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It's not what you say, but how you say it

The effectiveness of message frame-tailoring in online computer-tailored health communication

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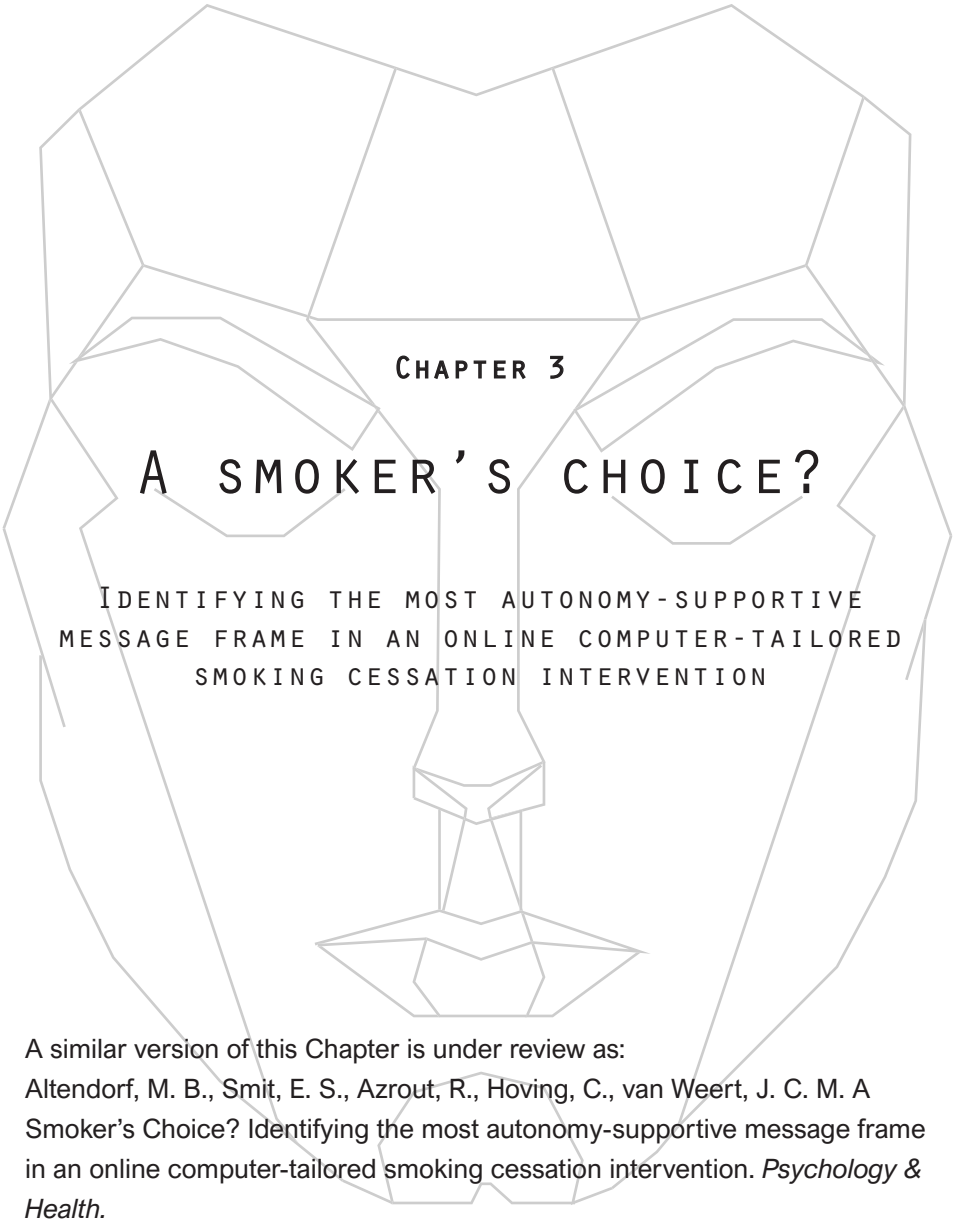

Chapter 3

A smoker's choice?

Identifying the most autonomy-supportive message frame in an online computer-tailored smoking cessation intervention

A similar version of this Chapter is under review as:
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Abstract

In this study, we aimed to test the effect of autonomy-supportive message framing on people's perceived autonomy-support while considering the individual need for autonomy as a moderator. Moreover, we aimed to test whether autonomy-supportive message frames – through increased perceived autonomy-support - lead to more self-determined motivation, and increased intention to quit smoking. We conducted an online 2 (autonomy-supportive; controlling language) x 2 (choice; no choice) between-subjects design with control condition (generic advice) among adult smokers intending to quit (N = 626). Structural equation modelling revealed no significant effect of autonomy-supportive-message frames on perceived autonomy-support or self-determined motivation, neither did the need for autonomy moderate these effects. Self-determined motivation had a positive, significant effect on intention to quit, mediated by attitudes, social influence, and self-efficacy. Although message frames did not affect perceived autonomy-support or self-determined motivation, higher self-determined motivation increased intention to quit via attitudes, social influence, and self-efficacy. Before drawing the conclusion that message framing has no effect, we recommend replicating this study in a real-life setting with smokers more likely to read and process the message frames more attentively.

Introduction

Smoking tobacco remains the leading preventable cause of ill-health and premature death worldwide (Bergh, Harteloh, & Croes, 2017; World Health Organisation, 2018). There is a critical need to support smokers to successfully quit smoking. Alongside effective face-to-face behavioural therapies for smoking cessation, such as therapist advice, the Internet provides behaviour change interventions that have the potential to be cost-effective, because of the Internet's great reach and low costs (Taylor et al., 2017). Previous research has shown that smokers can especially benefit from online computer-tailored (CT) health communication interventions (Etter & Perneger, 2001; Lustria et al., 2013; Smit, De Vries, & Hoving, 2012). Online CT interventions customise the provided information to a person's specific characteristics by means of computer software and therefore provide relevant information only, which increases message processing and the likelihood for behaviour change (De Vries & Brug, 1999; Hawkins et al., 2008; Kreuter & Wray, 2003; Noar, Harrington, & Aldrich, 2009). However, Lustria et al. (2013) conclude in their meta-analysis that effect sizes of online CT health interventions remain small.

Previous research found that people might process health messages better and are ultimately motivated to perform advocated behaviours when the way a message is presented or *framed* is adapted to preferred communication styles (Legault, 2016; Resnicow et al., 2008, 2014; Smit, Linn, & van Weert, 2015). It is known that individual differences exist in people's desire to regulate their behaviour themselves (Deci & Ryan, 1985b; 2000; Ryan & Deci, 2000; Legault, 2016). That is, while some people with a self-determined motivational orientation or high *need for autonomy,* choose their way of how to obtain a certain goal, such as to quit smoking, themselves, others have a lower need for autonomy and rather prefer to hear from an expert how to best to quit smoking (Gagné & Deci, 2005; Hagger & Chatzisarantis, 2011). The need for autonomy is a person's inherent desire to perceive freedom in actions and to have control over own behaviour (Ryan & Deci, 2000). Thus, the need for autonomy seems to determine people's preference for a communication style in health (i.e., autonomy-supportive style or not). For instance, Resnicow et al. (2008, 2014) found that the need for autonomy moderated effects of fruit and vegetable intake promotion messages and cancer screening promotion

messages. That is, people with a preference for an *autonomy-supportive communication* style who received leaflets framed autonomy-supportively had higher intake of fruit and vegetables or cancer screening rates than those with an autonomous preference who received leaflets written in a controlling language style. Thus, people with a higher need for autonomy may develop a self-determined motivation and a strong intention to substantially change their health behaviour (e.g., to quit smoking), only when feeling supported in their autonomy (i.e., perceive autonomy-support by means of autonomy-supportively framed messages) (e.g., Deci & Ryan, 1985b; Ryan & Deci, 2000; Williams, Cox, Kouides, & Deci, 1999; Williams, Gagné, Ryan, & Deci, 2002). Evidence from other offline health (care) contexts (i.e., interpersonal communication) has shown that the need for autonomy can be satisfied through *autonomy-supportive message framing* (Ng, Ntoumanis, Thogersen-Ntoumani, et al., 2012). That is, providing choice and using non-pressuring or autonomy-supportive language (e.g., using "you could" and "you may"), as opposed to controlling language style (e.g., directive and pressuring tone of voice and using "must", "should" and no provision of choice) (Deci & Ryan, 2000; Ryan & Deci 2000; Markland, Ryan, Tobin, & Rollnick, 2005; Su & Reeve, 2011; Williams et al., 1999). Previous studies found effects of autonomy-supportive messages and environments on perceived autonomy-support, motivation and behavioural performance. To illustrate, Williams et al. (1999) found that adolescents experienced physician-delivered appeals as autonomy-supportive when the appeals emphasised the adolescent's decision making power of whether to start or quit smoking, or not. Appeals that were in fact perceived as autonomy-supportive subsequently affected participants self-determined motivation to refrain from smoking. As another illustration, Moustaka and colleagues (2012) found that, among women, an autonomy-supportive exercise instructor (e.g., offering opportunities for choice and delivering a meaningful rational for exercises) led to significantly more perceived autonomy-support, self-determined motivation to exercise, and also more frequent exercise behaviour than a controlling exercise instruction style. In sum, there is evidence that (offline) interpersonal autonomy-supportive messages can be effective in terms of generating perceived autonomy-support. Online CT health interventions could also be more effective when the

way a message is presented or *framed* is adapted in an autonomy-supportive manner according to someone's preferred communication style with regards to the need for autonomy (Resnicow et al., 2008, 2014; Smit et al., 2015).

As far as we know, it has not been investigated yet whether autonomy-supportive message framing can increase people's perceptions of autonomy-support in an online (CT) smoking cessation context. It is also unknown which message frame element (choice or autonomy-supportive language or their combination) reflects the effective ingredient resulting in such increased perceived autonomy-support and whether a combined effect of the message frame elements is the most effective[1]. Therefore, we aim to test the effect of autonomy-supportive message framing on people's perceived autonomy-support while considering the individual need for autonomy as a potential moderator of effects in an online CT smoking cessation intervention.

Intervention content and message framing: from autonomy-support to intention

According to self-determination theory (SDT; Ryan & Deci, 2000), self-determined motivation mostly comes from own values or interests, but can also come from activities that align with own values (e.g., to quit smoking, because it is personally valued and important for self-satisfaction). The satisfaction of the need for autonomy is essential in the development of self-determined motivation (Ryan & Deci, 2000). Research has consistently revealed a significant positive effect of self-determined motivation on positive affect and improved well-being (Deci & Ryan, 2000), as well as on the implementation of desired health behaviours, such as smoking cessation (i.e., Ng et al., 2012; Williams et al., 2006; Williams, Gagné, Ryan, & Deci, 2002). In this sense, intentions are more likely to be translated into actions when the motivation to perform the target behaviour is self-determined (Hagger & Chatzisarantis, 2009).

The content of many effective online (CT) health interventions, such as the smoking cessation intervention used for the present study (Smit, Candel, Hoving, & De Vries, 2016), is often based on reflective health behaviour change theories, such as the Theory of Planned Behaviour (TPB; Ajzen, 1991) and the

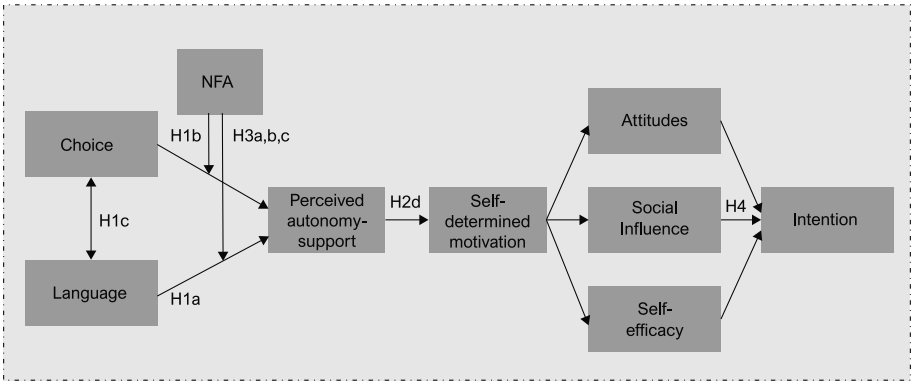
1 Known as synergy effect from the multimedia communication literature, when the combination of activities "exceeds the sum of their individual effects" (Naik & Raman, 2003).

I-Change Model (De Vries, Mudde, Leijs, et al., 2003b). In these theories of planned behaviour, the most proximal predictor of behaviour, such as smoking cessation, is a person's intention to perform this behaviour, in this case, to quit smoking. Furthermore, intention is most often assumed to mediate the effect of three belief-based perceptions concerning the target behaviour on the behaviour, namely: attitudes, social influence (e.g., subjective norms), and self-efficacy. When based on theories of planned behaviour, interventions usually offer feedback, tips and tricks relating to those perceptions to strengthen attitudes (i.e., a person's overall evaluation of whether the performance of smoking cessation, will lead to desirable outcomes), social influence (i.e., an individual's expectation of whether significant others would approve of him or her quitting smoking), and self-efficacy (i.e., one's relative perceived difficulty or ease of smoking cessation). While positive changes in these three beliefs are argued to lead to an increased intention to quit smoking, not every smoker who forms an intention to quit smoking will eventually quit (Sheeran & Webb, 2016). Previous research on intention suggest that intentions to perform a target behaviour will most likely get translated into actual behaviour when they are strong (Hagger & Chatzisarantis, 2009; Sheeran & Webb, 2016). The underlying mechanism is that by enhancing self-determined motivation, intentions are strengthened through the satisfaction of, for instance, the need for autonomy and a consequent perception of autonomy-support. This is, because self-determined beliefs about a target behaviour have been found to better predict intention than controlling beliefs that are based on, for example, social pressure (Joseph, Daniel, Thind, Benitez, & Pekmezi, 2016; Sheeran & Orbell, 2000). Moreover, in their meta- analysis, Hagger and Chatzisarantis (2009) provided evidence for the predictive power of self-determined motivation on intention via attitudes, subjective norms and self-efficacy. Thus, by integrating autonomy-supportive message framing in content-tailored interventions, SDT components are combined with constructs from theories of planned behaviour. Therefore, a potential way to increase online CT health intervention effectiveness, such as for smoking cessation, is to frame messages according to an individual's need for autonomy.

To the best of our knowledge, no study exists that has investigated whether satisfying the need for autonomy and enhancing perceived

autonomy-support and self-determined motivation by means of autonomy-supportive message framing in an online CT smoking cessation intervention has the potential to increase intention to quit smoking and subsequently may enhance the effectiveness of such interventions. Therefore, the present study aims to investigate whether autonomy-supportive message frames – through an increased sense of autonomy-support – lead to more self-determined motivation, and subsequently to an increased intention to quit smoking. Yet, based on SDT and evidence from previous studies, we expect that both autonomy-supportive message elements, i.e., providing choice and autonomy-supportive language use, lead to higher levels of perceived autonomy-support. Figure 1 depicts the hypothetical model, based on SDT and theories of planned behaviour.

Figure 1. Hypothetical model.



Note. Simplified version of the hypothetical model used in the present study. NFA = Need for autonomy.

The following hypotheses will be tested:

H1: The use of autonomy-supportive language (H1a) and the provision of choice (H1b) will lead to higher levels of perceived autonomy-support than the use of controlling language and no provision of choice. In addition, the combination of using autonomy-supportive language and the provision of choice will lead to higher levels of perceived autonomy-support than the use of autonomy-supportive language and the provision of choice alone (H1c).

H2: The use of autonomy-supportive language (H2a) and the provision of choice (H2b), and their combination even more so (H2c), will lead to higher levels of self-determined motivation than the use of controlling language and no provision of choice. This effect is mediated by perceived autonomy-support (H2d).
H3: The positive effect of autonomy-supportive language (H3a) and the provision of choice (H3b), as well as of their combination (H3c), on perceived autonomy-support is stronger for individuals with a high need for autonomy than for individuals with a low need for autonomy.
H4: Self-determined motivation leads to a higher intention to quit smoking through more positive attitudes, social influence, and self-efficacy (H4).

Materials and methods

Design

A 2 (autonomy-supportive language vs. controlling language) x 2 (providing choice vs. not providing choice) between-subjects design with a control condition (generic advice) was employed.

Intervention

The online CT smoking cessation programme was based on a previously developed effective and cost-effective intervention (Smit et al., 2012; Smit, Evers, De Vries, & Hoving, 2013) and grounded in the I-Change Model (De Vries et al., 2003b). The I-Change Model seeks to explain motivational and behavioural change and includes theoretical concepts from different socio-cognitive theories, such as the TPB (Ajzen, 1991). In the I-Change Model, it is assumed that a person's intention is regulated by motivation, attitudes, social influences, and self-efficacy beliefs. After respondents were asked to provide information on their intention to quit smoking, sociodemographic and medical status, their smoking behaviour and need for autonomy, they were invited to provide information on their attitudes towards smoking cessation. Then, respondents received tailored advice on the basis of their answers. Next, questions about social influence, and self-efficacy perceptions were asked which was followed by another piece of tailored advice. Subsequently, participants were invited to choose a "quit smoking date" within the next two

weeks. Then, respondents could choose situations in which they expected to have difficulties to refrain from smoking and also whether they wanted to formulate coping plans (to refrain from smoking) in those difficult situations. Later on, they received an overview of their self-formulated plans – in case they decided to make any. When the questionnaire was completed, all advice was combined into one overall smoking cessation advice, which could be saved, printed and emailed to the participant.

Recruitment and procedure

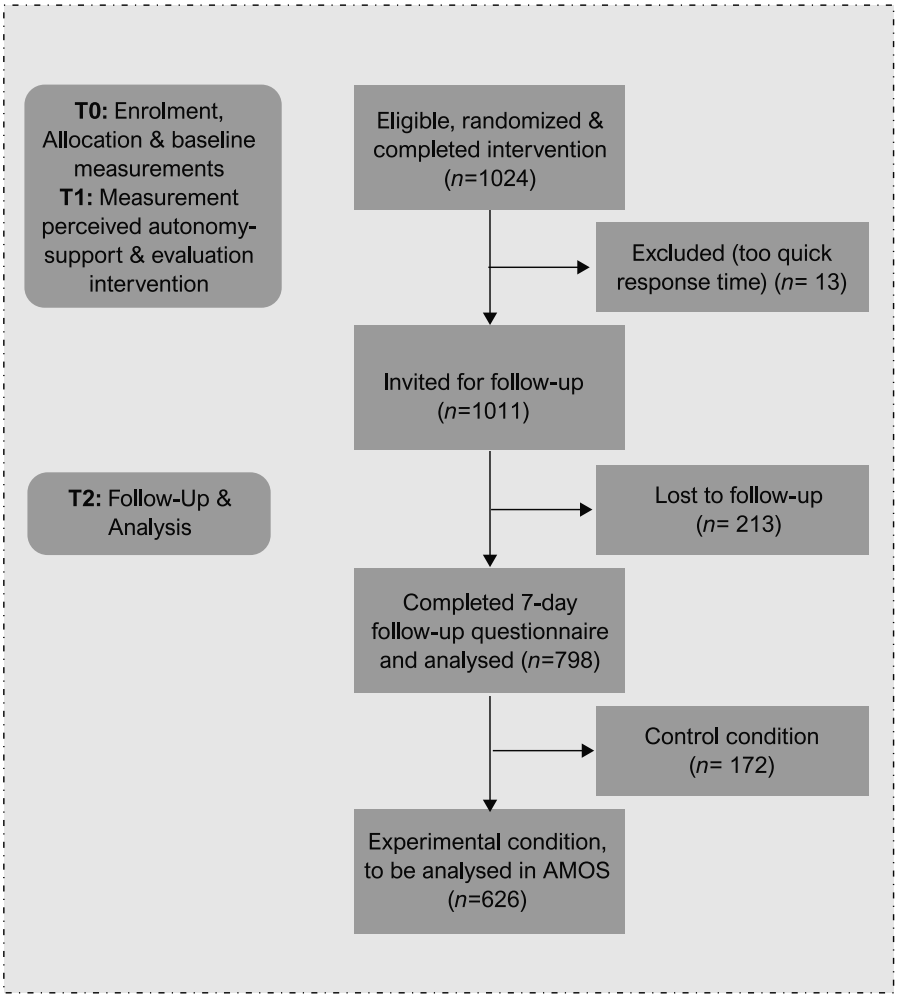
The study was approved by the Institutional Review Board (reference number 2017-PC-7599) and is registered with the Dutch Trial Register (NL6512 / NRT-6700). We recruited 1024 participants using an ISO-certificated online research panel, called PanelClix, from the end of February to mid-April 2018. Prior to their enrolment in the study, participants were provided with information about the study and were asked to give their online informed consent. Then (T0), respondents were automatically and at-random assigned to one of the five conditions by a computer software randomisation device. Seven days after respondents completed the baseline questionnaire, intervention, and intervention evaluation (T1), they were prompted via email by the same online research panel to fill out a brief follow-up questionnaire (T2). Participants' approximately 25-minute participation was rewarded by PanelClix with 200 Clix, which equals circa 2,50 euro. The participant flow throughout the study is illustrated in the flow chart below (Figure 2).

Inclusion and exclusion criteria. Participants eligible to participate in the study were 18 years or older, intended to quit smoking within the following six months, had access to the Internet, and provided online informed consent. In addition, participants had to have smoked during the last seven days and be sufficiently proficient in the Dutch language to complete the questionnaires and read the advice provided as part of the intervention.

Pilot

Two pilot studies were conducted. First, a sample of five smoking cessation feedback messages was pilot-tested among undergraduate communication science students (N = 18) from the local university. The objective of this first

Figure 2. Flow chart of participant progress.



pilot study was to examine whether participants were able to distinguish the autonomy-supportive from the controlling feedback messages, as rewritten based on the original intervention. Similarly, as in the study by Miller et al. (2007), students received a definition of autonomy-supportive and controlling language style and subsequently were asked to rate each feedback message as follows: *To what extent did you perceive the advice as autonomy-supportive or controlling?* on a five-point Likert scale from 1 (*strongly autonomy-supportive*) to 5 (*strongly controlling*). Students were also able to leave any comments

they wanted to make regarding these messages. Students who received autonomy-supportive messages also scored lower on the response scale (M = 2.46, SD =0.62, $p < 0.001$) than students who received controlling messages (M = 3.68, SD = 0.32). As students were well able to distinguish the autonomy-supportive from the controlling smoking cessation messages, we considered our language manipulation as successful and continued to manipulate the original intervention's feedback messages based on those five examples.

In a second pilot test, the five versions of the online intervention and assessment of our outcome measures were pilot tested among smokers from different socio-demographic backgrounds (N = 11) and experts from the fields of smoking cessation, internet interventions, and health communication (N = 5). Every version of the intervention was tested by one expert and at least two smokers. This second pilot study aimed to investigate the face validity of the instructions and questionnaire items (questions and response categories) as well as the lay-out and length of the intervention, in order to avoid falsified answers, misinterpretations, and missing responses by respondents. Also, we wanted to test whether the stimulus material was perceived as intended (i.e., whether the language and choice manipulation were clear and distinguishable). Pilot-test participants wished for more instructions in the questions of the intervention, so we added brief explanations to some questions to better guide participants through the intervention. Moreover, most pilot-test participants perceived the introduction of the intervention as too long. Therefore, the research team decided to shorten the introduction to a brief welcome, followed by participant information, and brief instructions on how to fill in the questionnaire. In addition, most participants had difficulties understanding the measure for the need for autonomy, as well as the manipulation measurement. Thus, we adapted the need for autonomy and manipulation measurements to make them better understandable (i.e., took out double negatives). The majority of participants perceived the experimental stimuli as intended, thus no adaptions were made in message frames.

Experimental stimuli

In four conditions, the message frame of the intervention was manipulated while keeping the content of the smoking cessation advice similar. In the

control condition, the message frame was not manipulated (i.e., stayed neutral as in the original smoking cessation intervention) and no content-tailoring was used.

Language. In the *autonomy-supportive condition*, all smoking cessation advice was manipulated by encouraging respondents to accept more responsibility for their own behaviour, by taking the message recipient's perspective into account through reflective feedback, and by using language which minimised pressure (Deci, Eghrari, Patrick, & Leone, 1994; Markland et al., 2005; Resnicow et al., 2008, 2014; Williams et al., 1999). In the *controlling language* condition, smoking cessation messages were manipulated by using directive and forceful sentences with imperatives and commands. Furthermore, controlling messages often stated the message source to be perceived as more authoritative. Positive filling terms were avoided where possible. For an example of the smoking cessation advice in autonomy-supportive and controlling language, see Table 1. To assess the validity of our language manipulation, we used three items asking to which degree respondents perceived the tone of the advice as controlling or autonomy-supportive, e.g., "The advice was formulated in a pressuring tone" (1 = *strongly disagree*; 5 = *strongly agree*). A lower value indicates a perception of choice. The three items could not form a reliable scale.

Choice. We operationalised the provision of choice as offering participants to choose for themselves whether they would like to receive additional information on smoking cessation seven times throughout the online assessment by responding to the question "Would you like to receive more tips about this topic?" (*yes* or *no*). Respondents could also choose to plan a quit date or not. Further, participants in the choice condition could choose whether and for which of nine potentially difficult situations they wanted to formulate coping plans, i.e., plans to cope with these situations in case they would occur (Smit, De Vries, & Hoving, 2010; Smit, Hoving, Schelleman-Offermans, West, & De Vries, 2014). These plans were expected to be personally relevant and helpful for participants in their smoking cessation attempt, as they were tailored to situations that were earlier indicated by participants as to be potentially difficult. In the *no choice* condition, participants were not asked whether they wanted to see additional information, or whether

they wanted to plan a quit date, but received additional smoking cessation information tailored to their earlier responses and a random quit date within the next two weeks. Furthermore, participants in the no choice condition were instructed to formulate coping plans for all nine situations that were presented by the intervention as situations in which it could be difficult to refrain from smoking. Three items examined the validity of our choice manipulation, by assessing whether respondents perceived a feeling of choice throughout the intervention, e.g., "In this programme, I could choose a quit smoking date myself" (1 = *strongly disagree*; 5 = *strongly agree*). A higher value indicates controlling language use. For the three choice manipulation items, a reliable scale could be formed (Cronbach's α= .83, *M* = 3.39, *SD* = 0.33). Respondents in the *no content-tailored control condition* were not offered any opportunity to receive or choose a quit smoking date or to make coping plans for smoking cessation, since formulating – and reading this plan as part of the tailored feedback – could be perceived as content-tailoring.

Measures

Background variables. At baseline (T0), demographic variables were measured: age, gender (1 = *male*, 2 = *female*), living arrangement (1 = *with partner*, 2 = *with partner and child(ren)*, 3 = *with child(ren)*, 4 = *by myself*, 5 = *other*), educational level (1 = *low: primary school/basic school,* 2 = *medium: secondary school/high school degree,* 3 = *high: high school/college degree/ university degree*), presence of respiratory or cardiovascular diseases (1 = *no,* 2 = *yes*). In case of female gender, we also assessed current pregnancy (1 = *no*, 2 = *yes*).

Outcome. Seven days post-intervention (T2) respondents' *intention* to quit smoking was measured based on the TPB, by measuring the respondent's intention, desire, and self-prediction to quit smoking (Armitage & Conner, 2001; Francis et al., 2004). Answers were given on a seven-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*), where a higher value indicates a higher intention to quit smoking. The scale had good reliability (Cronbach's α= .91, *M* = 4.75, *SD* = 0.14).

Mediators. Post-intervention (T1), *perceived autonomy-support* was measured with the Virtual Climate Care Questionnaire, which consists of 15

Table 1. Example of smoking cessation advice.

Condition	Autonomy-supportive language	Controlling language
No choice	Nice to hear that you wouldn't feel lonelier when you quit smoking. As other smokers, you are not sure whether you wouldn't feel sad. Many smokers think that smoking would help them against feelings of loneliness, anger, and sadness. Often, people feel bored and don't feel like doing anything when being sad. What could you do when you feel sad or lonely? We would like to offer you some tips. You could watch TV, read a book, call (a) friend(s), go outside or repair something. You could as well plan something nice, such as going to the cinema or the spa. Maybe it would help you to talk about your feelings with someone or write them down. Further, you may try to not think about the fact that you miss smoking. Maybe you like to distract yourself and think about the nice things in life, so the negative thoughts and feelings will fade away.	You don't think that you wouldn't feel lonelier when you quit smoking. However, you are not sure whether you wouldn't feel sad. According to experts, many smokers think that smoking would help them against feelings of loneliness, anger, and sadness. Experts say that many people feel bored and don't feel like doing anything when being sad. This is why you must watch TV, read a book, call (a) friend(s), go outside or repair something. You must look for distraction when feeling sad or lonely and plan something nice, such as going to the cinema or the spa. Also, you must share your feelings with someone or write them down. Don't think about it that you miss smoking. You have to think of the nice things in life, then the negative things will fade away.
Choice	Nice to hear that you wouldn't feel lonelier when you quit smoking. As other smokers, you are not sure whether you wouldn't feel sad. Many smokers think that smoking would help them against feelings of loneliness, anger, and sadness. Often, people feel bored and don't feel like doing anything when being sad. Below, you can choose whether you would like to receive some tips over how to prevent yourself from negative thoughts and feelings. Choice question: Do you want to receive these tips? Answered "yes": What could you do when you feel sad or lonely? We would like to offer you some tips. You could watch TV, read a book, call (a) friend(s), go outside or repair something. You could as well plan something nice, such as going to the cinema or the spa. Maybe it would help you to talk about your feelings with someone or write them down. Further, you may try to not think about the fact that you miss smoking. Maybe you like to distract yourself and think about the nice things, in life, so the negative thoughts and feelings will fade away.	You don't think that you wouldn't feel lonelier when you quit smoking. However, you are not sure whether you wouldn't feel sad. According to experts, many smokers think that smoking would help them against feelings of loneliness, anger, and sadness. Experts say that many people feel bored and don't feel like doing anything when being sad. Below, you can choose whether you would like to receive some tips over how to prevent yourself from negative thoughts and feelings. Choice question: Do you want to receive these tips? Answered "yes": You must watch TV, read a book, call (a) friend(s), go outside or repair something. You must look for distraction when feeling sad or lonely and plan something nice, such as going to the cinema or the spa. Also, you must share your feelings with someone or write them down. Don't think about it that you miss smoking. You have to think of the nice things in life, then the negative things will fade away.

Note. If respondents answered "no" to the choice question, the intervention continued without the provision of the tips.

items that can be answered on a seven-point Likert scale 1 (*strongly agree)* to 5 *(strongly disagree*) and a lower value indicates low perceived autonomy-support (VCCQ; Smit et al., 2017). The VCCQ scale had good reliability (Cronbach's α = .97, *M* = 3.46, *SD* = 0.15).

After seven days (T2), *self-determined motivation* to quit smoking was measured with the Treatment Self-Regulation Questionnaire (TSRQ; Levesque et al., 2007). The TSRQ has been validated for smoking cessation and was translated from English to Dutch. The TSRQ assesses the degree of self-determined motivation people hold with regards to their engagement in a health behaviour and was answered on a seven-point Likert scale ranging from 1 (*not true at all*) to 7 (*very true*), where high values indicate autonomous motivation. The TSRQ sub-scales had good reliability (Cronbach's $\alpha_{\text{self-determined}}$= .89, *M* = 3.87, *SD* = 0.15).

Also at T2, the concepts of attitude, social influence, self-efficacy, and intention to quit smoking were assessed. Eleven items derived from the I-Change model measured *attitude* towards smoking cessation on three dimensions (i.e., disadvantages of smoking cessation, physical and cognitive advantages of smoking cessation) and were answered on a five-point Likert scale ranging from 1 (*no, does not*) to 5 (*yes, does a lot*), with higher items indicating a positive attitude towards smoking cessation (and a negative attitude towards smoking cessation for items measuring disadvantages of smoking cessation, respectively). All sub-scales appeared to have acceptable reliability (Cronbach's $\alpha_{\text{disadvantages}}$= .76, *M* = 2.27, *SD*= 0.59; Cronbach's α_{physical}= .77, M = 4.05, SD = 0; Cronbach's $\alpha_{\text{cognitive}}$= .74, *M* = 3.25, *SD* = 0.48).

Social influence was assessed based on the I-Change Model, measuring the concepts of social support (three items) and social norms (three items), which take into account a respondent's partner, children, and family and were formulated as statements to which respondents could answer within five response categories ranging from 1 (*no support to quit smoking*) to 5 (*a lot of support to quit smoking*) (De Vries et al., 2003a; Smit, De Vries, et al., 2012). We recoded the social support scale, as we considered respondents who answered '9 = not applicable' as people who did not receive social support (Hoving, Mudde, & De Vries, 2006). The sub-scales for social support and social norms had acceptable to good reliability (Cronbach's $\alpha_{\text{social norms}}$ = .71,

M = 2.19, *SD* = .05; Cronbach's $\alpha_{\text{social support}}$ = .57, *M* = 3.20, *SD* = .08).

Self-efficacy was measured according to the I-Change Model by nine items, which were answered on a five-point Likert scale from 1 (*strongly disagree)* to 5 (*strongly agree*) and people with a lower value having a low self-efficacy perception. The scale had good reliability with Cronbach's alpha = .90 (*M* = 3.27, *SD* = .18). The scale measured respondents' stress-, routine-, and skill perceptions to refrain from smoking (e.g., *Do you think you can refrain from smoking after dinner?*).

Moderator. At T0, *need for autonomy* was measured with the Health Causality Orientations Scale (HCOS). The HCOS is a novel scale, which is based on the General Causality Orientations Scale (Deci & Ryan, 1985b). Responses were given on a five-point Likert scale from 1 (*very unlikely*) to 5 (*very likely*) and participants scoring high on the response scale having a higher need for autonomy. Participants received four different vignettes for which they had to indicate the likelihood of responding in three different ways (each reflecting a different type of orientation, i.e., self-determined, and controlled orientation towards experts, and towards family and friends). For instance, one of the vignettes read *Imagine you would have to get motivated to quit smoking. How likely would it be that you would: (A) motivate yourself* (self-determined orientation), *(B) ask an expert to motivate you* (controlled orientation experts)*, (C) ask family and friends to motivate you* (controlled orientation family and friends). Mean scores of the four responses reflecting a self-determined orientation resulted in a reliable scale (Cronbach's α= .76, *M* = 3.95, *SD* = 0.13)[2]. Full descriptions of scales including item-wording and factor loadings are provided in appendix A2.

Statistical analysis

First, descriptive analyses were conducted to determine sample characteristics. Second, two-sided t-tests and chi-square tests and analysis of variance (ANOVA) were conducted where appropriate to check for differences in background variables and smoking related behaviours between the intervention and

2 We also measured controlled orientation with eight items from the HCOS, which are for conciseness reasons not further described above. Items that reflected a controlled orientation combined into in scales with good reliability both for experts (Cronbach's α= .86, M = 2.69, SD = 1.05) and for family and friends (α= .89, M = 2.63, SD = 1.04), and correlations of controlled items with autonomous items were – as expected – in a different direction than self-determined items.

control groups. Also, ANOVAs were conducted to assess differences between our conditions and perceived autonomy-support, to assess whether our manipulation worked as intended. In addition, we conducted a non-response analysis to determine whether selective dropout had occurred by comparing those who completed the questionnaire at T2 with those lost to follow-up at T2 with regard to the same set of variables, with two-sided t-tests and chi-square tests. These analyses were all done using the statistical computer software program IBM SPSS version 25.

The full hypothesised model was tested with Structural Equation Modelling (SEM) in IBM AMOS version 25. SEM is better suited to conduct moderated mediation analysis of more complex regression models compared to conventional multiple regression, as SEM tests the overall goodness-of-fit of the theoretical model, which moderated mediation analysis using multiple regression (e.g., in SPSS) is unable to do. Also, SEM captures changes and additional relationships in the model that may emerge between variables (Kline, 2011). Multiple linear regression would be more difficult to regress multiple mediating and moderating variables simultaneously, as hypothesised in our model. Another benefit of SEM is that it combines a structural model with a measurement model, which subsequently reduces measurement error (i.e., systematic and random), as it is not assumed that scales perfectly measure underlying concepts.

SEM analysis was conducted with data from 626 participants from the experimental conditions. Firstly, we assessed the measurement of our theoretical constructs using confirmatory factor analysis. Then, interaction terms were created to test a moderation of the need for autonomy on the effect of choice and language, and their combination, on perceived autonomy-support. As we used latent variables for the analysis, matched-pair products were created, according to Marsh, Wen, and Hau (2004). With this method, information from the same indicator is not repeated (Kline, 2011). This was done for clarity reasons, as creating latent interaction terms with all possible combinations of the indicators would have made the model too complex. Next, interaction terms were stepwise added to the measurement model. We added error covariances between moderator-items and their interaction terms. This was expected, as those items were constructed by multiplication with each other and had high correlations ($\geq .8$). Also, error-covariances were

added among items measuring social norms, as those items measured similar concepts. After establishing model fit with the measurement model, we built the structural regression model based on our hypotheses with direct paths from the exogenous variables (i.e., language, choice, their combination and the need for autonomy) to perceived autonomy-support (*H1a,b,c, H3a,b,c*) (Figure 3). Also, we added direct and indirect paths from all exogenous variables to self-determined motivation (*H2a,b,c,d*) (Figure 3). Furthermore, we added direct and indirect paths from self-determined motivation, attitudes, social influence, and self-efficacy to the intention to refrain from smoking *(H4)* (Figure 3).

As our hypothesised structural regression model is nested under the earlier predicted measurement model, we compared this model to the measurement model with a chi-square comparison test[3]. Succeeding to establish sufficient model fit for our hypothesised model, we interpreted the model structure. As our model is very complex, for clarity reasons we present the results only for the significant regression weights. The significance level was set at 5% and we report total unstandardised effects. An a-priori power analysis estimated that a sample size of a minimum of 738 participants should be sufficient to detect small effects and interaction effects (power level = .80, effect size f = 0.15).

Results

Sample characteristics and non-response analysis

Sample descriptives can be found in Table 2. Comparisons of the 798 participants who completed the study and the 213 participants who were lost-to-follow-up after seven days showed no significant differences in demographics, such as gender, age, educational level.

However, people who did not complete the follow-up measurement were significantly more often living alone (= 10.25; df = 4; p=036), had lower perceptions of perceived autonomy-support (t = -3.14, df = 1009, p = .002),

3 We acknowledge that there might be existing equivalent models, however, we argue that those models would not be plausible according to SDT and theories of planned behaviour. Also, our theoretical model has been previously tested and proven to be valid. For a meta-analysis, see Hagger and Chatzisarantis (2009). Furthermore, we conducted an experiment and therefore adaptions of causal paths from the experimental conditions were not possible. Thus, we did not compare our measurement model to equivalent models.

and had more positive attitudes towards smoking cessation (t = -2.20, df = 1009, p = .028). The analysis did not reveal significant differences in smoking related behaviours, such as number of cigarettes smoked per day or past quit attempts (Table 2). Attrition after seven days was unrelated to experimental condition.

Randomisation

Comparisons of participants' demographics, such as age and educational level, as well as their smoking behaviour did not show significant differences between the experimental conditions, expect from one item assessing addiction level. Thus, we deemed the randomisation successful.

Manipulation assessment

As expected, participants in the choice conditions perceived more choice (M = 3.71, SD = .97) than participants in the no choice condition (M = 2.98, SD = .88), $F(1)$ = 125,345, p < .001 as higher values indicate a perception of choice. Three items testing whether the tone of our messages was perceived as intended were analysed separately. Only two language manipulation items showed significant differences between participants who received smoking cessation advice in autonomy-supportive language (M = 2.85, SD = 1.08; M = 2.35, SD = 1.00) compared to controlling language (M = 3.12, SD = 1.07; M = 2.53, SD = 1.13), $F(1)$ = 12,706, p < .001 and $F(1)$ = 5,421, p = .020 respectively, while lower mean scores indicate autonomy-support. One item, namely *I feel understood by the smoking cessation advice* did not show significant differences among the autonomy-supportive and the controlling language condition (autonomy-supportive language condition: M = 3.48; SD = 1.01 compared to controlling language condition: M = 3.51; SD = .95).

Normality

We evaluated the assumptions of multivariate normality and linearity, and observed several outliers among endogenous variables (i.e., perceived autonomy-support, self-determined motivation, social norms, negative and positive attitudes towards smoking cessation). All outliers were checked, considered random and therefore not removed. There was no missing data among the endogenous variables and we chose to use maximum likelihood

Tabel 2. Comparison of participants who completed the study with those who dropped

	Participants at T2		Participants in experimental conditions[4]		Dropout	
	n	%	*n*	%	*N*	%
n	*798*		*626*		*213*	
Demographics						
Sex (females)	351	44	259	41.4	101	47.4
Age (years), M (SD)	49.2 (14.1)		49.3 (14.4)		48.2 (14.8)	
Educational level						
High	246	30.8	200	31.9	66	31
Middle	427	53.5	323	51.6	111	52.1
Low	124	15.5	102	16.3	33	15.5
Other/missing	1	0.1	1	0.2	3	1.4
Living arrangement						
With partner	282	35.3	221	35.3	63	29.6
With partner and child(ren)	228	28.6	174	27.8	48	22.5
With child(ren)	50	6.3	35	5.6	15	7
Alone	218	27.3	178	28.4	80	37.6
Other/missing	20	2.5	18	2.9	7	3.3
Number of daily smoked:						
Cigarettes, M (SD)	9.7 (9.1)		9.4 (9.1)		9.9 (8.9)	
Shags, M (SD)	5.7 (8.5)		5.9 (8.4)		5 (8.4)	
Cigars, M (SD)	0.3 (1.6)		0.3 (1.6)		0.4 (2.6)	
Cigarillos, M (SD)	0.3 (2.4)		0.3 (2)		0.2 (1.3)	
Pipes, M (SD)	0.1 (0.9)		0.1 (0.9)		0 (0.5)	
Earlier quit attempts						
Earlier quit attemps M (SD)	5.4 (40.1)		4.2 (21.9)		3.7 (5.8)	
Existence of (chronic) disease						
Heart disease	99	12.4	82	13.1	27	12.7
COPD	150	18.8	121	19.3	33	15.5
Diabetes	69	8.6	59	9.4	22	10.3
Cancer	66	8.3	54	8.6	17	8

Note. M=Mean; Standard deviations are presented in parentheses.

4 Only respondents who were considered for analysis without respondents randomized into the control condition.

parameter estimation with 200 bootstrap samples with the bootstrap factor set at 2, as one item from social influence was non-normally distributed (Kurtosis = 3.93; Skewness = 2.06). No multicollinearity existed.

Confirmatory factor analysis to establish the measurement model

We conducted a CFA with all factors relating to our theoretical model (i.e., autonomy-supportive language, offering choice, their combination, need for autonomy, perceived autonomy-support, self-determined motivation, attitude, social influence, self-efficacy, and intention). Our default measurement model appeared to have a poor model fit according to conventional goodness-of-fit indices (Byrne, 2016): $\chi^2_{df=1461}$ (3810,711), p <.001[5], CMIN/DF = 2,608, Comparative Fit Index (CFI) = .89; Root Mean Square Error of Approximation (RMSEA) = .051, 90% confidence interval (CI) [.049, .053]. The modification indices suggested several error correlations: one between items of perceived autonomy-support, one between items measuring self-determined motivation, one between items measuring social influence, and three between items measuring self-efficacy. Stepwise adding those six error-covariances led to significantly better model fit. Table 3 provides an overview of model fit indices without and with interactions. Standardised factor loadings (see appendix A2) were all near to or above .70 showing good convergent validity, except for four items measuring attitudes towards smoking cessation, two items measuring social support and one item from social norms, two items measuring self-efficacy, one item assessing self-determined motivation, and two items from need for autonomy, which loaded with lower values (range: 0.22 and 0.64) on scales. As those items also had lower residual covariances, we assumed random measurement error.

Table 3. Fit indices of the measurement model.

Models Fit indices	No interaction	Only 2-way interaction	All interactions
CMIN *(df)*	3 300,313 *(1455)****	4112,866 *(1893)****	4529,789 *(2128)****
CFI	.92	.94	.95
RMSEA [CI]	.045 [.043, .047]	.043 [.042, .045]	.042 [.041, .044]

Note. CMIN = Chi-square. Df = degrees of freedom. CFI = comparative fit index; RMSEA = root mean square error of approximation. CI = 90% Confidence interval. *** p < .001.

5 As our sample size exceeds 400 cases, the chi-square was expected to be statistically significant (http://davidakenny.net/cm/fit.htm).

Model Testing

Our hypothesised model without the interaction terms of the moderator had good fit with the data $\chi^2_{df=1507}$ (3562,635), p = .000, CMIN/DF = 2,364, CFI=.91, and RMSEA of .047, 90% CI [.045, .049]. When adding the 3-way interaction of the need for autonomy and the experimental conditions, the structural model still had good fit with the data $\chi^2_{df=2203}$ (4539,979), p < .001, CMIN/DF = 2,061 , CFI=.95, and RMSEA of .041, 90% CI [.039, .043]. The results from SEM analysis are depicted in the structural model in Figure 3.

Hypothesis testing

Effects of autonomy-supportive message frames on perceived autonomy-support and self- determined motivation. In hypothesis 1, we expected a positive effect from autonomy-supportive language use (*H1a*), the provision of choice (*H1b*), and their combination (*H1c*) on perceived autonomy-support. Neither the use of autonomy-supportive language, the provision of choice, nor their combination had a significant effect on perceived autonomy-support. Subsequently, we reject hypothesis 1. Next, in our second hypothesis, we assumed that the use of autonomy-supportive language (*H2a*) and the provision of choice (*H2b*), as well as their combination (*H2c*), would lead to higher levels of self-determined motivation and that those effects were mediated via perceived autonomy-support (*H2d*). There was no significant effect of autonomy-supportive language, the provision of choice, or their combination on self-determined motivation to quit smoking. Also, perceived autonomy-support did not significantly mediate the effects of autonomy-supportive language and the provision of choice on self-determined motivation. Thus, we also reject hypothesis 2. Mean values of perceived autonomy-support, which were rather on the higher end of the scale, are provided in Table 4.

Moderation of the need for autonomy. We expected that people with a high need for autonomy would perceive higher levels of autonomy-support when receiving smoking advice in autonomy-supportive language (*H3a*), when being offered with choice (*H3b*), and even more so with their combination (*H3c*), than people with a low need for autonomy. Results from the structural model with interaction terms showed no significant moderation of respondents' need for autonomy on effects of autonomy-supportive language use, the provision of

choice, nor their combination on perceived autonomy-support. Yet, the need for autonomy had a positive direct effect on perceived autonomy-support (b = .31, p = .005). Hypothesis 3 is rejected. Also, as depicted in Table 4, smokers' need for autonomy was rather high.

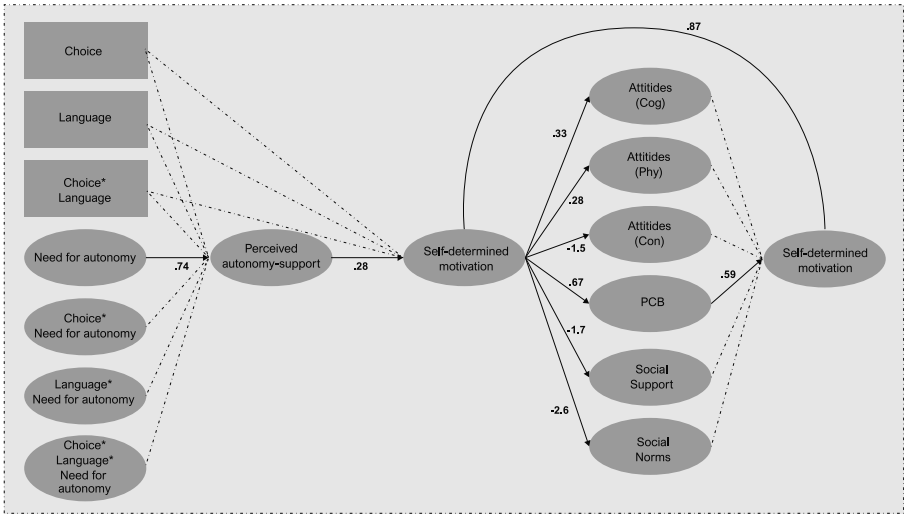
Table 4. Means of perceived autonomy-support and need for autonomy per experimental condition (N = 626).

Dependent variable	Perceived autonomy-support	Need for autonomy
Condition (N)	M (SD)	M (SD)
Autonomy-supportive language * choice (N = 167)	3.37 (.83)	3.95 (.83)
Autonomy-supportive language * no choice (N =160)	3.48 (.82)	3.92 (.74)
Controlling language * choice (N =147)	3.45 (.73)	3.89 (.73)
Controlling language * no choice (N =152)	3.54 (.74)	3.89 (.74)
Overall M (SD)	3.46 (.78)	3.87 (.76)

Note. N = Number of respondents. M= Mean. SD = Standard Deviation.

Effects from self-determined motivation to quit smoking on intention to quit. In hypothesis 4, we expected that self-determined motivation led to intention to quit smoking via self-efficacy, attitudes, and social influence. With our structural model, we could confirm a significant positive effect from self-determined motivation on intention to quit smoking (b = .86, p < .001), which was mediated by negative attitudes towards smoking cessation, subjective norms, and self-efficacy,. Moreover, self-efficacy had a weak positive direct effect on intention (b = .13, p = .002), whereas negative attitudes towards smoking cessation had a negative direct relationship with intention to quit smoking ($b_{\text{negative attitudes}}$ = -.29, p < .001) and receiving social support for smoking cessation enhanced intention to quit ($b_{\text{social suppor t}}$= .09, p = .012). Thus, we confirm hypothesis 4. An overview of the direct and indirect effects is provided in appendix A1.

Figure 3. Hypothesised structural model with significant paths.



Note. Results are presented as standardised total effects. For clarity, items of latent variables (ellipse) are not presented. Observed variables are presented as rectangles. Cog = cognitive advantages of smoking cessation. Phy = physical advantages of smoking cessation. Con = disadvantages of smoking cessation. Dotted lines represent non-significant paths. Straight lines represent significant paths ($p < .05$).

Discussion

The aim of the present study was to test the effectiveness of autonomy-supportive message frames in online communication about smoking cessation by means of testing the effects of the use of autonomy-supportive language and the provision of a choice on perceived autonomy-support. Also, we sought to test whether the individual need for autonomy interacted with the message frame used, in such a way that individuals with a higher need for autonomy would benefit more from autonomy-supportive message framing. Next, we tested whether autonomy-supportive message frames could lead to enhanced self-determined motivation to quit, and if this eventually led to the formation of a stronger intention to quit smoking. To the best of our knowledge, this was the first study testing effects of autonomy-supportive message frames in the context of an online health communication intervention aimed at smoking cessation.

Effects of the use of autonomy-supportive language, the provision of choice, and the need for autonomy on perceived autonomy-support and self-determined motivation

Contrary to our expectations, we did not find any significant effects of autonomy-supportive language, the provision of choice, or their combination on people's perceived autonomy-support. Also, we had to reject our hypothesis that the use of autonomy-supportive language and the provision of choice would lead to more self-determined motivation to quit smoking. Notable, however, is that the average level of perceived autonomy-support was rather high across all conditions, even in the control condition. Since smokers across all conditions – even in the neutrally formulated and non-tailored control condition – reported high levels of perceived autonomy-support, it could be that the internet environment itself is perceived as an autonomy-supportive context. People looking for online health communication interventions are able to do so whenever the time and location is convenient for them. Regardless of the type of message frame used, the internet environment could have led to such a feeling of freedom and choice, that variations in message frame no longer mattered. No literature was found to confirm this assumption. Moreover, participants' positive motivation to quit smoking, which was an inclusion criterion for this study, could possibly explain these findings. That is, participants who already wished to quit smoking before their enrolment in the study might not have perceived a pressure to stop (i.e., lower perceived autonomy-support) when receiving smoking cessation tips in controlling language or when not being provided with choice, in potential contrast with participants not yet motivated to quit. Smokers not (yet) motivated to quit smoking could have felt more pressure to quit and still have negative attitudes towards smoking cessation, which in turn could have diminished their perceived autonomy-support. Also, given study participant's positive motivation to quit, these participants could have already formed a positive opinion about smoking cessation. Thus, controlling wording, such as 'must quit' could not have diminished their perceived levels of autonomy-support. Our finding contradicts results from previous studies conducted in offline and face-to-face settings. For example, Williams and colleagues (2002) found that an autonomy-supportive interpersonal communication style (e.g., emphasising the smoker's own choice to quit and seeing smoking cessation from the smoker's perspective) in a brief smoking

cessation counselling session enhanced smokers' self-determined motivation. A potential reason that we were not able to replicate Williams and colleagues' findings could be rooted in the different environments, namely, face-to-face (offline) versus online setting. A teacher or physician talking to someone in person could be perceived more autonomy-supportive due to non-verbal cues as body language, tone of voice, or mimics, than an online feedback letter.

Politeness Theory (Jenkins & Dragojevic, 2013) provides an alternative explanation for why people perceived high levels of autonomy-support, also in our controlling language condition. According to this theory, controlling language does not necessarily have to be perceived as impolite or demeaning - thus lowering the message recipient's level of perceived autonomy or freedom - when the controlling message is formulated in a polite way and emphasises the message recipient's freedom to choose (i.e., in our controlling language & choice condition). An additional explanation for the high levels of perceived autonomy-support in this study, could be that smokers across all experimental conditions were asked (or forced, in the controlling language conditions) to formulate coping plans for potentially difficult situations. Subsequently, the formulation of coping plans could have been perceived as receiving freedom and being able to incorporate own ideas about smoking cessation. This is illustrated by responses to our open-ended think aloud measure like "feeling like I am creating my own advice".

The need for autonomy as a moderator

Next, we were not able to confirm Resnicow and colleagues' (2008, 2014) finding that smokers' need for autonomy moderates the effects of message framing. This might be explained by our finding that, in the present study, on average, smokers had a high need for autonomy. Congruent with previous research on SDT, study participants' high need for autonomy might provide an explanation for not finding any significant effects of autonomy-supportive message frames on perceived autonomy-support, as those people are more prone to perceive higher levels of autonomy-support (Deci & Ryan, 1987). In more detail, people with an autonomous orientation feel more volitional in their actions when the behaviour of question is congruent with their own values and goals. As participants needed to be motivated to quit to be eligible for

the study, this could have caused their high feelings of autonomy-support. Therefore, future studies investigating autonomy-supporting message frame effects should sample more heterogenic participants with regards to their need for autonomy, by means of a real-life trial instead of panel research.

Effects from self-determined motivation on intention

Self-determined motivation predicted intention to quit smoking which was positively mediated by a smoker's self-efficacy perception, and negatively mediated by people's negative attitudes towards smoking cessation and social norms about smoking cessation. This finding confirms earlier research on SDT and the integration of the motivational sequence in the TPB (Hagger & Chatzisarantis, 2009). Also, self-determined motivation to quit was negatively related to a person's social norms about quitting. This finding seems logical, as social norms and social pressures can be considered controlling beliefs – thus the opposite of self-determined beliefs and self-determined motivation to quit (Joseph et al., 2016). Next, self-determined motivation was negatively related to the negative attitudes towards smoking cessation, which also seems logical, as being intrinsically motivated to quit aligns with perceiving less disadvantages of smoking cessation. For instance, in Cognitive Dissonance theory (Harmon-Jones & Mills, 2019) it is stated that a person with non-congruent thoughts (such as simultaneously believing that quitting fits one's values and that it makes one unhappy), would try to eliminate the non-congruent thought to reach well-being. Thus, a smoker with a high level of self-determined motivation would likely change negative attitudes towards smoking cessation into positive ones to reduce cognitive dissonance – and vice versa. To support this line of argumentation, we found that self-determined motivation to quit enhanced self-efficacy, which also enhanced intention to quit smoking. Therefore, we could assume that as a person's trusts in own efficacy to quit smoking increases, negative attitudes decrease, too. This line of reasoning is supported by results from a secondary analysis, in which we found a negative direct effect from self-efficacy on negative attitudes (b = -.13, p < .001) in line with previous research (e.g., Smit et al., 2014; Wong & Cappella, 2009).

Limitations

A limitation of the current study is that for the measurement of the need for autonomy, we had to use a novel, not yet validated scale, the HCOS. However, the scale that was used as a basis for the development of the HCOS - the General Causality Orientations Scale - previously proved both valid and reliable (Deci & Ryan, 1985b). Moreover, the HCOS showed to have good reliability in our study. In addition, we preferred to use the HCOS, because this scale was adapted specifically to a health context. Given its theoretical basis, reliance on the both valid and reliable GCOS, and good reliability in the present study as well as in a previous study by (Smit & Bol, 2019), we highly recommend future research efforts to use, but especially validate, the HCOS.

Moreover, as the present study was an online experiment for which participants from an online panel were recruited, results might have a low ecological validity because participants might have been more used to online assessments, which could have potentially biased the results. As a result of their research experience, participants could for example have spent less time processing our stimulus material, might have clicked faster through the intervention, or could have on purpose responded in ways that they had lower chances to drop out from participation. Before drawing the conclusion that message framing has no effects, this study might need to be replicated in a more real-life setting with smokers actually searching for a smoking cessation intervention (e.g., via a search engine), having a strong intention to quit, and being more likely to read and process our message manipulations more attentively.

Conclusion

The results of this study suggest that autonomy-supportive message frames did not significantly induce higher levels of perceived autonomy-support and self-determined motivation to quit than controlling message frames. Also, the need for autonomy did not moderate the effect of autonomy-supportive message frames on perceived autonomy-support. On average, participating smokers reported a high need for autonomy and also perceived high levels of autonomy-support, regardless of the condition they were randomised into. This could be due to their positive motivation to quit smoking and likely positive

opinion towards smoking cessation. As expected, self-determined motivation had a positive effect on intention to quit smoking, which was mediated by smokers' self-efficacy, attitudes and subjective norms about smoking cessation. To our knowledge, our study is the first that aimed to test the effect of autonomy-supportive message framing on people's perceived autonomy-support while considering the individual need for autonomy as a moderator; and whether autonomy-supportive message frames – through increased perceived autonomy-support - lead to more self-determined motivation, and an increased intention to quit smoking. Therefore, one should be cautious in drawing the conclusion that online computer-tailored autonomy-supportive smoking cessation advice is not effective in inducing perceived autonomy-support and self-determined motivation. To draw more definite conclusions, future studies first need to test the hypotheses within more heterogenic samples of participants with regards to their need for autonomy, such as by means of a real life randomised controlled trial.