, and they provided digital informed consent. Participants were not informed that the study included future-self tasks. E-mail addresses were used to match post- and follow-up surveys to the correct participant and then removed from the dataset. Data were analyzed anonymously. After assessment of baseline measures (T0), participants were randomized 1:1 to an experimental condition. Participants in the control condition were then automatically redirected to a public non-identity related smoking cessation website (www.ikstopnu.nl). Participants in the future-self intervention condition completed a visual and verbal future-self task about their desired- and undesired future-self (see details below), completed T1, and were also redirected to the website. All participants were invited to complete the T2 and T3 measurements after one and three months. After the T3 measurement, all participants were debriefed and participants from the control condition were given the chance to take part in the intervention if desired. The procedure was approved by the Ethical Board of Leiden University's Department of Psychology (CEP17-0505/192) and pilot tested on five smokers.

Future-self tasks. Participants in the intervention condition were first asked to imagine themselves in a future where they successfully quit smoking (i.e., desired future-self). Then, in a counterbalanced order, participants were asked to write about this image (verbal task) and to upload self-selected pictures that matched this image (visual task). Next, participants were asked to provide five keywords that summarized the image of themselves when they quit smoking successfully.

The procedure was repeated for the undesired future-self. For this task, participants were asked to think about a future as continued smoker, to upload pictures and to write about and summarize how such a future did not fit with how they viewed themselves.

One day later, participants received an automatic e-mail containing their self-generated images, narratives and keywords, and were asked to place these materials somewhere where they could easily access and/or view them.

Measures

This study is part of a larger project for which more variables were measured [43]. Variables used in the current study are described below.

Background characteristics. Participants were asked at T0 to report their *sex*, *year of birth, age at smoking onset,* number of *smoking years* and *previous quit attempts* [y/n].

Intention to quit. At T0 and T2, participants were asked for an intended timeline to quit smoking. Answer categories were: 'I intend to quit (1) within 1 month; (2) within 6 months; (3) within 2 years; (4) within 5 years; (5) within 10 years; (6) sometime ever, but not within 10 years; (7) always to remain smoking, but smoke less; or (8) always to remain smoking, and not less' [44]; previously used in [25]). Participants choosing answer categories seven and eight were categorized as 'non-intenders'. Before data analysis, this variable was re-coded such that higher scores indicated stronger intention to quit.

New quit attempt. Were measured at T2 with one item requiring a yes/no answer (i.e., 'Have you made a quit attempt which lasted at least 24 hours since completing the first questionnaire?').

Smoking-related self-identity. At T0, T2 and T3, strength of *smoker self-identity, quitter self-identity and nonsmoker self-identity* were measured using respectively eight (α = .81), seven (α = .72) and seven (α = .80) items (cf. [13]) adapted from the Smoker Self-Concept Scale and the Abstainer Self-Concept Scale [45] and work by Tombor et al. [7] and Van den Putte et al. [8] (e.g., [smoking/quitting/ nonsmoking] is part of who I am', (1) strongly disagree – (5) strongly agree). Previous work has shown that these three scales are reliable [13]. To limit the length of the survey, at T1, *smoker self-identity, quitter self-identity and nonsmoker self-identity* were measured each using three items from the baseline (α = .71, .82, and .87 respectively): 'I see myself as [smoker/ quitter/nonsmoker]', '[Sustained smoking/quitting/not smoking] is part of who I am', '[Sustained smoking/ quitting/not smoking] fits with how I want to live', (1) strongly disagree – (5) strongly agree.

Expected identity loss*. Identity loss* was assessed at T0, T2 and T3 using four items (α = .83) from the Smoker's Identity Scale [37] (e.g., 'If I quit smoking, I will have to give up a part of myself', (1) strongly disagree – (5) strongly agree).

Socioeconomic position. Participants were asked for their highest attained education level at T0. This served as an indicator of *socio-economic position* (as in [10,46]). Answer categories ranged from (1) 'no education' to (8) 'university'. For the analyses, SEP was recoded into three categories, namely lower (no education, only primary school, pre-vocational secondary education or lower level vocational education), middle (middle level vocational

education and senior higher secondary education), and higher SEP (polytechnic or university level).

Nicotine dependence and cigarettes per day. Measured at T0, T1, T2 and T3 using the Fagerström Test for Nicotine Dependence [47], which contains an item ascertaining number of *cigarettes per day*.

Consideration of future consequences. Measured with the fourteen-item Consideration of Future Consequence Scale [48], translated into prevocational/ general secondary education level Dutch ([49]; α = .79) (e.g., 'I consider how things might be in the future, and try to influence those things with my day to day behavior').

Future-self thought clarity. Assessed with the three items (α = .68) from the 'Clarity' subscale in McElwee & Haugh [38] (e.g., 'When I picture myself in the future, I see clear and vivid images', (1) does not apply to me at all – (5) strongly applies to me).

Compliance with intervention instructions. It was assessed whether the future-self tasks were performed as intended, that is, compliance to the intervention instructions. Participants who either uploaded no image or used fewer than ten characters to describe one of their future-selves were considered as non-compliers to at least one task and categorized as non-complier.

Statistical Analyses

Attrition and preliminary analyses

Independent sample t-tests, Welch t-tests and χ^2 (goodness of fit) tests were performed to test for baseline differences between the participants in the two conditions, between responders and drop-outs, and between compliers and non-compliers on the future-self tasks. Pearson's and Spearman's correlation coefficients were computed between the variables used in the main analyses. Next, simple and multiple linear and binomial regressions were conducted to examine whether T0 smoker self-identity, quitter self-identity, nonsmoker self-identity and Identity loss were associated with quit intention at T2. Simple and hierarchical binomial logistic regressions were conducted to assess whether, after controlling for condition (Step 1), baseline smoker self-identity, quitter self-identity, nonsmoker self-identity and identity loss (Step 2) were associated with new quit attempts at T2. Bonferroni corrected results are reported and used for interpretations of effects and significance.

Main analyses for outcome variables

Multilevel analyses incrementally comparing nested models (see Supplement 2) through likelihood ratio tests were performed to answer all three hypotheses. Multilevel analyses were chosen over RM ANOVA because they can deal with an unbalanced number of measurements between conditions, handle missing values implicitly (through maximum likelihood estimation) while retaining maximum power, and deal with unequal time intervals between measurements. Moderate levels of between-participant variance were found for all outcomes (60% for smoker self-identity, 64% for quitter self-identity, 63% for non-smoker self-identity and 67% for identity loss), warranting the use of multilevel modeling [50]. Analyses were performed in R version 4.02 using the lmer and merTools packages. The ANOVA function from merTools was used for nested model comparisons, observing an alpha level of 5%. Bonferroni corrections [51] were applied for each outcome separately to correct for multiple testing (i.e., the four moderators included in the models).

The present study evaluated the same multilevel models using multiple imputed data, to verify robustness of the maximum likelihood-based complete case analyses (CCAs). Multiple imputations were generated conditionally for each intervention condition in 100 separated datasets using mice. A custom predictor matrix was specified and the imputation method was specific and separate for each variable. The maximum number of iterations was set to 25. The multilevel results were pooled using the mitml package. Also for robustness purposes, it was assessed whether reporting no intention to quit smoking on the survey item (despite having indicated intending to quit on the informed consent), and non-compliance to at least one future-self task affected the study results. To this end, the multilevel models were run again, respectively removing non-intenders and non-compliers, yielding minimal differences in results. Bonferroni corrected CCAs are reported and used for interpretations of effects and significance, because removing non-intenders and non-compliers from the analyses yielded too low statistical power at T2 and T3, and analyses with multiple imputations included numerous estimations.

RESULTS

Descriptive statistics of the outcomes and correlations between study variables are presented in Supplement 3.

Attrition Analyses

There was significantly more drop-out in the experimental condition than in the control condition at both T2 and T3 (see Supplement 1). Drop-outs did not differ significantly from responders on background characteristics (alls *ps* > .05).

Preliminary Analyses

There were no significant baseline differences between the conditions on background characteristics (see Supplement 1). Twenty eight participants (12.02%) were categorized as non-compliers to at least one visual or verbal future-self task. Non-compliers were significantly more likely to have a lower SEP ($\chi2(2) = 11.31$, $p = .004$, $V = .36$), be older ($t(44) = -3.87$, $p < .001$, $d = -.89$), have been smoking for longer ($t(44) = -3.53$, $p = .001$, $d = -.81$) and be more heavily dependent on nicotine ($t(85) = -2.71$, $p = .008$, $d = -.62$).

Smoking-related identity constructs in relation to intention to quit (T2) and new quit attempts (between T0 and T2) (H1a)

Simple linear regressions showed that, regardless of condition, smoker self-identity at T0 was negatively associated, while quitter self-identity and nonsmoker self-identity at T0 were positively associated with intention to quit at T2. Regardless of condition, identity loss at T0 was not significantly associated with intention to quit at T2. Multiple regression showed that smoker self-identity, nonsmoker self-identity and identity loss at T0 were each uniquely associated with intention to quit at T2 (see Table 1).

Simple hierarchical binomial regressions showed that, regardless of condition, stronger smoker self-identity at T0 was negatively associated, and stronger nonsmoker self-identity at T0 positively associated with new quit attempts between T0 and T2. Multiple hierarchical regression showed that, regardless of condition, only nonsmoker self-identity was uniquely associated with new quit attempts between T0 and T2 (see Table 1).

Table 1. Summary of Simple and Multiple ((Hierarchical) Binomial Logistic) Regression Analyses for Variables Predicting Intention to Quit at T2 (N = 135-155) and New Quit Attempts between T0 and T2 (N = 154-156)

		Intention to quit (T2)					
		Simple linear regressions			Multiple linear regression[a]		
Predictor		*b (se)*	*β*	*p*	*b (se)*	*β*	*p*
Step 1	Condition	0.12 (.31)	.03	.698	0.11 (.27)	.03	.687
Step 2	Smoker identity	**-0.77 (.21)**	**-.30**	**> .001**	**-0.71 (.25)**	**-.28**	**.006**
	Quitter identity	**1.28 (.23)**	**.43**	**> .001**	0.55 (.34)	.19	.108
	Nonsmoker identity	**1.29 (.22)**	**.46**	**> .001**	**0.87 (.33)**	**.31**	**.009**
	Identity loss	-0.22 (.18)	-.11	.222	**0.53 (.20)[b]**	**.26**	**.010**
		New quit attempt (between T0 and T2)					
		Simple hierarchal logistic regressions			Multiple hierarchal logistic regression[c]		
Predictor		*b (se)*	OR [95% CI]	*p*	*b (se)*	OR [95% CI]	*p*
Step 1	Condition	0.06 (.34)	0.94 [.48, 1.84]	.866	-0.06 (.37)	1.06 [.52, 2.15]	.876
Step 2	Smoker identity	**0.59 (.26)**	**1.80 [1.09, 2.98]**	**.025**	0.60 (.35)	1.83 [.93, 3.59]	.086
	Quitter identity	-0.11 (.28)	0.89 [.51, 1.55]	.695	0.85 (.54)	2.33 [.98, 5.55]	.062
	Nonsmoker identity	**-0.68 (.28)**	**0.51 [.29, .87]**	**.016**	**-1.14 (.45)**	**0.32 [.13, .76]**	**.013**
	Identity loss	0.16 (.20)	1.18 [.81, 1.72]	.399	-0.19 (.27)	0.83 [.49, 1.39]	.479

Notes. Bold-face indicates significant associations after Bonferroni corrections. New quit attempt between T0 and T2: 0 = yes, 1 = no. For intention to quit, the higher the scores, the stronger the intention to quit.

[a] There were three studentized deleted residuals greater than ±3 standard deviations and five leverage values greater than 0.5. The analysis was run with and without these points, with similar results.

[b] This effect was not considered meaningful since the predictor was not significantly associated with quit intention in the simple regression analysis. We suspect the presence of a suppression effect in the context of the other identity variables, given substantial correlations among the predictors (see Supplement 5).

[c] There was one standardized residual with a value of -2.06 standard deviations, which was kept in the analysis.

Multilevel Analyses

Effect of the future-self intervention: comparison between conditions (H2). Against expectations, there was no significant difference in the strength of smoker self-identity (p = .721), quitter self-identity (p = .349) or nonsmoker self-identity (p = .725), or identity loss (p = .405) between the two conditions at T1, T2 or T3. These results were robust in analyses without non-intenders and non-compliers, and analyses with imputed data (see Table 2 and Supplement 4, Condition and Condition x Time).

Evolution of smoking-related identity constructs over time (H3). As anticipated, results showed a significantly more pronounced decrease of smoker self-identity directly post-intervention compared to follow-ups (p = .003), although this applied to the entire sample and not only to the intervention condition. The decline in smoker self-identity was also significantly more pronounced directly post-intervention when removing non-intenders (p =.007), but not when removing non-compliers (p =.024) or when using analyses with data imputations (p =.127) (See tables 2 and Supplement 4, Time (linear) and Time (quadratic)). Contrary to our forecasts, however, there was a stable decrease in identity loss (p = .009), a stable significant increase of nonsmoker self-identity (p = .006), and no significant change in quitter self-identity (p = .988) over time for the entire sample. Against expectations, there were no changes in quitter self-identity over time (p = .988). These results were robust in analyses without non-intenders and non-compliers. Only results of analyses with imputed data differed from results with CCAs in that they showed only a marginal change in non-smoker self-identity (p = .074) and no change in identity loss (p = .242) over time (See Table 2 and Supplement 4, Time (linear) and Time (quadratic)).

Influence of personal factors on smoking-related self-identity constructs (H4a). See Table 2 and Supplement 4, Moderator for detailed results.

Socioeconomic position. Unexpectedly, SEP was not significantly related to strength of smoker self-identity (p = .668), quitter self-identity (p = .864), nonsmoker self-identity (p = .625) or identity loss (p = .668) at any timepoint. Findings were robust in analyses without non-intenders, non-compliers and in analyses with imputed data.

Nicotine dependence. In line with expectations, results from all analyses showed that at all times, the higher the nicotine dependence , the higher the smoker self-identity (p = .001) and identity loss (p = > .001). Against expectations, however, nicotine dependence did not significantly influence quitter self-identity (p = .942) and nonsmoker self-identity (p = .198). These results were robust in analyses without non-intenders and non-compliers and analyses with imputed data.

Consideration of future consequences. As anticipated, results from all analyses showed that, at all times, the higher the consideration of consequences, the weaker the smoker self-identity (p = .005), the stronger the quitter self-identity (p = .007) and nonsmoker self-identity (p = .004), and the lower the identity loss (p = 0.25).

Future-self thought clarity. As expected, all analyses showed that, at all times, having a clearer vision of oneself in the future was associated with weaker smoker self-identity (p = .006) and identity loss (p = .039), as well as stronger quitter self-identity (p = .002) and nonsmoker self-identity (p = > .001).

Influence of moderators on the effect of the future-self intervention (H4b). Effects of the intervention on smoker self-identity, quitter self-identity and identity loss were not moderated by SEP, nicotine dependence, consideration of consequences or future-self clarity, regardless of the set of analyses used. CCAs did, however, show that when future-self clarity was low, nonsmoker self-identity was significantly and consistently higher in the future-self intervention condition than in the control condition. However, when future-self clarity was high, participants in the intervention condition consistently held weaker nonsmoker self-identity than participants in the control condition. These findings applied to all analyses (see Table 2 and Supplement 4, Moderator x condition).

DISCUSSION

The current study was the first to examine whether desired-undesired future-self tasks can weaken smoker self-identity and expected identity loss if quitting (identity loss), and strengthen quitter- and nonsmoker self-identity, while accounting for personal factors – socioeconomic position (SEP), nicotine dependence, consideration of future consequences and future-self clarity.

It was anticipated that stronger quitter and nonsmoker self-identity would be positively related to quit intention and new quit attempts, while stronger smoker self-identity and identity loss would negatively relate to these outcomes (H1). Not fully in line with these expectations, results showed weaker smoker self-identity, stronger nonsmoker self-identity and weaker identity loss to be important for intention to quit, and nonsmoker self-identity to be important for renewed quit attempts. These findings are in line with prior research showing that self-identity constructs are important determinants of quit intention and attempts [5–10], and advocate for the development of effective identity-related smoking cessation interventions. Compared to prior findings [5,8,13] the strength of nonsmoker self-identity seems to be most important for quitting behaviors, that is, more so than quitter self-identity. However, these previous studies did not take all three self-identities, or

both self-identities and identity loss into account. As such, it is plausible that in these previous studies strength of quitter self-identity would have been found less important if other self-identity constructs had been controlled for. Identity-related interventions may need to focus primarily on strengthening nonsmoker self-identity when attempting to increase intention to stop and encourage quit attempts.

Other expectations included that after a future-self intervention, smoker self-identity and identity loss would be weaker, and quitter self-identity and nonsmoker self-identity stronger in the intervention condition compared to the control condition (H2). The future-self intervention did, however, not have significant effects on smoking-related identity constructs. These findings do not resonate with findings from Meijer et al. [25] – who observed a marginally significantly stronger quitter self-identity in smokers who wrote about their future-self as quitter – or with recently published [52] and past [27–30] successes of writing about one's future-selves in changing health behavior. One possible explanation for these findings is that future-self interventions may not work as effectively in the context of smoking, for example because smoking is an addictive behavior. As such, other identity-related interventions should be explored. Alternatively, future-self interventions might be more helpful when behavior change is already ongoing, because abstinence could reinforce the new desired identity [5]. Smokers with a short-term quit intention might also benefit more than smokers who intend to quit someday, because the (un)desired future-self may be more accessible, salient and personally relevant.

This could not be tested in the current study as the sample was too diverse for such a subgroup analysis, but would be an interesting path to explore in future research. Nevertheless, the current results do show trends in the expected directions. Although not statistically significant, smokers in the intervention condition, compared to those in the control condition, reported stronger follow-up quitter self-identity and nonsmoker self-identity, and weaker smoker self-identity and identity loss (see Supplement 3). Despite improvements from the future-self intervention in Meijer, Gebhardt et al. [25], a sufficiently effective operationalization still has not been found and further improvements are needed. Because the current and previous studies [5,8–10] have shown identity to be important for quitting intentions and behaviors – once operationalized successfully – we do believe that identity-related interventions have the potential to enhance the effectiveness of multicomponent smoking cessation interventions. As a first improvement, we recommend expanding the future-self intervention. This could be done by repeating the future-self tasks and/or making the mental visualization last longer, approaches that have been adopted in studies successfully changing other health behaviors [26,28–30,52]. Another possible expansion could be to include future vs. current self contrasting and action plan formulation. Possible selves facilitate comparison between the future and current self, and allow one to take steps towards achieving or avoiding the future self [17,18]. A second recommendation would be to let

smokers think about themselves in a closer future first and then in a more distant future, because individuals tend to feel closer to future- selves that are psychologically closer to the present [21]. Third, given that 12% of participating smokers did not follow instructions for the future-self tasks as intended, it may be necessary in the future to 1) verify that instructions are clear, 2) encourage participants to carry-out tasks as intended (e.g., through a pop-up notification). Last but not least, as human support appears beneficial to digital (health promotion) interventions [53], and interventions involving human interaction are most effective [54], future-self interventions may be better suited for real-life or hybrid settings than for online settings.

We expected smoker self-identity and identity loss in the intervention condition to be especially weakened, and quitter self-identity and nonsmoker self-identity to be especially strengthened directly post-intervention (H3). While there was a stable decrease of smoker self-identity and identity loss, and a stable increase of nonsmoker self-identity over a period of six months, these changes applied to the entire group of participants, regardless of whether they partook in the intervention or not. In line with previous findings, this illustrates that smoking-related identity is not static, but can evolve with time [1,2,31,55]. It is unlikely that these findings are the biproduct of attrition given that CCAs and analyses with data imputations show the same patterns over time, and that those with nonsmoker self-identity were more likely to drop-out. A possible explanation for these findings is the survey as intervention phenomenon, or, in other words, that the relatively long and extensive surveys triggered participants to critically think about their smoking and change how they perceived themselves [56]. It is also possible that, for smokers intending to quit, visiting a smoking cessation website providing information on how to durably quit also reinforced their nonsmoker self-identity and weakened their identification with smoking. Alternatively, as visitors accessing the website are asked to categorize themselves as 'someone who wants to quit smoking' or 'someone who wants to remain abstinent', participating smokers may have felt the urge to distance themselves from smoking to fit with the target group of the website.

In line with previous work, the current study was expected to show that smoking-related identity constructs vary depending on SEP, nicotine dependence, consideration of consequences and future-self clarity (H4a), and to add to current knowledge by looking at whether these personal factors moderate the effect of a future-self intervention targeting smoking-related identity (H4b). While there was no moderation effect of the studied personal factors on the effect of a future-self intervention, results do corroborate that smoking-related identity varies depending on personal factors. For example, as expected from prior findings [29,38–40], the higher the consideration of consequences and future-self clarity, the weaker the smoker self-identity, the weaker the identity loss if quitting , and the stronger the quitter and nonsmoker self-identity. Similarly, smokers with higher nico-

tine dependence reported stronger expectations of identity loss if quitting, and, in line with Blondé and Falomir-Pichastor [35] and Falomir-Pichastor et al. [36], the higher the nicotine dependence, the more smokers identified with smoking. Finally, although smoking-related identity was not significantly related to SEP, trends in the current results do suggest that smokers with higher SEP may identify more with nonsmoking than their middle or lower SEP counterparts (as in [9]). In light of the above findings, it may be important for interventions attempting to weaken smoker self-identity and/or strengthen quitter self-identity or nonsmoker self-identity to intervene on modifiable personal factors first or in parallel. For example, starting nicotine replacement therapy - one of the most efficient smoking cessation aids [54] - prior to an identity-related intervention may allow smokers to consider their (non)smoking future with reduced interference from (anticipated) nicotine withdrawal symptoms. Additionally, future identity-related interventions employing mental imagery could tailor the intervention to the smoker [57], for example, by having more repetitions of the future-self tasks, or a greater level of detail or audiotaped instructions (see [58]) for smokers with higher nicotine dependence, lower consideration of consequences and lower future-self clarity.

Table 2. Overview of the Best Fitted Model for Each Combination of Outcome and Personal Factors using Complete Case Analyses (N = 233-246)

Parameters	Smoker identity	Quitter identity	Nonsmoker identity	Identity loss		Smoker identity	Quitter identity	Nonsmoker identity	Identity loss
Fixed effects	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)		*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)
$R^2_{GLMM(c)}$ [a]	0.640	0.599	0.591	0.664		0.651	[b]	0.602	0.656
Intercept	**2.67 (0.16)*** **	**3.44 (0.04)*** **	**3.84 (0.24)*** **	**2.15 (0.05)*** **	Intercept	**3.40 (0.29)*** **	**2.90 (0.29)*** **	**2.70 (0.29)*** **	**3.49 (0.36)*** **
Time (linear)	**-3.92 (1.01)*** **		7.63 (3.03)*	**-1.88 (0.72)** **	Time (linear)	**-3.94 (1.01)*** **	0.82 (3.67)*	2.01 (0.92)*	-1.17 (1.11)
Time (quadratic)	**1.61 (0.56)** **		1.27 (0.55)*	0.18 (0.66)	Time (quadratic)	**1.60 (0.54)** **	0.28 (0.52)	1.29 (0.54)*	0.16 (0.65)
Condition	0.01 (0.08)		-0.65 (0.31)*		Condition	0.02 (0.09)	0.04 (0.08)	-0.03 (0.08)	-0.11 (0.11)
Time x Condition	-0.00 (0.08)		-0.01 (0.001)+		Time x Condition	-0.00 (0.001)	0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)
SEP	-0.10 (0.06)		-0.07 (0.10)		CFC	**-0.29 (0.09)** **	**0.23 (0.09)** **	**0.25 (0.87)** **	**-0.39 (0.11)*** **
SEP x Time			0.00 (0.001)		CFC x Time		-0.00 (0.001)*		
SEP x Condition			0.28 (0.13)*		CFC x Condition				
Time x Condition x SEP			-0.00 (0.001)+		Time x Condition x CFC				
$R^2_{GLMM(c)}$ [a]	0.715	0.599	0.585	0.715		0.652	[b]	0.593	0.660
Intercept	**2.27 (0.07)*** **	**3.44 (0.04)*** **	**3.51 (0.04)*** **	**1.89 (0.10)*** **	Intercept	**3.00 (0.21)*** **	**2.81 (0.20)*** **	**2.81 (0.21)*** **	**2.68 (0.20)*** **
Time (linear)	-1.53 (0.92)		**1.76 (0.63)** **	-0.02 (1.08)	Time (linear)	**-3.93 (1.01)*** **	0.54 (0.80)	2.00 (0.92)*	-1.11 (1.11)
Time (quadratic)	**1.33 (0.56)***		1.30 (0.55)*	-0.42 (0.65)	Time (quadratic)	**1.60 (0.55)** **	0.27 (0.53)	1.27 (0.54)*	0.15 (0.65)
Condition	0.03 (0.08)			-0.11 (0.11)	Condition	0.57 (0.30)+	0.63 (0.28)*	0.71 (0.29)*	-0.12 (0.11)
Time x Condition	-0.00 (0.001)			-0.00 (0.001)	Time x Condition	-0.00 (0.001)	0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)
ND	**0.08 (0.01)*** **			**0.12 (0.02)*** **	FSC	**-1.93 (0.07)** **	**0.21 (0.07)** **	**0.25 (0.07)*** **	**-0.17 (0.06)** **
ND x Time					FSC x Time				

Table 2. Overview of the Best Fitted Model for Each Combination of Outcome and Personal Factors using Complete Case Analyses (N = 233-246) (*continued*)

Parameters	Smoker identity	Quitter identity	Nonsmoker identity	Identity loss		Smoker identity	Quitter identity	Nonsmoker identity	Identity loss
ND x Condition					FSC x Condition	2.09 (0.10)*	-0.21 (0.10)*	**-0.26 (0.10)****	
Time x Condition x ND					Time x Condition x FSC				

Note. Bold-face indicates significant associations after Bonferroni corrections. Dependent variables are listed under model description. Time: 1 = baseline, 2 = post-test, 3 = one-month follow-up, 4 = three-months follow-up. Condition: 0 = control, 1 = intervention. Socioeconomic position (SEP), Nicotine dependence (ND), Consideration of future consequences (CFC), Future-self clarity (FSC): 1 = low, 2 = average, 3 = high. Empty fields = not applicable, variable was not included in the model.

[a] Conditional R^2, variance explained by both fixed and random effects. Determined as in Nakagawa et al. (2017).

[b] Could not be estimated due to convergence problems.

[+] $p < .10$; * $p < .05$; ** $p < .01$; ***$p < .001$.

LIMITATIONS

Upon inclusion, participants confirmed they had an intention to quit smoking in the future. Despite this, 13 participants reported having no quit intention on the baseline survey. A first limitation is, therefore, uncertainty as to the participants' true quit intentions. Despite this, non-intenders were equally distributed across conditions – respectively 6 and 7 in the control and intervention condition – and robustness analyses without non-intenders showed no differences from the main analyses. As such, we do not foresee a major impact of quit intention incongruency on our findings. We do advise future studies to consider including failsafes for measurement errors (e.g., attention check questions).

Finally, data time stamps showed that most of the intervention group, after completing the future-self tasks, temporarily left during the completion of the post-intervention survey, and then returned to complete it. This means that it is unclear whether measured identity constructs reflect the intervention or the activity undertaken in the meantime, or both. An online intervention was, however, the most efficient way to reach a large and varied group of smokers. Regardless, future studies administering online identity-related interventions may want to encourage participants to fully complete a survey wave before engaging in other activities.

CONCLUSIONS

Identity constructs – especially when accounting for personal factors – offer an interesting target for interventions trying to facilitate smoking cessation. However, more research is needed in order to find an effective operationalization of identity-related interventions. Suggestions are made to improve future-self interventions in the context of smoking and to intervene on personal factors of smokers in parallel to or before identity-related smoking cessation interventions.

REFERENCES

1 Berkman ET, Livingston JL, Kahn LE. Finding the "self" in self-regulation: the Identity-Value Model. *Psychol Inq*. 2017;28:77–98. doi: 10.1080/1047840X.2017.1323463

2 Burke PJ, Stets JE. *Identity theory*. Oxford, NY: Oxford University Press 2009.

3 Oyserman D, Elmore K, Smith G. Self, self-concept, and identity. *Handbook of self and identity*. 2012:69–104.

4 Tajfel H, Turner JC. An integrative theory of intergroup conflict. In: Austin WG, Worchel S, eds. *The social psychology of intergroup relations*. Monterey, CA: Brooks/Cole Publishing Company 1979:33–47.

5 Meijer E, Van den Putte B, Gebhardt WA, *et al.* A longitudinal study into the reciprocal effects of identities and smoking behaviour: Findings from the ITC Netherlands Survey. *Soc Sci Med*. 2018;200:249–57. doi: 10.1016/j.socscimed.2017.12.006

6 Smit ES, Hoving C, Schelleman-Offermans K, *et al.* Predictors of successful and unsuccessful quit attempts among smokers motivated to quit. *Addict Behav*. 2014;39:1318–24. doi: 10.1016/j.addbeh.2014.04.017

7 Tombor I, Shahab L, Brown J, *et al.* Positive smoker identity as a barrier to quitting smoking: Findings from a national survey of smokers in England. *Drug Alcohol Depend*. 2013;133:740–5. doi: 10.1016/j.drugalcdep.2013.09.001

8 Van den Putte B, Yzer M, Willemsen MC, *et al.* The effects of smoking self-identity and quitting self-identity on attempts to quit smoking. *Health Psychol*. 2009;28:535–44. doi: 10.1037/a0015199

9 Meijer E, van Laar C, Gebhardt WA, *et al.* Identity change among smokers and ex-smokers: Findings from the ITC Netherlands Survey. *Psychol Addict Behav*. 2017;31:465–78. doi: 10.1037/adb0000281

10 Meijer E, Gebhardt WA, Dijkstra A, *et al.* Quitting smoking: The importance of non-smoker identity in predicting smoking behaviour and responses to a smoking ban. *Psychol Health*. 2015;30:1387–409. doi: 10.1080/08870446.2015.1049603

11 Callaghan L, Yong H-H, Borland R, *et al.* What kind of smoking identity following quitting would elevate smokers relapse risk? *Addict Behav*. 2021;112:106654. doi: 10.1016/j.addbeh.2020.106654

12 Meijer E, Vangeli E, Gebhardt WA, *et al.* Identity processes in smokers who want to quit smoking: A longitudinal interpretative phenomenological analysis. *Health (N Y)*. 2020;24:493–517. doi: 10.1177/1363459318817923

13 Meijer E, Gebhardt WA, Van Laar C, *et al.* Socio-economic status in relation to smoking: The role of (expected and desired) social support and quitter identity. *Soc Sci Med*. 2016;162:41–9. doi: 10.1016/j.socscimed.2016.06.022

14 Tombor I, Shahab L, Brown J, *et al.* Does non-smoker identity following quitting predict long-term abstinence? Evidence from a population survey in England. *Addict Behav*. 2015;45:99–103. doi: 10.1016/j.addbeh.2015.01.026

15 Michie S, Richardson M, Johnston M, *et al.* The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions. *Ann Behav Med*. 2013;46:81–95. doi: 10.1007/s12160-013-9486-6

16 Michie S, Hyder N, Walia A, *et al.* Development of a taxonomy of behaviour change techniques used in individual behavioural support for smoking cessation. *Addict Behav*. 2011;36:315–9. doi: 10.1016/j.addbeh.2010.11.016

17 Markus H, Nurius P. Possible selves. *Am Psychol*. 1986;41:954–69. doi: 10.1037/0003-066X.41.9.954

18 Turner S, Hooker K. Possible Selves Theory. In: Gu D, Dupre ME, eds. *Encyclopedia of Gerontology and Population Aging*. Cham: Springer International Publishing 2019:1–6.

19 Frazier LD, Schwartz BL, Metcalfe J. The MAPS model of self-regulation: Integrating metacognition, agency, and possible selves. *Metacognition Learn*. Published Online First: 6 January 2021. doi: 10.1007/s11409-020-09255-3

20 Oyserman D, James L. Possible Selves. *Handbook of Identity theory and research*. New York, NY; Springer 2011:117–45.

21 Strahan EJ, Wilson AE. Temporal Comparisons, Identity, and Motivation: The Relation Between Past, Present, and Possible Future Selves. *Possible selves: Theory, research and applications*. Hauppauge, NY, US: Nova Science Publishers 2006:1–15.

22 Hitlin S, Elder GH. Time, Self, and the Curiously Abstract Concept of Agency. *Sociol Theory*. 2007;25:170–91. doi: 10.1111/j.1467-9558.2007.00303.x

23 Vangeli E, West R. Transition towards a 'non-smoker' identity following smoking cessation: An interpretative phenomenological analysis. *Br J Health Psychol*. 2012;17:171–84. doi: https://doi.org/10.1111/j.2044-8287.2011.02031.x

24 Bottorff JL, Johnson JL, Irwin LG, *et al.* Narratives of smoking relapse: The stories of postpartum women. *Res Nurs Health*. 2000;23:126–34. doi: 10.1002/(SICI)1098-240X(200004)23:2<126::AID-NUR5>3.0.CO;2-2

25 Meijer E, Gebhardt WA, van Laar C, *et al.* Strengthening quitter self-identity: An experimental study. *Psychol Health*. 2018;33:1229–50. doi: 10.1080/08870446.2018.1478976

26 King LA. The Health Benefits of Writing about Life Goals. *Pers Soc Psychol Bull*. 2001;27:798–807. doi: 10.1177/0146167201277003

27 Layous K, Katherine Nelson S, Lyubomirsky S. What Is the Optimal Way to Deliver a Positive Activity Intervention? The Case of Writing About One's Best Possible Selves. *J Happiness Stud*. 2013;14:635–54. doi: 10.1007/s10902-012-9346-2

28 Murru EC, Ginis KAM. Imagining the Possibilities: The Effects of a Possible Selves Intervention on Self-Regulatory Efficacy and Exercise Behavior. *J Sport Exerc Psychol*. 2010;32:537–54. doi: 10.1123/jsep.32.4.537

29 Ouellette JA, Hessling R, Gibbons FX, *et al.* Using Images to Increase Exercise Behavior: Prototypes Versus Possible Selves. *Pers Soc Psychol Bull*. 2005;31:610–20. doi: 10.1177/0146167204271589

30 Perras MGM, Strachan SM, Fortier MS. Possible Selves and Physical Activity in Retirees: The Mediating Role of Identity. *Res Aging*. 2016;38:819–41. doi: 10.1177/0164027515606191

31 Rutchick AM, Slepian ML, Reyes MO, *et al.* Future self-continuity is associated with improved health and increases exercise behavior. *J Exp Psychol Appl*. 2018;24:72–80. doi: 10.1037/xap0000153

32 Oettingen G. Future thought and behaviour change. *Eur Rev Soc Psychol*. 2012;23:1–63. doi: 10.1080/10463283.2011.643698

33 Oyserman D, Destin M, Novin S. The Context-Sensitive Future Self: Possible Selves Motivate in Context, Not Otherwise. *Self Identity*. 2015;14:173–88. doi: 10.1080/15298868.2014.965733

34 Mayer RE, Massa LJ. Three Facets of Visual and Verbal Learners: Cognitive Ability, Cognitive Style, and Learning Preference. *J Educ Psychol*. 2003;95:833–46. doi: 10.1037/0022-0663.95.4.833

35 Blondé J, Falomir-Pichastor J-M. Tobacco dependence and motivation to quit smoking: An identity-based framework. *Int J Soc Psychol*. 2021;1–26. doi: 10.1080/02134748.2021.1882224

36 Falomir-Pichastor JM, Blondé J, Desrichard O, *et al.* Tobacco dependence and smoking cessation: The mediating role of smoker and ex-smoker self-concepts. *Addict Behav*. 2020;102:106200. doi: 10.1016/j.addbeh.2019.106200

37 Dupont P, Tack V, Blecha L, *et al.* Smoker's identity scale: Measuring identity in tobacco dependence and its relationship with confidence in quitting. *Am J Addict*. 2015;24:607–12. doi: https://doi.org/10.1111/ajad.12272

38 McElwee RO, Haugh JA. Thinking Clearly Versus Frequently About the Future Self: Exploring This Distinction and its Relation to Possible Selves. *Self Identity*. 2010;9:298–321. doi: 10.1080/15298860903054290

39 Norman CC, Aron A. Aspects of possible self that predict motivation to achieve or avoid it. *J Exp Soc Psychol*. 2003;39:500–7. doi: 10.1016/S0022-1031(03)00029-5

40 Pozolotina T, Olsen SO. Consideration of immediate and future consequences, perceived change in the future self, and health behavior. *Health Mark Q*. 2019;36:35–53. doi: 10.1080/07359683.2019.1567003

41 Stephan E, Shidlovski D, Sedikides C. Self-prospection and energization: The joint influence of time distance and consideration of future consequences. *Self Identity*. 2018;17:22–36. doi: 10.1080/15298868.2017.1314319

42 Cohen J. *Statistical power analysis for the behavioral sciences*. 2nd ed. Hillsdale, N.J: L. Erlbaum Associates 1988.

43 Meijer E, Gebhardt WA, van Laar C, *et al.* Identified or conflicted: a latent class and regression tree analysis explaining how identity constructs cluster within smokers. *BMC Psychol*. 2022;10:231. doi: 10.1186/s40359-022-00937-y

44 Dijkstra A, Bakker M, De Vries H. Subtypes within a sample of precontemplating smokers: A preliminary extension of the stages of change. *Addict Behav*. 1997;22:327–37. doi: 10.1016/S0306-4603(96)00054-8

45 Shadel WG, Mermelstein R. Individual differences in self-concept among smokers attempting to quit: Validation and predictive utility of measures of the smoker self-concept and abstainer self-concept. *Ann Behav Med*. 1996;18:151–6. doi: 10.1007/BF02883391

46 Schaap MM, Kunst AE. Monitoring of socio-economic inequalities in smoking: Learning from the experiences of recent scientific studies. *Public Health*. 2009;123:103–9. doi: 10.1016/j.puhe.2008.10.015

47 Heatherton TF, Kozlowski LT, Frecker RC, *et al.* The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. *Br J Addict*. 1991;86:1119–27. doi: 10.1111/j.1360-0443.1991.tb01879.x

48 Strathman A, Gleicher F, Boninger DS, *et al.* The consideration of future consequences: Weighing immediate and distant outcomes of behavior. *J Pers Soc Psychol*. 1994;66:742–52. doi: 10.1037/0022-3514.66.4.742

49 Rappange DR, Brouwer WBF, van Exel NJA. Back to the Consideration of Future Consequences Scale: Time to Reconsider? *J Soc Psychol*. 2009;149:562–84. doi: 10.1080/00224540903232324

50 Koo TK, Li MY. A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. *J Chiropr Med*. 2016;15:155–63. doi: 10.1016/j.jcm.2016.02.012

51 Tabachnick BG, Fidell LS. *Using multivariate statistics*. Pearson new international edition, sixth edition. Harlow: Pearson 2014.

52 Priebe CS, Beauchamp M, Wunderlich K, *et al.* "I'm a runner not a smoker": Changes in identity as predictors of smoking cessation and physical activity. *Psychol Sport Exerc*. 2020;49:101702. doi: 10.1016/j.psychsport.2020.101702

53 Beishuizen CR, Stephan BC, van Gool WA, *et al.* Web-Based Interventions Targeting Cardiovascular Risk Factors in Middle-Aged and Older People: A Systematic Review and Meta-Analysis. *J Med Internet Res*. 2016;18:e55. doi: 10.2196/jmir.5218

54 Hartmann-Boyce J, Fanshawe TR, Lindson N, *et al.* Behavioural interventions for smoking cessation: an overview and network meta-analysis. *Cochrane Database Syst Rev*. Published Online First: 20 December 2018. doi: 10.1002/14651858.CD013229

55 Kearney MH, O'Sullivan J. Identity Shifts as Turning Points in Health Behavior Change. *West J Nurs Res*. 2003;25:134–52. doi: 10.1177/0193945902250032

56 Godin G, Sheeran P, Conner M, *et al.* Which survey questions change behavior? Randomized controlled trial of mere measurement interventions. *Health Psychol*. 2010;29:636–44. doi: 10.1037/a0021131

57 Bol N, Smit ES, Lustria MLA. Tailored health communication: Opportunities and challenges in the digital era. *Digit Health*. 2020;6:2055207620958913. doi: 10.1177/2055207620958913

58 Wynd CA. Guided Health Imagery for Smoking Cessation and Long-Term Abstinence. *J Nurs Scholarsh*. 2005;37:245–50. doi: https://doi.org/10.1111/j.1547-5069.2005.00042.x

Supplement 1

Differences Between Conditions on Background Characteristics and Chance of Dropping out at Follow-Ups: Chi-Square Goodness of Fit Tests and Independent Samples T-Tests (N = 233).

Characteristic		*Intervention (n = 114)*	*Control (n = 119)*	
		Frequency (Expected count)		***χ^2 statistic***
Nationality	Dutch	104 (106.7)	114 (111.3)	$\chi^2(1) = 2.02$ $p = .187$, $V = .09$
	Belgian	10 (7.3)	5 (7.7)	
Sex [a]	Male	36 (33.8)	33 (35.2)	$\chi^2(1) = .41$, $p = .567$, $V = .52$
	Female	78 (80.2)	86 (83.8)	
SEP [a]	Low	16 (13.2)	11 (13.8)	
	Middle	60 (63.8)	65 (61.2)	$\chi^2(2) = 1.33$, $p = .515$, $V = .08$
	High	38 (41.4)	43 (39.6)	
Past quit attempt	No	15 (20.1)	26 (20.9)	$\chi^2(1) = 3.03$, $p = .088$, $V = .08$
	Yes	99 (93.9)	93 (98.1)	
Drop-out T2	No	64 (76.8)	93 (80.2)	**$\chi2(1) = 12.83$, $p < .001$***, $V = .24$**
	Yes	50 (37.2)	26 (38.8)	
Drop-out T3	No	65 (73.4)	85 (76.6)	**$\chi2(1) = 5.27$, $p = .028$*, $V = 0.15$**
	Yes	49 (40.6)	34 (42.4)	
		M (SD)		***t-statistic***
Age [b]		37.63 18.64)	37.91 (18.49)	$t(230) = .113$, $p = 910$, $d = -0.02$
Years smoked [b]		20.34 (18.75)	20.11 (18.12)	$t(230) = -.096$, $p = .923$, $d = 0.01$
Age at smoking onset		16.33(2.34)	17.04 (4.63)	$t(231) = 1.46$, $p = .145$, $d = -0.19$
Number of cigarettes per day [b]		12.05 (8.83)	12.14 (7.24)	$t(218) = .09$, $p = .932$, $d = -0.01$

Notes. Bold-face indicates significant associations. Participants were recruited through previous research participation (n = 64), participation for university course credits (n = 41), social media such as LinkedIn or Facebook (n = 32), direct approach by a researcher (n = 26), radio advertisement (n = 20), snowball sampling (n = 20), health websites (n = 10), newspaper (n = 7), an internet search engine (n = 4) or a flyer at a cigarette vending point (n = 3) (missing, n = 35).

[a] Chi-square goodness of fit tests were used.

[b] Equal variances not assumed.

* $p < .05$; ** $p < .01$; ***$p < .001$.

Supplement 2

Stepwise Multilevel Models

Model 1	Unconditional means model
Model 2	Model 1, with fixed effect of time added
Model 3	Model 2, with random slopes added
Model 4	Model 3, with fixed effect of condition (2) added
Model 5	Model 4, with interaction effect of time and condition added
Model 6	Model 5, with the main effect of moderator added
Model 7	Model 6, with interaction effect of moderator and condition added
Model 8	Model 6, with the interaction effect of moderator and time added
Model 9	Model 8 with interaction effect of moderator and condition and moderator and time added
Model 10	Model 9 with the three-way interaction of moderator, condition and time added

Supplement 3

Descriptive Statistics of Outcomes at Baseline, Post-Intervention and at Follow-Ups per Experimental Condition and Pearson Correlations between Variables Included in the Multilevel Analyses (N = 87-233).

	(M (*SD*))		S0	Q0	N0	L0	S1	Q1	N1	S2	Q2	N2	L2	S3	Q3	N3	L3	CFC	FSC	ND1	ND2	ND3
Variable	Intv	Ctrl																				
T0 SID (S0)	2.63 (0.68)	2.58 (0.73)																				
T0 QID (Q0)	3.40 (0.61)	3.41 (0.62)	-.25**																			
T0 NSID (N0)	3.46 (0.65)	3.52 (0.66)	-.40**	.62**																		
IDLoss (L0)	2.13 (0.86)	2.24 (0.94)	.61**	-.26**	-.35**																	
T1 SID (S1)	2.57 (0.82)		.61**	-.30**	-.36**	.44**																
T1 QID (Q1)	3.59 (0.89)		-.33**	.54**	.63**	-.26*	-.55**															
T1 NSID (N1)	3.45 (0.81)		-.29**	.53**	.66**	-.29**	-.54**	.81**														
T2 SID (S2)	2.35 (0.69)	2.41 (0.69)	.65**	-.30**	-.47**	.50**	.54**	-.39**	-.52**													
T2 QID (Q2)	3.42 (0.75)	3.40 (0.64)	-.23**	.58**	.60**	-.19*	-.38**	.59**	.58**	-.34**												
T2 NSID (N2)	3.43 (0.74)	3.39 (0.74)	-.33**	.58**	.61**	-.21**	-.45**	.63**	.65**	-.47**	.79**											
T2 IDLoss (L2)	2.06 (0.87)	2.17 (0.84)	.48**	-.30**	-.33**	.63**	.45**	-.42**	-.50*	.63**	-.27**	-.35**										
T3 SID (S3)	2.29 (0.73)	2.29 (0.83)	.59**	-.32**	-.46**	.55**	.50**	-.40**	-.44**	.78**	-.38**	-.48**	.68**									
T3 QID (Q3)	3.47 (0.74)	3.42 (0.63)	-.21**	.55**	.58**	-.19*	-.36**	.70**	.62**	-.40**	.90**	.80**	-.30**	-.42**								

Descriptive Statistics of Outcomes at Baseline, Post-Intervention and at Follow-Ups per Experimental Condition and Pearson Correlations between Variables Included in the Multilevel Analyses (N = 87-233). (*continued*)

	(M (*SD*))		S0	Q0	N0	L0	S1	Q1	N1	S2	Q2	N2	L2	S3	Q3	N3	L3	CFC	FSC	ND1	ND2	ND3
T3 NSID (N3)	3.59 (0.74)	3.55 (0.80)	-.37**	.50**	.62**	-.29**	-.33**	.56**	.57**	-.52**	.67**	.77**	-.42**	-.61**	.77**							
T3 IDLoss (L3)	1.97 (0.77)	2.10 (0.95)	.49**	-.26**	-.36**	.64**	.32*	-.20	-.28*	.59**	-.31**	-.41**	.77**	.74**	-.31**	-.48**						
CFC[a]			-.18**	.18**	.19**	-.24**	-.11	.11	.19	-.23**	.12	.09	-.17*	-.19*	.07	.15	.14					
FSC[a]			-.13**	.14*	.13*	-.17**	.06	.05	.09	-.07	.06	.13	-.09	-.09	.06	.14	-.09	.18**				
T0 ND (ND1)			.28**	-.03	-.09	.30**	.19	-.11	-.13	.27**	-.03	-.09	.31**	.20*	-.07	-.15	.29**	-.01	-.08			
T2 ND (ND2)			.24**	-.05	-.05	.40**	.25	-.17	-.24	.32**	-.06	-.11	.42**	.27**	-.13	-.16	.36**	.01	-.04	-90**		
T3 ND (ND3)			.15	.02	.00	.34**	.19	-.09	-.20	.22*	-.02	.02	.33**	.25**	-.04	-.09	.35**	.05	.05	.83**	.91**	
SEP[ab]			-.10	.00	.03	-.10	-.16	.25*	.28**	-.07	.03	-.03	-.09	-.11	.07	-.01	-.11	.09	-.01	.13	.13	.13

Note. Intv = intervention condition, Ctrl = control condition, SID = smoker self-identity, QID = quitter self-identity, NSID = nonsmoker self-identity, IDLoss = expected identity loss when quitting, CFC = consideration of future consequences, FSC = future-self clarity, SEP = socioeconomic position. Empty fields = not applicable for that measurement.

a. Assessed only at baseline. b. Spearman's correlations were used for correlations involving SEP.

* p < .05 (two-tailed), ** p < .01 (two-tailed).

Descriptive Statistics of Outcomes at Baseline, Post-Intervention and at Follow-Ups per Experimental Condition and Pearson Correlations between Variables Included in the Multilevel Analyses (N = 87-233).

Supplement 4

Overview of Best Fitted Multilevel Model for Each Combination of Outcome and Moderator using Multiple Dataset Imputations and without Non-Intenders and Non-Compliers (N = 205-233).

Parameters	*Multiple data imputations (n =233)*				*Non-intenders removed (n = 13)*				*Non-compliers removed (n = 28)*			
	Smoker self-identity	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***	***Smoker self-identity***	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***	***Smoker self-identity***	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***
	b (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)
Intercept	**2.68 (0.15)*** **	**3.44 (0.04)*** **	**3.68 (0.21)*** **	**2.55 (0.18)*** **	**2.40 (0.04)*** **	**3.49 (0.04)*** **	**4.12 (0.24)*** **	**2.10 (0.05)*** **	**2.43 (0.04)*** **	**3.45 (0.04)*** **	**3.52 (0.04)*** **	**2.12 (0.06)*** **
Time (linear)	**-4.14 (1.13)*** **		4.08 (2.59)	-2.05 (1.31)	**-4.24 (0.72)*** **		**9.64 (3.19)** **	**-1.93 (0.74)** **	**-4.18 (0.69)*** **	0.08 (0.57)	**1.72 (0.67)***	**-1.89 (0.77)***
Time (quadratic)	1.05 (0.67)		0.93 (0.69)	0.01 (0.79)	**1.65 (0.60)** **		1.09 (0.57)+	0.12 (0.69)	1.37 (0.56)*	0.18 (0.54)	1.31 (0.59)*	0.13 (0.71)
Condition	0.03 (0.09)		-0.53 (0.27)+	-0.10 (0.11)			**-7.88 (0.30)***					
Time x Condition	0.00 (0.001)		-0.00 (0.001)	-0.00 (0.001)			-0.00 (0.001)*					
SEP	-0.11 (0.06)+		-0.04 (0.09)	-0.17 – 0.07*			-0.14 (0.10)					
SEP x Time			-0.00 (0.001)				0.00 (0.001)					
SEP x Condition			0.23 (0.12)*				**0.34 (0.13)** **					
Time x Condition x SEP							-0.00 (0.001)*					
Intercept	**2.24 (0.08)*** **	**3.44 (0.04)*** **	**3.50 (0.04)*** **	**1.88 (0.09)*** **	**2.20 (0.08)*** **	**3.49 (0.04)*** **	**3.57 (0.04)*** **	**1.86 (0.10)*** **	**2.28 (0.08)*** **	**3.45 (0.04)*** **	**3.52 (0.04)*** **	**1.89 (0.10)*** **
Time (linear)	**-3.52 (1.12)*** **			-1.13 (1.30)	-1.63 (1.05)		**1.84 (0.65)** **	0.05 (1.13)	-2.15 (1.12)+	0.08 (0.57)	**1.72 (0.67)***	0.21 (1.23)
Time (quadratic)	0.92 (0.66)			0.01 (0.79)	**1.46 (0.53)** **		1.11 (0.57)+	-0.52 (0.68)	**1.24 (0.48)***	0.18 (0.54)	1.31 (0.59)*	-0.56 (0.68)

Overview of Best Fitted Multilevel Model for Each Combination of Outcome and Moderator using Multiple Dataset Imputations and without Non-Intenders and Non-Compliers (N = 205-233). (*continued*)

Parameters	*Multiple data imputations (n =233)*				*Non-intenders removed (n = 13)*				*Non-compliers removed (n = 28)*			
	Smoker self-identity	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***	***Smoker self-identity***	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***	***Smoker self-identity***	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***
	b (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)
Condition	0.02 (0.08)			-0.11 (0.10)	0.07 (0.08)			-0.12 (0.11)	0.00 (0.09)			-0.15 (0.12)
Time x Condition	0.00 (0.001)			-0.00 (0.001)	0.00 (0.001)			-0.00 (0.001)	0.00 (0.001)			-0.00 (0.001)
ND	**0.07 (0.02)*** **			**0.11 (0.02)*** **	**0.08 (0.02)*** **			**0.11 (0.02)*** **	**0.07 (0.02)*** **			**0.12 (0.02)*** **
ND x Time												
ND x Condition												
Time x Condition x ND												
Intercept	**3.30 (0.26)*** **	**2.81 (0.24)*** **	**2.81 (0.26)*** **	**3.27 (0.31)*** **	3.04 (0.29)***	**3.15 (0.28)*** **	**2.97 (0.28)*** **	**3.14 (0.37)*** **	**3.25 (0.31)*** **	**2.45 (0.43)*** **	**2.83 (0.30)*** **	**3.27 (0.38)*** **
Time (linear)	**-4.14 (1.13)*** **	-0.07 (1.03)	1.80 (1.13)	-2.05 (1.31)	**-3.91 (1.06)*** **	8.69 (3.56)*	1.79 (0.94)+	-1.15 (1.14)	**-3.78 (1.12)*** **	0.10 (5.70)+	2.00 (1.08)+	-0.97 (1.32)
Time (quadratic)	1.05 (0.67)	0.09 (0.67)	0.93 (0.69)	0.21 (0.81)	1.61 (0.56)**	0.09 (0.55)	1.09 (0.56)+	0.09 (0.68)	1.35 (0.56)*	0.13 (0.54)	1.29 (0.59)*	0.11 (0.69)
Condition	0.03 (0.09)	0.08 (0.08)	-0.02 (0.08)	-0.09 (0.11)	0.04 (0.09)	0.06 (0.08)	-0.03 (0.08)	-0.12 (0.11)	-0.03 (0.09)	1.25 (0.57)*	-0.02 (0.09)	-0.18 (0.12)
Time x Condition	0.00 (0.001)	0.00 (0.001)	0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)	0.00 (0.001)	0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)
CFC	**-0.27 (0.08)*** **	0.18 (0.07)*	**0.22 (0.08)** **	**-0.34 (0.09)*** **	**-0.20 (0.09)***	0.17 (0.08)+	-0.18 (0.08)*	**-0.30 (0.11)** **	**-0.24 (0.09)** **	**-0.37 (0.12)** **	0.21 (0.09)*	**-0.33 (0.11)** **
CFC x Time						-0.00 (0.001)*				-0.00 (0.00)+		
CFC x Condition										-0.36 (0.17)*		

Overview of Best Fitted Multilevel Model for Each Combination of Outcome and Moderator using Multiple Dataset Imputations and without Non-Intenders and Non-Compliers (N = 205-233). (*continued*)

Parameters	*Multiple data imputations (n =233)*				*Non-intenders removed (n = 13)*				*Non-compliers removed (n = 28)*			
	Smoker self-identity	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***	***Smoker self-identity***	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***	***Smoker self-identity***	***Quitter self-identity***	***Nonsmoker self-identity***	***Identity loss***
	b (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)	*b* (*se*)
Time x Condition x CFC										-0.00 (0.001)		
Intercept	**2.90 (0.20)*** **	**2.88 (0.19)*** **	**2.85 (0.20)*** **	**2.55 (0.18)*** **	**2.92 (0.20)*** **	**2.91 (0.19)*** **	**2.94 (0.20)*** **	**2.62 (0.20)*** **	**2.80 (0.16)*** **	**2.82 (0.20)*** **	**2.81 (0.21)*** **	**2.75 (0.20)*** **
Time (linear)	**-4.14 (1.13)*** **	-0.07 (1.03)	1.80 (1.13)	-2.05 (1.31)	**-3.91 (1.06)*** **	-0.63 (0.82)	3.07 (2.41)	-1.11 (1.14)	**-3.75 (1.12)** **	0.49 (2.07)	1.57 (2.49)	-0.91 (1.29)
Time (quadratic)	1.05 (0.67)	0.09 (0.67)	0.93 (0.69)	0.21 (0.81)	**1.62 (0.56)** **	0.07 (0.55)	1.08 (0.57)+	0.09 (0.68)	1.35 (0.57)*	0.11 (0.54)	1.27 (0.59)*	0.12 (0.71)
Condition	-0.52 (0.27)	**0.72 (0.25)** **	**0.72 (0.27)** **	-0.10 (0.11)	-0.54 (0.29)+	0.54 (0.27)*	0.60 (0.28)*	-0.13 (0.11)	-0.05 (0.09)	0.69 (0.29)*	**0.79 (0.30)** **	-0.21 (0.12)+
Time x Condition	0.00 (0.001)	0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)	0.00 (0.001)	0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)	0.00 (0.001)	-0.00 (0.001)	-0.00 (0.001)
FSC	**-0.17 (0.07)** **	**0.19 (0.06)** **	**0.24 (0.06)*** **	-0.13 (0.06)*	**-0.19 (0.07)** **	**0.18 (0.06)** **	**0.24 (0.07)*** **	**-0.16 (0.06)***	-0.12 (0.05)*	**0.21 (0.07)** **	**0.25 (0.07)*** **	**-0.19 (0.07)** **
FSC x Time					0.20 (0.10)*	-0.16 (0.09)+	-0.00 (0.001)			-0.00 (0.001)	0.00 (0.001)	
FSC x Condition	0.19 (0.09)*	**-0.23 (0.08)** **	**-0.26 (0.09)** **				-0.22 (0.09)*			-0.22 (0.10)*	**-0.29 (0.10)** **	
Time x Condition x FSC												

Notes. Bold-face indicates significant associations after Bonferroni correction. Dependent variables are listed under model description. Time: 1 = baseline, 2 = post-intervention, 3 = one-month follow-up, 4 = three-months follow-up. Condition: 0 = control, 1 = intervention. Socioeconomic position (SEP), Nicotine dependence (ND), Consideration of future consequences (CFC), Future-self clarity (FSC): 1 = low, 2 = middle/average, 3 = high. Empty fields = not applicable, variable was not included in the model.

$^{+}$ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.