

Predictors of Smoking Cessation: How and Under Which Conditions do Intrinsic Motivation and Self-Efficacy Predict Successful Smoking Cessation? – a Longitudinal Study

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Abstract

Smoking is regarded as the world's leading reason for preventable and premature mortality and morbidity. As stopping to smoke can reduce smoking-related health consequences considerably, smoking interventions are highly relevant. Previous academic literature has hinted that intrinsic motivation and self-efficacy are two crucial drivers in successful smoking cessation. Therefore, for the present study, data of a smoking intervention was analysed to assess how and under which conditions self-efficacy and intrinsic motivation predict successful smoking termination and how they are related to the quitting strategy to stop at once, or to having a depression. The smoking intervention was conducted by trained counsellors at the Outpatient Smoking Cessation Clinic at the Medisch Spectrum Twente, Enschede, the Netherlands. This clinical study has a longitudinal design of four waves where data of 344 participants was collected with questionnaires or, in the case of people's smoking status, with biochemically validated exhaled carbon monoxide (CO) levels and cotinine measures at baseline (T0), three, six, nine and 15 months (T1-T4). Against empirical evidence and theory, the results showed that self-efficacy and intrinsic motivation did not significantly influence smoking cessation, quitting at once or depression in an expected way. Though, the study supported that stopping at once is significantly and positively related to smoking cessation. Limitations of the present study as well as implications for research and practice are discussed for the clinical health literature.

Introduction

“Smoking is highly addictive, don’t start” or “Smoking kills” are sentences that can be found on cigarette packages; since 2008, they are also accompanied by pictorial representations of smoking-associated health consequences (World Health Organization, 2020). Despite the warnings, about 20% of the Dutch population smokes, every 9th smoker is regarded as a heavy smoker, consuming more than 20 cigarettes a day. Taken together, in the Netherlands alone, about 11 billion cigarettes are lit every year (van Gelder, 2020). The exposure and consumption of tobacco is harmful to people’s health and goes along with an increased risk to develop smoking-related health problems (WHO, 2020). Such, smokers are at major risk of developing several forms of cancer, cardiovascular and respiratory diseases (US Department of Health and Human Services, 2004; WHO, 2020). Besides the increased risk for premature morbidity, smoking is also the leading reason for preventable and premature mortality, killing about 8 million people annually (Pirie et al., 2013; WHO, 2020). Stopping to smoke reduces these health risks considerably and steadily over time, whereby the benefits are greater, if smoking is stopped earlier (Pirie et al. 2013; US Department of Health and Human Services, 2004). Looking at these negative consequences for people’s health and the chance to recover from smoking-related issues states the importance of successful smoking cessation.

A successful smoking cessation is dependent on many factors. So far, the academic literature proposes two promising drivers of successful smoking cessation, namely intrinsic motivation and self-efficacy. Intrinsic motivation, a type of motivation driven by internal rewards, and self-efficacy, the belief in one’s ability to successfully perform a task were found to be positively related to quitting to smoke by several studies (Bandura, 1986; Boardman et al., 2005; Curry et al., 1997; Williams et al., 2002). Though, the scientific literature is inconclusive of how and under which conditions self-efficacy and intrinsic motivation influence successful smoking termination, so that this study is aimed at shedding light onto the predictors, mediators and moderators of these relationships. In particular, the underlying mechanism between intrinsic motivation [or self-efficacy] and smoking cessation was investigated, so that it was assessed whether stopping smoking abruptly explained this relationship. The study also explored under which conditions self-efficacy and intrinsic motivation influence smoking cessation by assessing the relationship between depression and smoking cessation and whether this relation was influenced by intrinsic motivation or self-efficacy, so that they buffer against experienced difficulties in smoking cessation when having a depression.

Theoretical background

Social-cognitive predictors of smoking cessation.

Intrinsic motivation and smoking cessation. Motivation is known as a key element in smoking cessation (Curry et al., 1997, Curry et al., 1990; Williams et al., 2002). Following the Self-Determination Theory (SDT) by Deci and Ryan, especially the type of motivation is crucial in driving behaviour. Such, motivation can be subdivided into autonomous and controlled motivation. Autonomous motivation is characterised as a wilful and voluntary act, an act that is deeply valued and accompanied by being interested and experiencing enjoyment while controlled motivation is focused on receiving rewards or avoiding punishments (Deci & Ryan, 1985; Deci & Ryan, 2000; Ryan & Deci, 2000). Autonomous motivation was shown by several studies to be associated with positive outcomes such as increased positive emotions, persistence, creativity, performance, and psychological and physical well-being compared to performance based on controlled motivation (de Jesus et al., 2013; Grant, 2008; Ryan & Deci, 2000). Looking at these findings, it is preferable to be autonomously motivated which can be achieved by satisfying three psychological needs, namely the need for competence, feeling effective in what one is doing, the need for relatedness, feeling belongingness to close others, and the need for autonomy, feeling independent. One form of autonomous motivation that was researched profoundly by Deci and Ryan was intrinsic motivation. Intrinsic motivation is driven by internal rewards, a desire to achieve results that are important to the person itself, such as one's health or personal development (Deci & Ryan, 1985; Deci & Ryan, 2000). Especially the protection of one's own health is a strong intrinsic motivator that drives behaviour. People's sense of competence, belongingness and independence enables them to quit smoking, so that intrinsic motivation appears to be a significant predictor to smoking cessation.

Previous research supports this notion (Curry et al, 1990; Curry et al., 1997; Williams et al., 2002). The study by Williams et al. (2002) researched on the relationship between autonomous motivation and smoking cessation and found autonomous motivation to predict smoking abstinence at 6, 12 and 30 months. Further, they found support that the SDT can explain the relationship between autonomous motivation and smoking abstinence whereby especially perceived competence predicted smoking cessation (Williams et al., 2002). Other studies found that intrinsically compared to extrinsically motivated people were more successful in quitting to smoke (Curry et al.,1990; 1997).

Self-efficacy and smoking cessation. Another crucial and often-mentioned factor in successful smoking cessation is self-efficacy (Boardman et al., 2005; Condiotte &

Lichtenstein, 1981; DiClemente, 1981; Dijkstra & Vries, 2000; Mudde et al., 1995). Self-efficacy is the degree to which people believe in their abilities to successfully execute a task or achieve a desired result and is linked to the social-cognitive theory (SCT) by Bandura (Bandura, 1986; Bandura & National Inst of Mental Health, 1986). The SCT is about determinants of human behaviour and comprises behavioural, environmental and cognitive (or also often referred to as personal) factors that reciprocally influence each other. Environmental factors are external factors such as social norms or the influence of others, cognitive factors are internal, personal, cognitive, emotional and physical factors such as knowledge and expectations, and behavioural factors are actions and decisions such as skills and practice (Bandura & National Inst of Mental Health, 1986). Comparing the cognitive component self-efficacy of the SCT, characterised as the belief in people's ability to successfully perform a task, to the SDT's component competence, as people's perception to be effective in one's performance, it can be noted that both components are similar. Based on this theoretical resemblance, it is assumed that intrinsic motivation and self-efficacy are to some extent interrelated predictors of smoking cessation, so that self-efficacy is also added as an alternative predictor of successful smoking cessation.

Bandura's over 20 years long research found that people with high self-efficacy are on average "healthier, more effective and more successful than those with low self-efficacy" (Bandura, 1997). As stopping to smoke is related to being successful in the termination process and to a healthy lifestyle, self-efficacy is supposed to be related to successful smoking cessation. This reasoning was also supported by several studies. Those studies found that people with high self-efficacy are more successful quitters in the short- and long-term and are more likely to maintain abstinent over time, offering overall support to the SCT by Bandura (Boardman et al., 2005; Condiotte & Lichtenstein, 1981; DiClemente, 1981; Mudde et al., 1995).

Quitting strategy and smoking cessation.

To get a better understanding of how self-efficacy and intrinsic motivation influence successful smoking cessation, the quitting strategy is researched as an explanatory link between the two whereby stopping at once, also called cold turkey, is assumed to have an advantage over stopping gradually. Especially people who gradually reduce cigarettes on their own experience most difficulties, starting off by giving up cigarettes that are easiest to give up but sticking the longest to the cigarettes that are most crucial to them, making it in the end more difficult to cease the last cigarettes (Cinciripini et al., 1997). Further, when cutting down cigarettes, smokers experience for a longer duration withdrawal symptoms such as anxiety,

irritability and negative affect in-between smoking cigarettes compared to abrupt stopping. Meeting the urge to smoke then regarded as a relieve, being associated with positive experiences and pleasant feelings while it is in fact the source of these withdrawal symptoms, making it harder to give up cigarettes (Bergen & Caporaso, 1999; Hughes, 2007). Although people who stop abruptly also experience withdrawal symptoms, they experience sooner the benefits of being nicotine-free, so that they do not feel as tempted to cheat (Fletcher, 2018).

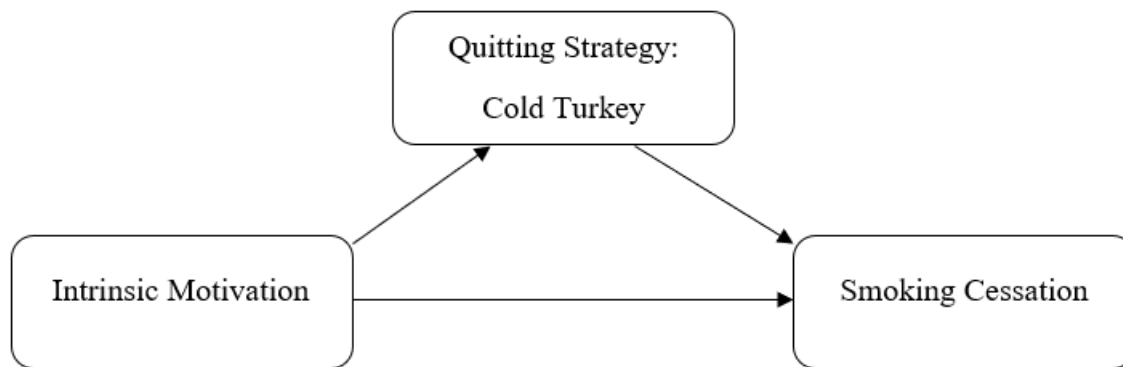
According to some smoking cessation guidelines, the cold turkey method has a better success rate to stop smoking compared to gradual smoking reduction (American Cancer Society, 2020). Research supports this notion; Fiore et al. (1990) found that the most successful quitters made use of the method ‘cold turkey’, being the strongest predictor for successful smoking termination (Fiore et al., 1990). Additionally, another study found that smokers who quit with the strategy cold turkey were about twice as successful to quit smoking (22-27%) compared to stopping gradually (12-16%) (Cheong et al., 2007).

Intrinsic motivation and quitting strategy. Smokers’ intrinsic motivation seems to be related to people’s quitting strategy to stop at once (Cheong et al., 2007; Fiore et al., 1990). Reasoning why intrinsic motivation might be related to quit smoking at once can be done by following the SDT. People who are intrinsically motivated, perceive more autonomy, competence and belongingness which increases their determination and persistence to stick to their goal (Deci & Ryan, 2000; Grant, 2008). Further, adjusting the reasoning by Cheong et al. (2007), it can be assumed that people who are more motivated are more likely to stop at once. Although the study did not find support for this assumption, their reasoning of people’s motivation being associated with higher commitment to change and with increased confidence in one’s success to stop smoking, was regarded as credible, offering promising ground to replicate this research (Cheong et al., 2007).

Hypothesis 1: The relationship between intrinsic motivation (T0) and smoking cessation (T1-T4) is mediated by the quitting strategy cold turkey.

Figure 1.

Mediation Model of the Relationship Between Intrinsic Motivation and Smoking Cessation as Mediated by the Quitting Strategy Cold Turkey.

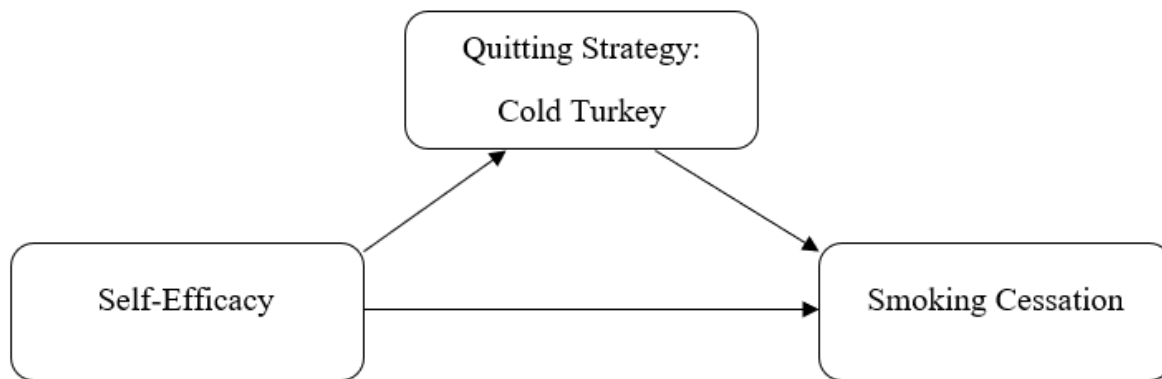


Self-efficacy and quitting strategy. Although no study researched onto the relationship between people’s degree of self-efficacy and their preferred quitting strategy, self-efficacy appears to have a similar motivational effect as intrinsic motivation on smoking cessation. As described in the reasoning of how intrinsic motivation is related to stopping at once, people’s self-efficacy is expected to function in a likewise manner, influencing people’s commitment and confidence to successfully stop smoking (Cheong et al., 2007). Repeating the mediation analysis with self-efficacy as the independent variable, therefore, appears as relevant and as a confirmatory analysis of the first hypothesis. Also on a theoretical level, self-efficacy is assumed to be related to successful smoking cessation. Oftentimes, smokers perceive it as more difficult to quit smoking abruptly compared to stopping gradually (Siahpush et al., 2010). Following the SCT by Bandura (1986), the cognitive, environmental and behavioural components influence each other reciprocally, so that it is assumed that high levels of self-efficacy (i.e., cognitive component) positively influence people’s intention to quit smoking (i.e., behavioural component) through increased commitment, engagement and perceptions of effectiveness in one’s performance to successfully reach their goal of smoking cessation and overcoming the perceived difficulty of stopping at once (Bandura, 1997). Based on this reasoning it is assumed that:

Hypothesis 2: The relationship between self-efficacy (T0) and smoking cessation (T1-T4) is mediated by the quitting strategy cold turkey.

Figure 2.

Mediation Model of the Relationship Between Intrinsic Motivation and Smoking Cessation as Mediated by the Quitting Strategy Cold Turkey.



Depression and smoking cessation.

Another crucial factor that is related to smoking cessation is depression. A depression is according to the DSM-5 a mood disorder that is characterized by persistent feelings of sadness and/or a loss of interest. A depression is accompanied by symptoms such as a loss of concentration, changes in weight or appetite, fatigue, feelings of worthlessness and guilt (APA, 2013). Smoking additionally contributes negatively to experiencing depressive symptoms or can aggravate them (Jamal et al., 2012). Those findings might be attributable to smoking being used as a maladaptive strategy to regulate emotions. People with a depression are more likely to experience negative affect and as smoking can relieve negative affect in the short term, people attribute their pleasant feelings towards smoking (Hall et al., 1993; Hughes, 2007). But as stated above, smoking also contributes to experience negative affect in the first place due to withdrawal symptoms in-between cigarettes, so that smoking to relieve negative affect in the short term is a maladaptive coping strategy (Hughes, 2007). Following this reasoning, people who are depressed are more likely to initiate smoking to regulate their emotions but, over time, need more cigarettes to compensate for the additional negative affect triggered by withdrawal symptoms in-between the cigarettes, so that people with depressions seem to be caught in a loop of negative affect and smoking.

Studies on the relationship between smoking and depression found that people with a history of depression are overrepresented among smokers, are twice as likely to start smoking, are more likely to develop a nicotine dependence, experience higher withdrawal symptoms and more likely to experience difficulties in quitting and remaining abstinent (33%) compared to people without a history of depression (57%) (Breslau et al., 1993; Covey et al., 1990; Glassman et al., 1988; Mendelsohn, 2012).

Interaction effects. As stated above, some studies showed that people with a depression are less likely to stop smoking. In contrast, a meta-analysis on depression and smoking cessation found, contrary to expectations, that most studies found a history of

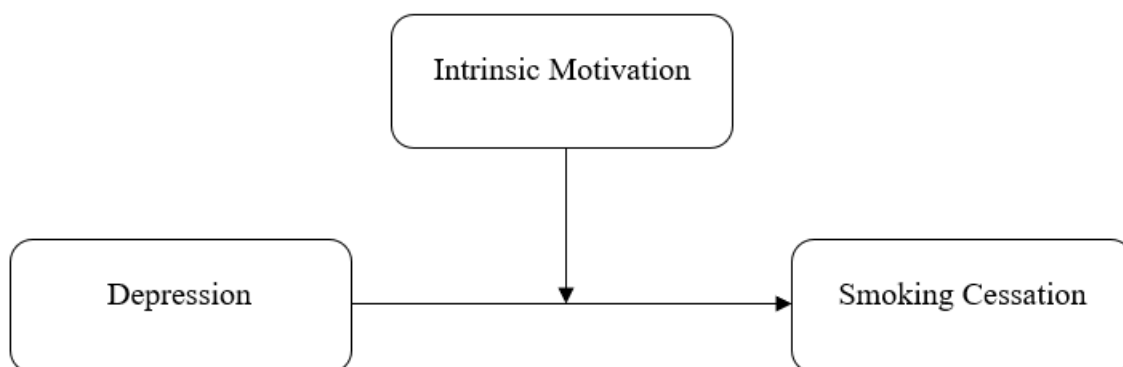
depression not influencing short-term abstinence (Hitsman et al., 2003). As some studies find a negative, others no relationship between depression and smoking cessation, it appears as if there are some boundary conditions that give more insight into this relationship. Intrinsic motivation and self-efficacy appear not only to be direct predictors of smoking cessation, they might also compensate for difficulties in smoking cessation which are experienced by people with a depression, functioning as moderators of this relationship.

Interacting effect of intrinsic motivation. Previous studies are inconclusive in determining the relationship between depression and motivation as one study found a positive relationship while another study found no relationship between depression and motivation (Haukkala et al., 2000; Tsoh & Hall, 2004). Intrinsic motivation appears to be a promising moderator of the relationship between depression and smoking cessation, especially when reminding on the positive influence of intrinsic motivation on persistence, affect, commitment and performance, therefore possibly protecting against being depressed (Grant, 2008; Ryan & Deci, 2000). Based on the above-mentioned reasoning it is assumed that:

Hypothesis 3: Depression (T0) negatively predicts smoking cessation (T1-T4), but this effect is attenuated by intrinsic motivation (T0), in such a way that intrinsic motivation buffers against being depressed.

Figure 2.

Moderation Model of the Relationship Between Depression and Smoking Cessation as Moderated by Intrinsic Motivation.

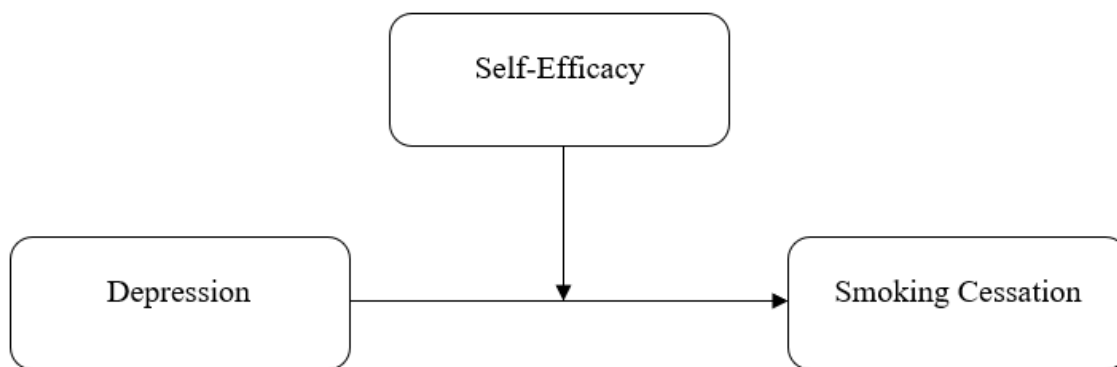


Interacting effect of self-efficacy. A similar protective effect is expected of self-efficacy. Similar to intrinsic motivation, also people’s degree of self-efficacy might contribute to a better understanding of the relationship between depression and smoking cessation. According to the SCT by Bandura (1986), human behaviour is influenced by cognitive/ personal factors such as self-efficacy. Following the above-mentioned link that depression might negatively contribute to smoking cessation, high degrees of self-efficacy could

minimize the negative impact of depression on smoking cessation, so that it protects against it. Repeating the above-stated analysis with self-efficacy as promising moderator and a confirmatory analysis of the third hypothesis to assess an expected similar protective effect, it is assumed that:

Hypothesis 4: Depression (T0) negatively predicts smoking cessation (T1-T4), but this effect is attenuated by self-efficacy (T0), in such a way that high self-efficacy buffers against being depressed.

Figure 4.
Moderation Model of the Relationship Between Depression and Smoking Cessation as Moderated by Self-Efficacy.



Method

Sample

The sample was a voluntary response sample. Participants who were interested in an intervention to quit smoking either referred themselves or were referred by their general practitioner to the Outpatient Smoking Cessation Clinic (SRP) at the Department of Pulmonary Medicine of the Medisch Spectrum Twente (MST), Enschede, the Netherlands. Data for this study was collected as part of a bigger research project on the effectiveness of Blended Smoking Cessation Treatment compared to Face-to-Face treatment by Siemer et al. (2016). Participants were recruited from March 2015 to March 2019. Being in line with the Dutch Medical Research Ethics Committee (MREC), the study was approved by the MREC Twente (P14-37/NL50944.044.14) and registered with the Dutch Trial Registration (NTR5113) on the 24th of March 2015. All personal data was encrypted and stored securely and comply with the Personal Data Protection Act in the Netherlands. Informed consents were signed before the voluntary and financially non-compensated participation that could be stopped at any time. The inclusion criteria were being at least 18 years old, smoking at least one cigarette a day and having access to the internet and e-mails. Excluded from the study were participants who were not able to read or speak the Dutch language.

The sample consisted of 344 participants, of which 50.2% were female. Participants were on average 46.9 years old ($SD= 12.85$), the youngest being 16, the oldest being 77 years old. The vast majority of participants were Dutch (97.9%). Participants lived with a partner and children (33.6%), with a partner only (31.2%), alone (21.9%), with only their children (8.3%) or with their parents (2%). Participants educational background varied, to most participants, MBO is their highest degree (39.3%), followed by LBO/MAVO/VBO (28.5%) and HBO (17.3%), Basisschool (4.3%) and WO (2.5%). At the beginning of the study, most participants smoked cigarettes (65%). On average 17.91 ($SD= 7.4$) cigarettes were consumed daily, ranging from 1 cigarette to 50 cigarettes per day. Many participants also smoked shags (35.3%), on average 19.78 ($SD= 9.69$), ranging from 1 shag to 65 shags per day. Some participants also consumed cigars (4%) or e-cigarettes (1.8%). About half of participants (50.9%) sought professional help for psychological or emotional problems during their lifetime. Of those who consulted professional help, most of them received it to treat a depression (31.9%), making up about 15% of the total sample.

Design

The data was derived from a single centre randomized controlled non-inferiority trial with parallel group design. As smokers are often regarded to be fully smoke-free if they did not smoke for a year, a longitudinal study design with four waves was chosen, namely at baseline (T0), at three, six, nine, and 15 months (T1-4), determining whether the intervention was successful after one year after the cessation treatment and led to living smoke-free (Osler & Prescott, 1998). This longitudinal study design is one of the most powerful designs to assess concepts in the field that cannot be measured experimentally (Spector, 2001). It further allows to assess temporal sequences that reinforce cause-and-effect interpretations (Roth & MacKinnon, 2012). To find robust effects, a power analysis of 80% with a Cronbach's alpha of 0.025 and an estimated 5% abstinence rate was conducted and yielded a required sample size of 344 participants (see Siemer et al., 2016).

Procedure

The expected quit date was about 3 months after the beginning of the treatment. Participants could decide for one of three quitting strategies: stopping at once, stopping gradually on their own, or stopping gradually with a schedule. Patients who decided to stop at once, set together with the counsellor a quit date, worked on a preparation plan and stopped abruptly to smoke on the indicated quitting date. Stopping gradually on their own included following step-by-step daily activities without habitual smoking and stopping gradually with a schedule included regular intervals that progressively reduced smoking over time (Cinciripini et al., 1997). The choice of the quitting strategy did not influence the order or content of sessions.

Participants had to fill in online questionnaires at baseline (T0) and at four time points (T1-T4). Their responses were tracked. When online questionnaires were not filled in, participants received weekly reminders after two weeks for four consecutive weeks, two times via e-mail, the last two times via telephone calls. In case a participant expressed difficulties with filling in the online questionnaire, a paper version of the questionnaire with a return envelope was sent. More detailed information on the procedure can be found in the study protocol by Siemer et al. (2016).

Treatment

Participants received high intensity treatment of 10 sessions that were 20 minutes long except of the first one being 50 minutes long by health care professionals who are registered in the Dutch quality register of qualified smoking cessation counsellors. The frequency of sessions faded over time, the first six sessions took place in the first three months, the last four took place within the final three months, so that the total duration of the treatment was about six

months. The treatment was in accordance with the Dutch Guideline Tobacco Addiction and with the Dutch care module for smoking cessation (Partnership Stop met Roken, 2019; Trimbos-Instituut, 2017). The costs of the treatment were covered by the patient's health care insurance.

Measures

Participants received a questionnaire at baseline (T0) and at four time points (T1-T4). The baseline survey measured demographic and background variables and smoking-related general questions such as smoking status, behaviour and duration. Furthermore, the baseline included study-related questions that were partially asked at the four later surveys as well. An overview of all measures can be seen in Table 1.

Smoking cessation. Smoking cessation and remaining abstinence were assessed by self-reported measures that were complemented with biochemically validated exhaled carbon monoxide (CO) levels and cotinine measures. Self-reported abstinence was assessed at baseline and at the four measurement points (T0-T4). For those participants who reported to be abstinent in the questionnaire, the biochemically validated measures were administered at some face-to-face sessions that took place at the hospital (CO at baseline, week 14, week 22; Cotinine at 3 months) (SRNT Subcommittee on Biochemical Verification, 2002). One year after the expected quit date, patients returned to the hospital for a final CO- and cotinine measurement (T4). Cotinine measures were the primary outcome parameter to assess smoking cessation as it can indicate prolonged smoking abstinence (Hughes et al., 2003). Prolonged smoking abstinence is defined as having low salivary cotinine levels (<20ng/ml) (Jarvis et al., 2008). To measure the cotinine in people's saliva, people chewed for about a minute on a cotton swab to increase the saliva flow rate. Afterwards, the sample was frozen and analysed in a laboratory. When saliva samples exceeded the 20ng per millilitre, the participant was regarded as a smoker. As the CO-measurements were routinely assessed during smoking cessation treatments, they were used as a backup for the cotinine measurements and were only analysed if the saliva samples could not be used. Participants were regarded as smokers if their CO level exceeded the cut-off score of 5ppm.

Intrinsic motivation. People's type of motivation was assessed during the baseline questionnaire (T0). They were asked what their main reason for participation was and could choose one of six response options. People were regarded as intrinsically motivated if they chose one of the items "I would like to have advice", "I personally think that I should not smoke" and "I worry about my health".

Self-efficacy. People’s degree of self-efficacy was measured at two time points, at baseline (T0) and at the second measurement (T2). Self-efficacy was measured with six items asking how difficult resisting to smoke was in different situations. Examples of those items were “You feel stressed or tense. Can you resist smoking?”, “You are (very) angry. Can you resist smoking?” or “You see someone enjoying a cigarette. Can you resist smoking?”. Answers to those items ranged from 2 “*Yes, I can*” to -2 “*Surely not*”, meaning that each participant received a value between 12 and -12, whereby higher numbers indicated a higher degree of self-efficacy. The Cronbach’s alpha of this scale was 0.84, indicating good internal consistency.

Quitting strategy. The quitting strategy was discussed with the counsellor and determined in the first counsellor session. Participants could choose from stopping abruptly, gradually on their own or gradually with a schedule (see Procedure).

Depression. Depression was measured at baseline (T0), at the three measurement points (T2-T4). It was assessed by the DASS21 (Depressions-Angst-Stress Skalen) that is a self-reported scale designed to measure the negative emotional states of depression, anxiety and stress (Antony et al., 1998; Lovibond & Lovibond, 1995). Depression was measured by seven of the 21 items. Example items were “I couldn’t seem to experience any positive feelings at all”, “I felt down-hearted and blue” and “I felt I wasn’t worth much as a person”. People were asked how much the indicated statement applied to them over the past weeks, ranging from 0 “*did not apply to me at all*” to 3 “*applied to me very much/most of the time*”. The severity of the depression was assessed by the summed score of all items and rated according to a scoring sheet where the severity ranged from normal (0-4) to extremely severe (14+). The Cronbach’s alpha of this scale was 0.91, indicating excellent internal consistency.

Table 1

Measurement Schedule.

Variables	Measurements				
	Baseline (T0)	3-month (T1)	6-month (T2)	9-month (T3)	15-month (T4)
Dependent variable					
Self-reported	x	x	x	x	x
Smoking Status					
Cotinine-measure		x			x
CO-measure		x		x	x

Predictors and moderators

Intrinsic Motivation	x			
Self-efficacy	x	x		
Depression	x	x	x	x

Analyses

Before the analyses were conducted, the dataset was carefully prepared to rule out any anomalies. Afterwards, descriptive statistics including means, zero-order correlations and standard deviations of all test variables were obtained and depicted in Table 2. All analyses were based on the intention-to-treat principle, so that missing data of smoking cessation was regarded as if the participant smoked. To test the mediation and moderation hypotheses, the bootstrapping mediation method by Preacher and Hayes (2008) was used for which the extension PROCESS macro by Preacher and Hayes was installed in SPSS 26 (IBM SPSS Statistics). For all analyses, a confidence interval of 95% and bootstrapped samples of 5000 were set. Statistical significance was indicated when the confidence interval of the indirect effect did not contain zero (Preacher & Hayes, 2008).

For the mediation hypotheses (Hypothesis 1 and 2), a series of regressions analyses proposed by Baron and Kenny (1986) were performed. To determine a mediation, four conditions needed to be met. First, the independent variable needed to be significantly related to the dependent variable (Path *c*). Second, the independent variable needed to be significantly related to the mediator variable (Path *a*). Third, the mediator variable needed to be significantly related to the dependent variable (Path *b*). And lasty, the relationship between the independent variable and the dependent variable was significantly decreased when the mediator is controlled for (Path *c'*) (Baron & Kenny, 1986).

First, the first hypothesis that assumed that abrupt quitting to smoke mediates the relationship between intrinsic motivation and smoking cessation was assessed. The independent variable was intrinsic motivation, a binary predictor (0= extrinsic motivation; 1= intrinsic motivation) measured at baseline (T0). The mediator was the quitting strategy of stopping at once, a categorical variable (1= stopping at once; 2= stopping gradually on their own; 3= stopping gradually with a schedule), measured as well at baseline (T0). The dependent variable was the participant's smoking cessation status, a binary variable (1= quitter; 2= smoker) that was measured at four time points (T1-4) with self-reported data or biochemically validated data (Cotinine- or CO-measure). The different measures at the four

time points were entered successively to the analysis, so that for the first hypothesis 9 mediation analyses were conducted.

Similarly, the second hypothesis that stated that the quitting strategy cold turkey mediates the relationship between self-efficacy and smoking cessation was tested. The independent variable was self-efficacy, a continuous variable (-12 – 12) measured at baseline (T0). The mediator variables of participant's quitting strategy and the dependent variables of participant's smoking cessation status were the same as in the first hypothesis, meaning that also the second hypothesis yielded 9 mediation analyses in total.

Also, for the moderation hypotheses (Hypothesis 3 and 4), multiple regressions were performed. First, the independent variable was regressed on the dependent variable (Path *a*). Second, the impact of the moderator on the relationship between the independent and the dependent variable was assessed (Path *b*). Lastly, the interaction product of the independent and moderator variable on the dependent variable was determined (Path *c*). If the interaction was regarded as significant (Path *c*), the moderation hypothesis was supported (Baron & Kenny, 1986).

Hypothesis 3 assumed a moderation effect of intrinsic motivation that buffers against the negative relation of depression on smoking cessation. The independent variable was depression, a continuous variable (0 – 14+) that was measured at baseline (T0). The moderator intrinsic motivation, a binary variable (0= extrinsic; 1=intrinsic) was also measured at baseline (T0). The dependent variable smoking cessation, a binary variable (1= quitter; 2= smoker) was measured at four measurement points (T1- T4) with self-reported data and biochemically validated measures (CO- and cotinine-measure) and entered again successively to the analysis, so that 9 moderation analyses were conducted. Hypothesis 4 assessed a similar interaction effect with the only difference that self-efficacy, a continuous variable measured at baseline was the moderator.

Further, two covariates were entered in some of the mediation and moderation analyses. Because preliminary analysis showed that marital status, a binary variable (0= living alone, 1=living with a partner) was correlated to the six-month CO-validated abstinence, it was entered to the respective analysis. Likewise, preliminary analysis showed that gender, a binary variable (1=male, 2=female) was correlated to the 15-month cotinine-validated abstinence, so that the covariate was entered into the respective analysis.

Results

Descriptive statistics and preliminary analyses

The descriptive statistics that included the means, standard deviations and zero-order correlations of all test variables can be found in Table 2. Before the mediation and moderation effects were investigated, it was assessed whether the variables intrinsic motivation (T0) and self-efficacy (T0) are related to each other or to other social-cognitive variables (positive/negative attitudes). Analyses showed that no social-cognitive variable was significantly associated with intrinsic motivation at baseline. The independent samples t-test showed that there were no significant differences in the scores for self-efficacy in intrinsic ($M=-.01$, $SD=4.84$) and extrinsic motivation ($M=-1.04$, $SD=5.45$), $t(314)= 1.67$, $p =.171$; no significant differences in the scores for positive attitudes in intrinsic ($M=10.37$, $SD=3.10$) and extrinsic motivation ($M=9.85$, $SD=2.31$), $t(314) = 1.50$, $p =.41$; and no significant differences in the scores for negative attitudes in intrinsic motivation ($M=-6.53$, $SD=3.25$) and extrinsic motivation ($M=-6.67$, $SD=3.40$), $t(314)= .35$, $p =.41$. Regarding the variable self-efficacy, findings showed an existing a positive correlation between self-efficacy and negative attitudes at baseline (T0) ($r=.20$, $N=316$, $p<.01$). Moreover, the zero-order correlations showed that the three-month CO-validated abstinence and the three-month cotinine-validated abstinence and the 15-month CO-validated abstinence and 15-month cotinine-validated abstinence are fairly consistent (.50, .67, respectively), confirming the validity of both biochemically validated measures. The correlations of all study variables can be found in Table 2.

Mediation analyses

The first two hypotheses stated that the relationship between intrinsic motivation (H1) and smoking cessation (T1-T4), and self-efficacy (H2) and smoking cessation (T1-4) is mediated by the quitting strategy of stopping abruptly. For both hypotheses, a series of regression analysis were performed in PROCESS macro.

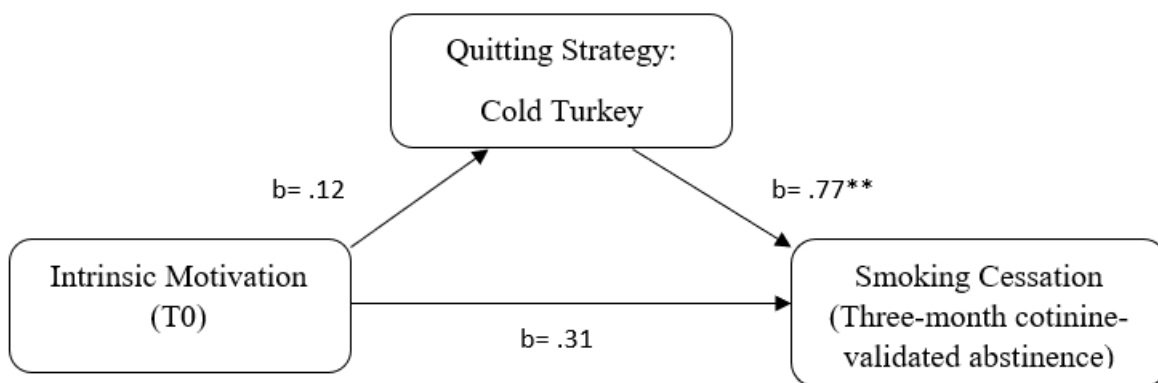
First, it was found that intrinsic motivation is in no analysis significantly related to smoking cessation (Path *c*). The results of the three-month cotinine-validated abstinence ($b=.31$, $SE = .40$, $p = .44$) represent this notion. The next step was determining whether stopping at once was significantly related to smoking cessation (Path *b*). Results showed that there were some significant relationships in the nine-month self-reported abstinence ($b= .60$, $SE = .26$, $p = .02$), in the three-month CO-validated abstinence ($b= .52$, $SE = .16$, $p = .002$) and in the three-month cotinine-validated abstinence ($b= .77$, $SE = .24$, $p = .001$). Third, no significant relationship between intrinsic motivation and stopping smoking at once was found

(Path *a*). Lastly, the relationship between intrinsic motivation and smoking cessation (T1-T4) did not decrease when controlling for the stopping to smoke at once.

In two of the nine performed mediation analysis, covariates were entered to the regression models. In the six-month CO-validated abstinence, marital status was a significant predictor of smoking cessation ($b = .86, SE = .37, p = .01$). Although gender appeared a significant predictor in the chi-square test of independence, it was not a significant predictor of smoking cessation when being entered as a covariate ($b = .54, SE = .44, p = .22$). Overall, after controlling for two covariates, there was no mediation found. Taken together, as one out of four conditions was met, Hypothesis 1 was rejected.

Figure 5.

Standardized Regression Coefficients for the Relationship between Intrinsic Motivation and Smoking Cessation measured by the Three-Month Cotinine-Validated Abstinence Mediated by the Quitting Strategy Cold Turkey.



* $p < .05$, ** $p < .001$.

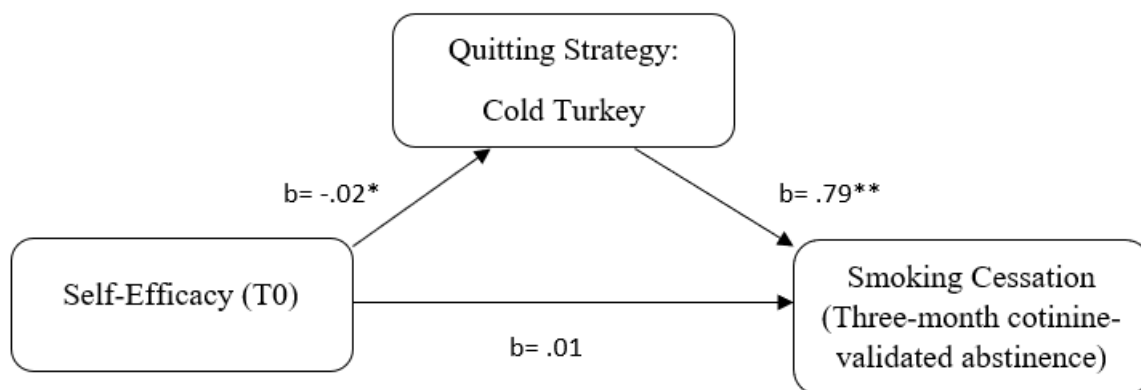
The same procedure was followed for the second hypothesis that was an alternative to the first hypothesis, with the difference that self-efficacy was the independent variable. A significant relationship of self-efficacy and smoking cessation (Path *c*) was not found in the biochemically validated measures but at the nine-month self-reported abstinence ($b = .12, SE = .05, p = .009$). Secondly, the quitting strategy to stop at once was significantly related to smoking cessation (Path *b*) in the nine-month self-reported abstinence ($b = .59, SE = .27, p = .03$), in the three-month CO-validated abstinence ($b = .51, SE = .17, p = .002$) and in the three-month cotinine-validated abstinence ($b = .79, SE = .24, p < .001$). The results showed that self-efficacy was significantly related to the quitting strategy to stop at once ($b = -.02, SE = .01, p = .03$), fulfilling the third requirement (Path *a*). Lastly, the relationship between self-efficacy and smoking cessation did not significantly decrease when being controlled for the quitting strategy to stop at once, so that no mediation was found. The results of the direct

effect after controlling for the quitting strategy in the three- and 15-month cotinine-validated abstinence ($b = .01, SE = .03, p = .76$; $b = -.05, SE = .05, p = .30$) represent this finding, respectively.

Also, in these analyses, it was controlled for covariates. Marital status and gender were significantly related to the six-month CO-validated abstinence ($b = .87, SE = .37, p = .02$) and 15-month cotinine-validated abstinence ($b = 1.21, SE = .59, p = .04$), respectively. Still, also after controlling for these confounders, no mediation effect was found. Looking at the four conditions that were only partially met, there is no mediation effect, so that Hypothesis 2 was rejected.

Figure 6.

Standardized Regression Coefficients for the Relationship between Self-Efficacy and Smoking Cessation measured by the Three-Month Cotinine-validated abstinence Mediated by the Quitting Strategy Cold Turkey.



* $p < .05$, ** $p < .001$.

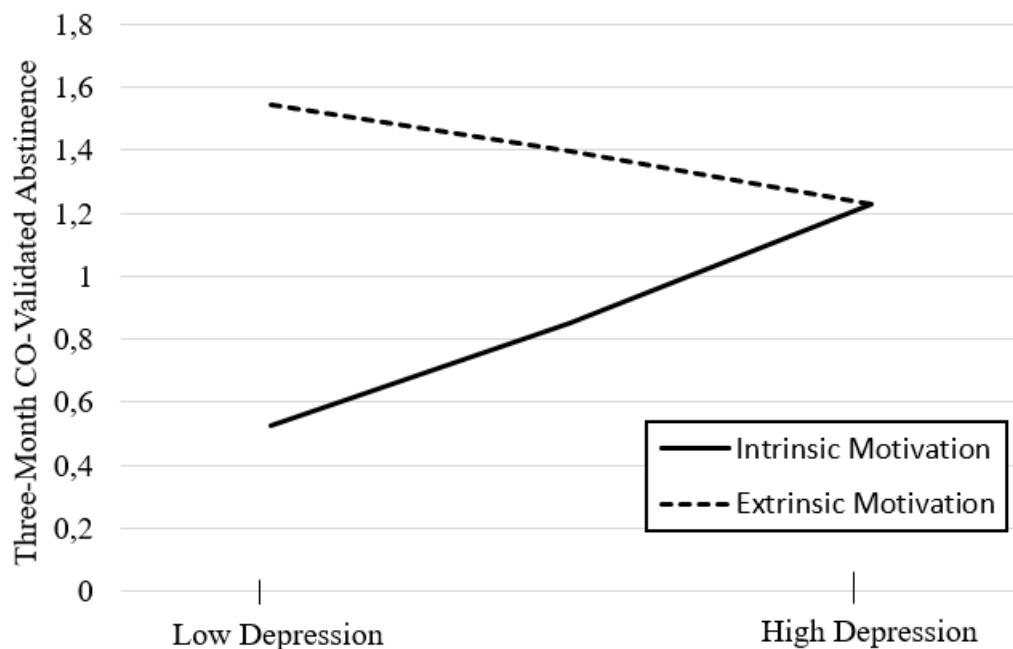
Moderation analyses

Interaction of intrinsic motivation. The third hypothesis stated that depression negatively predicts smoking cessation and this effect was assumed to be attenuated by intrinsic motivation. Overall, no moderation of intrinsic motivation on the relationship between depression and smoking cessation was found. Though, the analyses showed that depression is a significant, positive predictor of smoking cessation, independent of motivation, found in the three-month CO-validated abstinence ($b = .11, SE = .05, 95\% CI [.01; .22]$) and the 15-month cotinine-validated abstinence ($b = .46, SE = .23, 95\% CI [.01; .91]$). At three-month CO-validated abstinence, the overall model was significant ($-2LL = 362.42, df = 3, p = .02$) as well as in the 15-month cotinine-validated abstinence ($-2LL = 123.65, df = 3, p$

=.03). At the three-month CO-validated abstinence, motivation also independently, positively and significantly predicted successful smoking cessation ($b=1.02$, $SE=.40$, 95% CI [.01; .24]). The interaction effect of this model did just not reach statistical significance ($b=-.07$, $SE=.04$, 95% CI [.06; -.14]). Though the result was close to being statistically significant, almost yielding a moderation effect in such a way that the relationship between depression and smoking cessation was weakened by intrinsic motivation. Overall, the interaction of depression and motivation did not significantly increase the model fit and motivation is therefore not a moderator of the relationship between depression and smoking cessation.

Figure 6.

Interaction of Intrinsic Motivation and Depression toward the Three-Month CO-Validated Smoking Abstinence.



Adding the covariates to the respective analyses, it was observed that marital status had a predicting effect on the six-month CO-validated abstinence ($b= .71$, $SE = .36$, $p = .05$) and gender had a predicting effect on the 15-month cotinine-validated abstinence ($b= 1.32$, $SE = .59$, $p = .03$). Though, adding the covariates to the regression models did not affect the moderation effect. Overall, as in no interaction effect of motivation was found in any measurement, it can be assumed that motivation at baseline is not a significant moderator of the relationship between depression and smoking cessation, so that Hypothesis 3 was rejected.

Interaction of self-efficacy. The fourth hypothesis assumed self-efficacy to moderate the relationship between depression and smoking cessation in such a way that self-efficacy

buffers against the negative effect of depression on smoking cessation. Overall, results showed that there was no significant moderation effect of self-efficacy at baseline (T0) on the relationship between depression at baseline (T0) and smoking cessation in the biochemically validated measures (CO-measure at T1, T2, T4, Cotinine-measure at T1, T4). Though, the regression analysis revealed some other findings. Depression was found to be a significant predictor of people's self-reported abstinence at six months ($b=.07$, $SE=.05$, 95% CI [.01; .13]) and at 15 months ($b=.09$, $SE=.04$, 95% CI [.01; .18]). It was also observed that self-efficacy (T0) is a significant predictor of self-reported abstinence at nine months ($b=.14$, $SE=.06$, 95% CI [.02; .26]).

The covariates marital status and gender were added to the analyses of CO-measure at T2 and Cotinine-measure at T4, respectively. Adding the covariates to the respective analyses, the results showed that marital status was not significantly related to the six-month CO-validated abstinence ($b= .69$, $SE = .34$, $p = .054$). Gender was significantly related to the 15-month cotinine-validated abstinence ($b= 1.21$, $SE = .59$, $p = .04$) but did not influence the interaction effect. Overall, as no interaction of self-efficacy at baseline on the relationship between depression at baseline and smoking cessation (T1-4) was significant, Hypothesis 4 was rejected.

Table 2*Means, Standard Deviations and Zero-Order-Correlations of all Study Variables.*

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Gender	1.5	.50	-														
2. Age	47.07	12.69	-.16**	-													
3. Marital Status	1.37	.48	.11*	-.08	-												
4. Education	.64	.48	-.12*	-.07	-.02	-											
5. Motivation	1.31	.46	-.01	.10	.02	-.10	-										
6. Dependence	5.32	2.81	.09	-.08	.10	-.08	-.01	-									
7. Negative Attitude	-6.57	3.30	-.07	.20**	.04	-.06	-.02	-.16**	-								
8. Positive Attitude	10.21	2.86	.07	-.12*	-.11	-.08	-.08	-.08	-.10	-							
9. Self-efficacy T0	-3.39	5.05	-.03	.18**	-.03	-.02	-.09	-.15**	.20**	.05	-						
10. Depression T0	7.04	8.16	.04	-.01	.11*	-.12*	.07	-.12*	-.20**	-.02	-.19*	-					
11. CO measure T1	1.73	.44	-.07	-.01	.09	-.02	.11	-.02	.01	.01	-.12*	.08	-				
12. CO measure T2	1.84	.37	.02	-.05	.13*	-.08	.06	-.08	-.02	.05	-.05	.09	.40**	-			
13. CO measure T4	1.92	.27	.07	-.10	.05	-.07	.01	-.07	-.05	.07	.01	.10	.26**	.39**	-		
14. Cotinine measure T1	1.88	.33	.13*	-.01	.09	-.06	.04	-.06	.02	-.01	-.01	.09	.50**	.41**	.26**	-	
15. Cotinine measure T4	3.08	.69	-.02	-.12*	.01	-.06	.01	-.06	.01	.09	-.06	.11*	.17**	.31**	.67**	.25**	-

Note. Pearson's *r* was performed to assess associations between the study variables. *M* and *SD* represent mean and standard deviations, respectively. The sample consisted of two genders (1=male, 2=female), two marital status (1=with a partner, 2=alone), two educational backgrounds (0=lower education, 1=higher education) and two motivations (1=intrinsic, 2=extrinsic). All smoking cessation variables (CO and Cotinine) were binary (1=quitters, 2=smokers). *N*=316.

* $p < .05$. ** $p < .01$.

Discussion

As smoking is related to diverse negative health consequences, being the leading reason for preventable and premature death globally, a clinical study on smoking cessation was conducted to support smokers in their quitting process by qualified healthcare professionals while at the same time having the possibility to get more insights into the predictors, underlying mechanisms and boundary conditions of successful smoking termination (Pirie et al., 2013; WHO 2020). The study was a randomized controlled non-inferiority trial with a longitudinal design of four waves, whereby measurements took place at the beginning of the study (T0), after three (T1), six (T2), nine (T3) and after 15 months (T4) (Siemer et al., 2016). This study focused on successful smoking cessation and assessed how and under which conditions self-efficacy and intrinsic motivation are related to it. To get more insight into the interplay of intrinsic motivation, self-efficacy and smoking cessation, it was researched whether stopping to smoke at once can explain the relationship between the two or if they can buffer against the negative influence of a depression on smoking cessation.

Overview of the main findings

The present study found that intrinsic motivation and self-efficacy did not play an as important role in successful smoking cessation as assumed. The analysis showed that no full mediation or moderation effects as proposed were found. Intrinsic motivation neither was significantly related to smoking cessation, nor did it positively contribute to people's quitting strategy cold turkey. Nevertheless, the quitting strategy cold turkey was significantly related to smoking cessation, so that this strategy can be confirmed to be preferable over stopping gradually. It was also found that people's self-efficacy additionally positively influenced people's decision to stop at once. Self-efficacy was not found to protect against being depressed and its associated difficulties in the quitting process, but the study found near marginal significant results for intrinsic motivation to buffer against the negative influence of a depression on smoking cessation measured by the three-month CO-validated abstinence. Lastly, against assumptions and theoretical derivation of the SDT, SCT and TPB, intrinsic motivation was not associated with self-efficacy or positive or negative attitudes.

Underlying mechanisms of smoking cessation

The first hypothesis stated that the relationship between intrinsic motivation measured at baseline and smoking cessation across the duration of the study is mediated by the quitting strategy to stop at once. Overall, there was no mediation found, neither after controlling for confounders, so that the quitting strategy cold turkey did not mediate the relationship between

intrinsic motivation and smoking cessation. An explanation for this finding might be attributable to the way motivation was measured. In the present study, intrinsic motivation was assessed by a forced-choice item, where participants had to choose the best suitable reason for participation that was coded as either intrinsic or extrinsic motivation. This measure yields limited statistical power and poses a threat to the internal validity as measuring the type of motivation by one item might not capture the variation of being intrinsically or extrinsically motivated. Furthermore, this study followed the SDT, whereby especially the type of motivation was determined to be crucial in successful smoking cessation (Deci & Ryan, 1985; Ryan & Deci, 2000). Though, motivation for smoking cessation refers not only to the type of motivation but also to the degree of their motivation (Curry, 1990; 1997). A study on smoking cessation showed that intrinsic motivation was linked to cessation success but in being intrinsically motivated, those who had significantly higher levels of intrinsic motivation were most successful (Curry, 1990). Moreover, motivation was measured at baseline only. Though, research suggests a general trend for motivation to decline over the course of a cessation programme, whereby this effect was weaker for those who were highly motivated at the beginning (Boardman et al., 2005). Additionally, motivation was measured three months before the actual quitting date, which was indicated to be too far away in time to be able to capture the sensitive dynamics of motivation (Taylor et al., 2014).

Nevertheless, the mediation analysis revealed a significant relationship between the quitting strategy cold turkey and smoking cessation at nine-months self-reported abstinence, and in the three-month biochemically validated abstinence (CO- and cotinine-measure). This finding is in line with expectations and previous studies that researched onto this relationship (Cheong et al., 2007; Fiore et al., 1990). As recommended by many quitting guidelines and supported by previous research, quitting at once is the most successful quitting strategy and superior to stopping to smoke gradually (American Cancer Society, 2020; Fiore et al., 1990; Cheong et al., 2007). A possible explanation for this is the steady degradation process of nicotine that is not interrupted by cigarettes in-between as it would be the case in the gradual reduction method. Hereby positive health benefits such as dropping heart rate and blood pressure, increased tasting and smelling sense, reduced coughing and shortness of breath are experienced sooner, making quitters more likely to maintain their abstinence (Hatsukami et al., 2018; Fletcher, 2018).

The second hypothesis was an alternative to the first hypothesis whereby the relationship of self-efficacy at baseline and smoking cessation throughout the study (T1-T4)

was assessed and researched whether this relationship was mediated by the quitting strategy of stopping at once. The findings did not support an existing mediation effect of the cold turkey quitting method between self-efficacy and smoking cessation, neither after controlling for the covariates gender and marital status. However, the mediation analysis offered support for some links. Self-efficacy was found to be related to the quitting strategy to stop at once. No previous studies researched onto this relationship before but as theoretically derived from the SCT by Bandura (1986), people's believe in their capabilities, positively influences their choice to choose the quitting strategy cold turkey. Further, people's self-reported smoking cessation status at nine months showed that self-efficacy and smoking cessation are statistically significantly related. This is in line with previous research that investigated the link between self-efficacy and smoking cessation (Boardman et al., 2005; Condiotte & Lichtenstein, 1981; DiClemente, 1981; Dijkstra & Vries, 2000; Mudde et al., 1995). Nevertheless, all other measurement points did not find an existing relation between self-efficacy and smoking cessation opposed to findings of other studies (e.g., Boardman et al., 2005).

To explain this unexpected finding, a meta-analysis on the relationship between self-efficacy and smoking cessation concluded that a link between the two is most often rather modest when self-efficacy is assessed before the quitting attempt took place, as it was in the present study the case, and stronger when self-efficacy was measured after having quit (Gwaltney et al., 2009). Although not as crucial as expected in predicting successful smoking termination, a literature review stated that self-efficacy is especially important in maintaining abstinence, so measuring self-efficacy and its strength throughout the study and working on increasing it, appears to be favourable for successful abstinence (Ockene et al., 2000). It further is under debate whether high self-efficacy is always preferable as studies show inconclusive findings. On the one hand it is argued and found that high levels of self-efficacy will raise people's goals and goal attainment and enhance an optimistic perception towards reaching those goals while on the other hand, high self-efficacy can backfire because of reduced effort in attaining one's goals due to an inflated sense of progress (Bandura & Locke, 2003; Schmidt & DeShon, 2009; Schmidt & DeShon, 2010; Vancouver et al., 2014).

Boundary conditions of the relationship between depression and smoking cessation

The third and fourth hypothesis investigated the relationship between depression and smoking cessation by taking the two moderators intrinsic motivation (Hypothesis 3) and self-efficacy (Hypothesis 4) into account. The findings of the third hypothesis showed that

intrinsic motivation did not statistically moderate the relationship between depression and smoking cessation at any timepoint. Though, depression was found to be a significant predictor of smoking cessation, independent of motivation, measured by the three-month CO-validated abstinence and the 15-month cotinine-validated abstinence. This finding indicates that with increasing levels of depression, participants tend to have increased success in smoking cessation which is contrary to expectations. As previous findings showed that people with a depression were more likely to start smoking, to develop a nicotine dependency and to experience aggravated withdrawal symptoms when stopping to smoke, it was assumed that higher scores in depression are negatively related to successful smoking cessation (Breslau et al., 1993; Jamal et al., 2012; Mendelsohn, 2012). Yet, a possible explanation could be that because of experiencing fairly strong withdrawal symptoms in between the cigarettes, participants might be more determined in quitting to not experience the withdrawal symptoms for a longer time than necessary. Further, many people with high depression scores indicated to have been or to currently be in a therapy, so that it is possible that people received additional support, possessed additional coping skills or might have a higher readiness to overall make a positive change in their lives, including stopping to smoke (Forman et al., 2012; Lewis et al., 2009).

However, a near-marginal significant interaction effect ($p=.06$) of intrinsic motivation on the relationship between depression and the three-month CO-validated abstinence was found. It showed that intrinsic motivation weakened the effect of being depressed on smoking cessation. A further finding of this study was that people with an extrinsic motivation, a type of motivation driven by external rewards, had higher success rates, especially when their depression score was low (Deci & Ryan, 1985). This implies that depression played a bigger role for people who are extrinsically motivated compared to being intrinsically motivated. Hence, depression creates for extrinsic motivated people a risk factor as it lowers the chances of successful quitting. For intrinsically motivated people, depression was not related to quitting, so that it can be noted that intrinsic motivation weakened the effect of a depression, therefore, protecting against it. This marginal moderation effect is in line with expectations and empirical evidence that proposed intrinsic motivation to buffer against the negative effect of depression on smoking cessation (Haukkala et al., 2000). Important to note is that this finding did not reach statistical significance at the $p>.05$ level, so that no inferences should be made, and the finding should be treated with caution.

Further, the by the social-cognitive theory derived assumption that self-efficacy at baseline might protect against the negative impact of a depression on smoking cessation over

time (T1-4) by positively contributing to people's sense of commitment and success was not validated by the present study (Bandura, 1986). The study results showed that there was no interaction effect of depression and self-efficacy, so that the third hypothesis was rejected which is contrary to expectations. Nevertheless, the zero-order correlations showed that depression and self-efficacy were significantly negatively correlated, so that the lower self-efficacy, the higher the depression scores or vice versa tend to be. This can, therefore, be interpreted in two ways. First, because of low levels of self-efficacy, there might emerge a discrepancy between high expected standards and reached standards and the perceived inability to reach the expected standards might let negative feelings emerge, contributing to experience depressive symptoms over time (Bandura et al., 1999, as cited in Tak et al., 2017). Secondly, high levels of a depression might be related to increased negative self-talk and rumination, being associated with low levels of believes in one's self-efficacy (Bandura, 1977, as cited in Tak et al., 2017).

Associations between predictors of smoking cessation

The study also explored if the motivational and social-cognitive predictors are related to each other. A remarkable finding of this study was the lack of any associations between intrinsic motivation at baseline, and other predictors of smoking cessation outcomes, contrasting with theory. First, it was assumed that self-efficacy and intrinsic motivation are related to each other because they are characterized in a similar way by the SCT and SDT. While the subcomponent competence of intrinsic motivation is characterised by the SDT as people's perception to successfully perform a task, self-efficacy is characterised by the SCT as the belief in successfully performing a task, emphasising the conceptual similarity (Bandura, 1986; Deci & Ryan, 1985; Ryan & Deci, 200). Secondly, it was assumed that people's intrinsic motivation is related to their attitudes towards change. Following the Theory of Planned Behaviour (TPB), attitudes are described as people's overall evaluation of objects, other people or behaviours, influencing people's intention that in turn influence their behaviour, so that attitudes lead via their intentions to behavioural change (Ajzen, 1991; Ajzen & Fishbein, 1977). As the SDT and the TPB both explain drivers of human behaviour, they were also assumed to be related to each other. All the more noticeable, that neither self-efficacy, not people's positive or negative attitudes were correlated with intrinsic motivation. This unusual finding might be attributable to the above-mentioned way intrinsic motivation was measured in this study, creating an exceptional limitation to statistical power.

Furthermore, it was also assessed how self-efficacy is related to other predictors of smoking cessation. Findings revealed that there was a significant weak and positive correlation between self-efficacy and negative attitudes towards smoking cessation. It was expected that self-efficacy as the believe in one's ability to stop smoking was rather correlated with positive attitudes towards smoking cessation such as increased health benefits for oneself and others when quitting instead of negative attitudes (Bandura, 1986; Sheeran et al., 2016). Negative attitudes such as thinking to miss smoking or to be less relaxed when stopping to smoke or anticipating high withdrawal symptoms were expected to be linked to lower levels of self-efficacy as estimating difficulties in cessation might diminish the belief to trust in one's abilities to stop smoking. Though, it could also be that despite or especially because of the negative outlook to terminate smoking, the belief in one's capabilities was stronger because participants expected the process to be more difficult, hence, needed to believe more in themselves. This is in line with a study that showed how self-doubt is related to increased motivation and linked to self-efficacy which was positively related to performance (Schmidt & DeShon, 2010).

Limitations and suggestions for future research

Overall, the study had a few limitations that need to be taken into account and that offer ground for future research in this field. First of all, being supported when stopping to smoke can more than double the success when having suitable supportive measures (WHO, 2019). Though, aid centres often report lower quitting rates (23.6%) compared to people who stop on their own (47.5%) (Fiore et al., 1990). When looking at the quitting rate of this study that was determined based on the intention-to-treat analysis, the success rate lied at 19.3%, being remarkably below the success rate of self-quitters. Though, a study on smoking cessation with comparable study design of a 12-month cessation programme, also reported about abstinence rates of 19% (Christenhusz, 2006). But when putting this finding into perspective, self-quitters are often more confident in their ability to quit and less nicotine dependent while smoking cessation programmes often attract particularly heavy and dose-dependent smokers (Fiore et al., 1990). People taking part in those programmes further have a poorer overall health and often have limited social support that were often identified as a resource in cessation (Curry et al., 1997). In this regard, it might not be surprising that the quitting rates are generally lower as higher addiction rates and a longer past of smoking make it more difficult to quit smoking (Curry et al., 1997; Fiore et al., 1990). But despite the seemingly limited success, cessation programmes are particularly important for those people with these

needs, who often cannot stop on their own and also often are at highest risk for developing severe smoking-related health difficulties (Fiore et al., 1990).

The way intrinsic motivation and self-efficacy were measured in this study created a limitation that should be taken into consideration in future research. Based on measuring intrinsic motivation with a forced-choice item, by its type only instead of including its strength and its distant measurement point of having taken place three months before the actual quitting date, the variable yielded limited statistical power. Therefore, future research should give participants the option to choose from multiple motivational reasons, should measure also the strength of people's motivation, such as by making use of a Likert scale and by measuring it several times throughout the study to assess its dynamic changes and variability over time (Boardman et al., 2005). If it turns out that motivation should be assessed only at baseline, it appears to be more promising to determine participant's readiness to change and their stage to quit smoking as it can give more insight into their determination and openness to initiate a desired behavioral change (DiClemente et al., 1985). Furthermore, as previous studies have shown self-efficacy to fluctuate across the course of a cessation attempt, being more important in maintaining abstinence than in starting to give up smoking, self-efficacy should also be rather tracked over the course of the study (Ockene et al., 2000).

Besides the researched underlying mechanisms and boundary conditions, there are other moderators that were not assessed during the study and that might give more insight into successful smoking cessation, namely perceived risks and benefits of smoking cessation and self-regulation. Perceived risks were found to be negatively related to treatment outcomes and motivation while perceived benefits were positively related to treatment outcomes. Both are linked to people's intention to quit which, following the TPB, is an antecedent of actual behavioural change and a successful treatment response (Ajzen, 1991; McKee, 2005). In this regard, assessing perceived risks and barriers, researching how they are related to motivation, overall quitting success and to SDT and components of the TPB offers promising ground to develop appropriate cessation support to aid prospective quitters in their smoking termination process. Secondly, self-regulation as a crucial resource and the ability to control impulses and urges and to resist temptations but also to comply to goals, rules or regulations appears to be another promising moderator (Gailliot et al., 2007; Hall & Fong, 2007; Baumeister et al., 1998). Quitting attempts are most often connected to temptations to smoke and, require quitters to control their urges and impulses and often result in relapses (Baumeister & Vonasch, 2015). So far, there was much research undertaken in this field, but it still appears relevant to measure trait- and state self-regulation across the duration of a study, how self-

regulation develops over the course of the quitting attempt, if it changes after a relapse and how it is related to other important predictors such as self-efficacy or motivation.

A minor limitation during this study was an anomaly in participant age, indicating that the exclusion criteria were not followed as expected. Another limitation that often occurs in studies with a longitudinal study design, is the disadvantage of relatively high drop-out rates over time which was amplified by missing data of people who did not attend the appointments during which the biochemically validated smoking abstinence was assessed, leading to a lower quitting rate based on the intention-to-treat principle (Spector, 2001). To find robust effects, a recommendation for future research is to include a higher sample size from the beginning and to set the expected drop out especially in the case of smoking cessation programmes higher.

Though, this study also has several advantages. Longitudinal studies are superior to cross-sectional studies as they can assess concepts that cannot be measured experimentally, as time series of cross-sectional data of the same sample is collected that can offer insights into the development of variables over time and as it allows to assess cause-and effect relationships (Field, 2013; Spector 2001). Previous research has shown that the presence of trained physicians plays a crucial role in quitting and maintaining abstinent, so that another strong point of this study was the inclusion of trained healthcare professionals (Fiore et al., 1990; Simmons et al., 2009).

Practical Implications

This clinical study offers some implications for future smoking cessation programmes and healthcare professionals. Although the study's results did not align with findings of previous studies of self-efficacy playing an important role in smoking cessation, some research suggests that self-efficacy plays a bigger role in maintaining abstinent compared to stopping to smoke than in stopping to smoke (Boardman et al., 2005; Condiotte & Lichtenstein, 1981; DiClemente, 1981; Dijkstra & Vries, 2000; Gwaltney et al., 2009; Mudde et al., 1995; Ockene et al., 2009). In this regard, increasing people's self-efficacy during a quitting attempt is not of harm, but it might be especially important during participant's abstinence phase where they need to maintain high levels of self-efficacy to resist a relapse (Ockene et al., 2000). Future cessation programmes should take this finding into account and should plan especially during abstinence phases to work on increasing people's degree of self-efficacy. Additionally, especially in the case of relapses, people need to be increasingly supported in their self-efficacy as people's degree of self-efficacy drops when relapsing (Boardman et al., 2005).

Furthermore, people's mental resources play an important role in the cessation process whereby mental well-being and quality of life were pointed out to be especially important for people with higher scores in depression. People's quality of life (QoL) was found to be an important predictor in successful smoking cessation and individuals with low QoL were less successful in quitting (Goldenberg et al., 2014). Moreover, a previous study has shown that relapses were linked to disappointments and decreased levels of mental health, so that people who relapse, especially if they also possess high levels of depression, should be additionally supported in their QoL and well-being (Taylor et al., 2014).

But not only patient's mental resources, self-efficacy and motivation should be held at a high level, also healthcare providers should actively look out for possibilities in remaining high levels of it. A study on Dutch healthcare professionals who offered support in cessation treatment showed that many healthcare professionals perceive psychological barriers in working with patients and do not find sufficient room to use motivational interviewing as they perceive participants to favour factual information. Not being able to motivate the patients in turn also negatively influenced their own self-efficacy and decreased their perception on making a positive contribution to the patients (de Ruijter et al., 2017). Despite these challenges, they overall reported to be confident with the therapy and had the impression to be able to provide a client-centred and empathic therapy, therefore, fulfilled the core elements in motivational interviewing (de Ruijter et al., 2017). A communication technique that shares the same core values with motivational interviewing but appears to be particularly relevant during smoking cessation programmes is called autonomy support. Autonomy support is derived from the SDT and is about supporting patient's autonomous regulation and perceived competence and aimed at increasing their responsibility for their health-relevant behaviour (Williams et al., 2002). Working with this communication technique will help participants in developing resources, increase their intrinsic motivation and provides them with higher perceived competence in reaching their goals.

Conclusion

To conclude, this study investigated the predictors, underlying mechanisms and boundary conditions of successful smoking cessation in form of a clinical study with a longitudinal design of four waves. The study researched on two main drivers of successful smoking cessation, namely self-efficacy and intrinsic motivation. In particular, it was investigated how self-efficacy and intrinsic motivation are related to the quitting strategy cold turkey and if they contribute to a lower vulnerability for relapse for people with a depression. The results have shown that the quitting strategy cold turkey did not mediate the relationship between self-efficacy/ intrinsic motivation and smoking cessation. Though, it was found that stopping at once is significantly related to a successful smoking cessation. Moreover, self-efficacy and intrinsic motivation did not moderate the relationship between depression and smoking cessation by buffering against the negative effect of a depression on smoking cessation but still positively contributed to successful smoking cessation when being depressed.

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