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Exploration of the relationship between self-efficacy towards smoking cessation and smoking behaviour within four COPD patients, participating in the REDUQ II study

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Abstract

Aim: Chronic obstructive pulmonary disease is the fifth leading cause of chronic morbidity and mortality and is related to years of smoking. A combination of a behavioural intervention, with the aim of smoking reduction, and Nicotine Replacement Therapy like the REDUQ study, can have beneficial effects on smoking cessation. However, the REDUQ intervention was not effective. The REDUQ II study was set up to understand and evaluate the effects of the intervention and the smoking-related cognitions and behaviours during the process of smoking reduction. This paper focuses on the relationship between smoking behaviour and self-efficacy towards smoking cessation over time and uses a within-subject approach in four of the participants.

Method: A repeated measures ANOVA and an independent sampled t-test was executed to investigate whether there is a significant change in the degree of self-efficacy towards smoking cessation in the intervention phase, within the intervention group in comparison to the control group. Then several linear multiple regression analyses were conducted for each of the selected participants from the REDUQ SCED study over 26 measurements, while taking the autocorrelation into account. This was done to investigate whether there is a correlation between self-efficacy towards smoking cessation and smoking behaviour over time and to investigate the nature of the reciprocal relationship within each of the four selected participants.

Results: There was no significant change of self-efficacy towards smoking cessation in the intervention phase in comparison to the other phases found, neither in the participants from the intervention nor in the control group. The relation between the two relevant variables was found not significant. While investigating the nature of the reciprocal relationship of the two variables (marginal) significant negative relations in two of the participants were found. In this case self-efficacy towards smoking cessation operated as the dependent variable.

Discussion: The results of the present study are in contrast to earlier studies which found self-efficacy towards smoking cessation a significant predictor for smoking cessation. This study rather indicates that the reduction in smoking behaviour predicts self-efficacy. The degree of self-efficacy did not change during the SCED study within both groups and maintained relatively high. The absence of changes can be an explanation therefore, that the REDUQ-study was not effective. Another explanation could be that self-efficacy is not an important predictor at all, related to smoking cessation. One further conclusion that can be drawn based on the present study is that self-efficacy predicts behavioural change related to smoking behaviour differently in individuals. Further research is necessary to investigate how strong certain psychosocial predictors within participants are, related to their stages of change towards their addiction in order to develop successful smoking cessation interventions for COPD patients.

Table of Contents

..... 1

1. Introduction 5

1.1 Chronic obstructive pulmonary disease 5

1.2 Smoking cessation and smoking reduction 5

1.3 The REDUQ study and the REDUQ II-study 6

1.4 The Theory of Planned Behaviour related to health behaviours 7

1.5 Self-efficacy and Smoking 8

1.6 Aims of this paper 9

2. Methods 10

2.1 Design and Procedure 10

2.2 Sample 11

2.3 Treatment of the subjects 11

2.4 Materials 12

2.4.1 Self-efficacy variable 12

2.4.2 Smoking behaviour variables 12

2.5 Selection of the participants 13

2.5.1 Participant 301 13

2.5.2 Participant 309 13

2.5.3 Participant 310 14

2.5.4 Participant 367 14

2.6 Data analysis 15

2.6.1 Missing data 15

2.6.2 Research question 1. Change in self-efficacy during the intervention phase (B) 15

2.6.3 Research question 2- Correlation between self-efficacy and smoking behaviour 15

2.6.4 Research question 3- Causal relation between self-efficacy and smoking behaviour ... 16

3. Results 16

3.1 Research question 1: Intervention group 16

3.2 Research question 1: Control group 16

3.3 The effect of the intervention group in comparison to the control group 17

3.4 Autocorrelations 18

3.5 Research question 2 20

3.6 Research question 3 22

4. Discussion 22

4.1 Strengths of the study 24

4.2 Limitations of the study 25

4.3 Suggestions for further research 25

5. References 27

6. Appendix 30
6.2 C: Table. Self-efficacy during all phases within the control group 31

1. Introduction

1.1 Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is the fifth leading cause of chronic morbidity and mortality in the developed world and is related to years of smoking (Viegi et al., 2007). The World Health Organization (WHO, 2015) estimates that 65 million people suffer from moderate to severe COPD. More than three million people died in 2012 of COPD. According to the WHO (2015), this was six percent of all deaths globally in that year. Estimates of the WHO show that in 2030 COPD will become the third leading cause of death worldwide (WHO, 2015). According to the Global Initiative for Obstructive Lung Disease (GOLD, 2016) guidelines, COPD is a preventable and treatable disease which pulmonary component is characterised by airflow limitation that is not fully reversible. This airflow limitation is associated with the inflammatory response of the lungs to noxious particles or gases (GOLD, 2016). As reported by Viegi et al. (2007), COPD influences the health status of people and contributes to a high disease burden and an early mortality. COPD patients have comorbid diseases like muscle wasting, cardiovascular disease, depression, reduced fat-free mass, osteopenia and chronic infections (Viegi et al., 2007).

Predictive factors of COPD mortality are the starting age of smoking, the total years smoked and the current smoking status (Viegi et al., 2007). According to Mannino and Buist (2007) 73% of COPD mortality in high-income countries are related to smoking. Not all smokers develop COPD because it is highly affected by genes but about 50% of smokers have been noted to develop COPD (Mannino & Buist, 2007).

1.2 Smoking cessation and smoking reduction

According to the WHO, smoking cessation is an evidence-based treatment to improve the health status of people with COPD (WHO, 2015). This treatment can improve the COPD prognosis through decreasing the annual decline in lung function, reducing the symptoms of cough and sputum, improving the health status and reducing the exacerbations of COPD (GOLD, 2015).

However, Fagerström (2005) states that smoking cessation seems to be difficult for most COPD patients. According to him, one reason for this is that a lot of COPD patients already tried to stop smoking in the past, but did not succeed. These experiences make it even more difficult, to try to stop smoking again. To directly stop smoking seems to be an impossible task to accomplish for COPD patients who have been smoking for years (Fagerström, 2005).

Therefore, a possible alternative to smoking cessation is smoking reduction. A successful reduction of 50% or more leads to less inflammation and a reduced decline in lung function in heavy smokers (Pisinger and Godtfredsen, 2007). Furthermore, according to Chan et al. (2011) smoking reduction can function as an intermediate step towards complete cessation and this way it can be especially effective for smokers, who are not motivated to quit smoking immediately. It is also found that a reduction in smoking improves self-efficacy, which is associated with increased cessation (Cinciripini, Lapitsky, Seay, Wallfisch, & Kitchens, 1995). Smoking reduction in COPD patients leads

to a higher motivation regarding smoking cessation. This way the probability that they actually are able to stop smoking, becomes higher (Tverdal & Bjartveit, 2006; Willemsen & Emst, 2008). Carpenter, Hughes, Solomon and Callas (2004) found that a combination of a behavioural intervention, with the aim of smoking reduction, and Nicotine Replacement Therapy (NRT) can have beneficial effects on smoking cessation, especially among smokers who are not willing to quit. One study with a combination therapy like this is the REDUQ study.

1.3 The REDUQ study and the REDUQ II-study

The REDUQ study is a Dutch intervention with the aim that COPD patients successfully reduce their smoking habit to 50% or more. This method is used to increase their motivation to quit, which makes them actually ready to quit. Ready to quit means the intention to stop smoking within a month. This is based on the transtheoretical model (Prochaska & DiClemente, 1992). The stages of this model represent a temporal dimension. It distinguishes between the stages: Precontemplation (not ready), Contemplation (getting ready), Preparation (Ready) and Action. According to Prochaska and DiClemente (1992), the transtheoretical model recognizes change as a process over time (Prochaska & DiClemente, 1992).

The strategy of the intervention is to let the patients take small, attainable (intermediate) steps so that the transition to completely quit smoking is smaller. By using this strategy, it was expected that the participants get, while reducing their cigarette consumption, the feeling that they are able to achieve their goals. This way one hoped that the participants improve their attitude and their self-efficacy towards quitting and rebuild levels of self-control over their addictive smoking habit.

Within this REDUQ study there was one experimental group for which an intensive smoking reduction intervention (SRT) was developed. This intervention combines on the one hand behavioural therapy and on the other hand nicotine replacement therapy (NRT). The REDUQ study compared the intensive smoking reduction therapy to a self-help intervention. As soon as a person showed readiness to quit, an intensive smoking cessation programme was advised to this person regardless of the group.

Results show that the REDUQ intervention was not effective in comparison to the self-help control intervention in reducing smoking and in smoking cessation (Hagens, Pieterse, Brusse-Keizer & van der Palen, 2014).

A new study was set up to understand this negative result and to measure behavioural variables such as the daily cigarette consumption and also psychosocial predictors of behavioural change such as social influence, attitudes and self-efficacy towards quitting. This study is the REDUQ II study. Part of the REDUQ II study is a single-case experimental design (SCED). This design can deal with variations within and between subjects. The SCED study assesses the mechanisms of cognitive and behaviour change within the participants of the intervention. This is done, to evaluate the effects of the smoking reduction intervention and the smoking-related cognitions and behaviours during the process of smoking reduction, while each subject serves as its own control. Understanding the factors that keeps people from reducing or quitting smoking is necessary to improve future

smoking cessation interventions.

For the SCED study a combination of an ABA design and a multiple baseline design was used. The ABA design consists of the following three phases: no-intervention phase (A), intervention phase (B), and no-intervention withdrawal phase (A'). This design offers the possibility to examine cognitions and behaviour before, during and after the intervention. In the A-phase the baseline data about the patient will be provided. In this phase no treatment or intervention will be provided. If the intervention is provided, the B-phase will give detailed information about the changes in cognitions and behaviours during the treatment. In the case of changes, this information can explain when, how and why changes occur. If the change occurs only after the implementation of the intervention these changes are seen as evidence for the effectiveness of the treatment.

The ABA design does not address the role of extraneous factors selectively associated with the independent variable (Johnston & Pennypacker, 2009). This is why also a multiple baseline design is used. In order to fulfil the requirements for a multiple baseline design the A, B and A' sequence is replicated four times across the participants and the length of the baseline phase varies across the subjects. The participants were divided into three groups with different lengths of baseline and post-intervention-phases. By using different baselines of different lengths, treatment effects and changes in cognitions like intention-to-quit and smoking behaviour can be distinguished from random effects.

This study included in total 3 phases (A, B and A') and four study groups with different length of baseline. The length of the A-phase and the follow-up A'-phase can vary from five to eight weeks. If for example someone has a longer A-phase his or her follow up A'-phase will be shorter. The total duration of the phases A and A' for each participant is 13 weeks. The A-phase was specified and assigned to the participants a priori to assure that based on the non-concurrent baselines conclusions can be drawn. The design of the REDUQ II SCED study is shown in Figure 1.

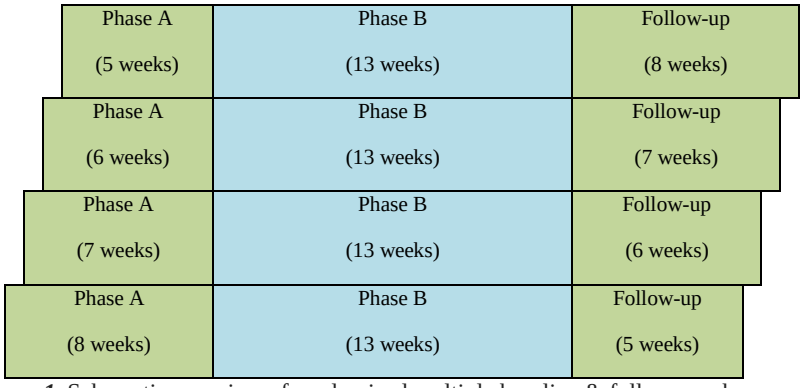

Figure 1. Schematic overview of randomized multiple baseline & follow-up phases

1.4 The Theory of Planned Behaviour related to health behaviours

One theory that is currently often used related to health behaviours and interventions, is the Theory of Planned Behaviour (TPB). According to this theory, the proximal determinants of behaviour are the intention to engage in a certain behaviour and the perceived behavioural control. Intentions are according to Ajzen (1991) a person's motivation to perform the behaviour. People with strong

intentions are thus likely to exert more effort to achieve their goals. Intentions are assumed to be a linear function of the cognitions attitude (positive or negative evaluation of the behaviour), subjective norm (perceived approval of performing the behaviour) and perceived behavioural control (PBC) (Ajzen, 1991). PBC originates from the self-efficacy theory proposed by Bandura (1977). The concept of PBC and the concept of self-efficacy are comparable (Fishbein & Cappella, 2006). Self-efficacy is of central interest in this paper.

Self-efficacy is a concept that was developed by Bandura (1977). According to his Social Learning Theory, it is next to the incentives and outcome expectations a key concept in predicting and explaining behaviour. He further states that self-efficacy means the expectations about one's ability, to engage in or execute the behaviour. The self-efficacy expectations show the beliefs about how capable one is of performing the behaviour that leads to the desired outcomes. Self-efficacy does not refer to a character trait; it is a belief about capabilities of performing specific behaviours in particular situations (Bandura, 1977). According to Bandura (1977), self-efficacy influences all aspects of behaviour. This includes new behaviours, inhibition of existing behaviours and disinhibition of behaviours. It affects the choice of the social environment, the amount of efforts one invests on a task and the length of time one will persist in the face of obstacles. Research has shown that interventions that target behavioural control or self-efficacy beliefs based on the TPB are effective in changing the health behaviour of a person directly (Johnston et al., 2007).

1.5 Self-efficacy and Smoking

The influence of self-efficacy on smoking behaviour has already been studied earlier. One of these studies is the Annenberg tobacco survey (Slovic, 2001). This survey found that the degree of self-efficacy towards smoking cessation influences the smoking behaviour of the participants. It was also found that the perceived ease of quitting predicts the intention to quit and reduces the number of smoked cigarettes. The general result of this study shows that self-efficacy towards smoking cessation is a deterrent to continued smoking (Slovic, 2001).

A study by Prenger et al. (2013) focused on time varying predictors for cessation and found that the intention to quit and self-efficacy are the strongest covariates for cessation. This effect is only observable with a time varying measurement because the variables show a delayed effect. The interplay between self-efficacy, the intention indirectly and the quitting behaviour determine the long-term maintenance of abstinence within the lengthy process of smoking cessation (Prenger et al., 2013). Also a reciprocal relation of cognitions and behaviour was found. Furthermore, it was concluded that self-efficacy is valid for making inferences on the longer term. According to this study, the cognition self-efficacy had a small negative effect during the intervention phase which turned into a positive effect in the post-treatment phase. This effect even grew in the end of the follow-up period (Prenger et. al, 2013). Based on the results of the mentioned studies above one can say that the degree of self-efficacy affects the behaviour of a person in the longer term.

1.6 Aims of this paper

The additional study of the earlier executed REDUQ intervention was set up to investigate why it was not effective in comparison to the self-help control intervention, as mentioned earlier. Understanding these results means to understand the factors that underlie relapse or rather that keeps them from reducing or quitting. The knowledge of these factors is necessary to improve smoking cessation interventions. Therefore, behavioural and psychosocial predictors of behavioural change related to smoking behaviour were measured. This paper focuses on one of the predictors of successful reducing and stopping with smoking, more precisely on self-efficacy towards smoking cessation.

When a set of measures is collected at multiple points in time from multiple individuals there are two possible approaches to analyse the predictors of behaviour. These approaches are the between-subject and the within-subject analysis (Raudenbush & Bryk 2002). According to Molenaar (2004) the majority of psychological theories posit within-subject processes but the conducted research to evaluate these theories often involves the collection and analysis of between-subject data. These data are mostly in the form of cross-sectional or single time point assessments of behaviour although it is known that such data are poorly suited for evaluating within-person processes. This is why a proper separation of between-subject and within-subject effects is necessary to evaluate many theories in psychology (Molenaar, 2004). Between-subject approaches do not reflect the underlying within-subject principle that is proposed by the TPB. Furthermore, there is consistently more recognition of the need to understand the cognition and processes within one person (Curran & Bauer, 2011). According to Molenaar and Campbell (2009) between-subject design cannot establish whether the models can predict and change the behaviour within one individual. As mentioned earlier, the within-subject design consists of repeated measurements of variables within one individual over a period of time. This way variability in the measured cognitions can be observed and theoretically and clinically important relationships between variables can be explored (Crane, Martin, Johnston & Goodwin, 2003). One aim of this paper therefore is to execute a within-subject approach based on the TPB.

Another aim of this study is to investigate the reciprocal relation of the cognition self-efficacy and behaviour found earlier over time (Prenger et. al, 2013). Bandura's Social Cognitive theory (1986) already explained psychosocial functioning in terms of reciprocal causation. According to him behaviour, environmental events, cognitive, biological and other personal factors are operating as interacting determinants that influence each other bidirectionally. These aims lead to the following research questions and hypotheses:

Research question 1: Does self-efficacy towards smoking cessation change during the intervention phase (B) of the REDUQ II SCED study within the COPD patients of the intervention group in comparison to the control group?

Hypothesis 1: Self-efficacy towards smoking cessation increases linearly within the COPD patients of the intervention group during the intervention phase of the REDUQ II SCED study.

Hypothesis 2: Self-efficacy towards smoking cessation does not change within the COPD patients of the control group during the intervention phase of the REDUQ II SCED study.

Research question 2: Is there a correlation between self-efficacy towards smoking cessation and smoking behaviour (number of daily cigarettes) within one subject over time during the whole REDUQ II SCED study?

Hypothesis 2: There is a negative correlation between self-efficacy towards smoking cessation and smoking behaviour over time during the whole REDUQ II SCED study.

2.1 People who have a high degree of self-efficacy towards smoking cessation are more likely to reduce their smoking behaviour over time during the whole REDUQ II SCED study.

2.2 People who are reducing their smoking habit or completely quit smoking during the whole REDUQ II-study get increasingly more self-efficious over time.

Research question 3: What is the reciprocal nature of the relationship between self-efficacy towards smoking cessation and smoking behaviour?

Hypothesis 3: There is more often a rise of self-efficacy towards smoking cessation after his reduction of cigarettes smoked.

2. Methods

2.1 Design and Procedure

The REDUQ II study is a quantitative analysis embedded within a multi-centre randomised controlled trial. Part of this study is a single-case experimental design (SCED) study as described earlier. The SCED study is primarily evaluative and makes investigating longitudinal relationships in a limited number of patients possible. The REDUQ II study was conducted at the pulmonary outpatient clinic of the Medisch Spectrum Twente hospital in Enschede.

The recruitment of new participants for the REDUQ II study began in August 2013. Potential participants were given explanations and implications of the study and were asked to complete a brief screening interview via telephone. The aim of this procedure was to verify the preliminary inclusion criteria of the participants. Those who fulfilled the inclusion criteria were sent an invitation letter with participant information material and a consent form. In addition, they were invited to an information session. After providing informed consent, the patients attended an intake visit with a chest physical to determine final eligibility based on medical history screening and a lung function test. The patients also completed several other questionnaires that asked for the demographics, smoking (cessation) history, tobacco dependence, health status, determinants of health behaviour change, anxiety and depression. Then the patients who fulfilled the inclusion criteria were randomly allocated to an intervention or a control group by using a computer-generated schedule.

2.2 Sample

To participate in the REDUQ II study the participants had to meet several inclusion criteria. The participants were between 40 and 80 years old, diagnosed with COPD, in one of the GOLD stages I-IV, had two or more failed lifetime quit attempts, smoked at least 10 cigarettes per day at the beginning of the study, and were motivated to reduce their smoking behaviour but were not ready to quit (yet).

Exclusion criteria were inability to understand, speak, read and write Dutch, indications for the use of all forms of nicotine replacement therapy, serious psychiatric morbidity, pregnancy, breastfeeding or intending to conceive during the course of the study.

The REDUQ-II study had a sample size of 22 COPD patients of the outpatient clinic of the Medisch Spectrum Twente hospital. 15 (68.2%) of these participants are male and 7 (31.8%) are female. The average age was 61.55. The youngest participant was 48 and the oldest was 77. Further information about the sample of the REDUQ II study are shown in Table 1.

Table 1. ***Baseline characteristics of the whole sample***

Demographics	N	Percentage
Gender		
Male	15	68.2%
Female	7	31.8%
Family status		
Married or living together	11	50%
Divorced or past durable living together	7	31.8%
Widow or widower	2	9.1%
Single (never been married or living together)	2	9.1%
Reason for participation		
I want to reduce smoking, but not completely quit smoking	5	22.7
I first want to reduce smoking and then completely stop smoking	15	68.2
Other reason	2	9.1

2.3 Treatment of the subjects

According to the REDUQ study protocol, the intensive reduction-to-quit smoking programme of the intervention group consisted of behavioural counselling and nicotine replacement therapy (NRT). The behavioural counselling part included eight small-group sessions of 90 minutes, provided by smoking cessation counsellors, and four telephone contacts of 10 minutes each between the meetings over a period of 18 months. For the participants of the intervention group, the NRT was for

free for a period of 12 weeks. The treatment of the control group consisted of one information meeting, which took 60 minutes, and provided information on smoking reduction, quitting and a self-help manual with reduction strategies. As soon as participants, regardless of study group, showed readiness to quit, they were referred to an intensive smoking cessation programme.

During the SCED study, in total 26 telephone questionnaires were taken to measure behavioural variables and psychosocial predictors of behavioural change. Furthermore, the setting and methodology were constant throughout the study to maximize the experimental control. There was also tried to call each participant on the same day of the week at about the same time every week. The whole REDUQ intervention has a duration of 18 months, which is only be the participation in the smoking reduction programme or in cessation programme. The SCED study began five to eight weeks before the start of the intervention.

2.4 Materials

All participants completed a total of 26 weekly telephone-administered questionnaires during the baseline-stage (phase A), the (reduction-) intervention-stage (phase B) and the maintenance/postintervention (phase A'). This questionnaire consisted in total of 12 items concerning behavioural variables and psychosocial predictors of behavioural change. One example of a behavioural variable is the daily cigarette consumption. Psychosocial predictors of behavioural change are for example self-efficacy or readiness-to-quit.

2.4.1 Self-efficacy variable

Self-efficacy is measured by using the following variable: 13c): "*On a scale from 1 (not at all) to 10 (very much): How confident are you that you can manage to become a non-smoker (if you smoke now) or to continue of being a non-smoker (if you already stopped)*?".

2.4.2 Smoking behaviour variables

To evaluate the smoking behaviour of a patient the self-reported number of daily smoked cigarettes compared to baseline consumption was used as an indicator for smoking reduction. The variable that measures smoking behaviour is: "*How many cigarettes (roll-ups, cigarillos, cigars, pipe) have you on average smoked in the last seven days every day*?". The answer options distinguish between weekdays and weekend. The patient had to fill in how many cigarettes on average he or she smoked during the week and during the weekend previous to the measurement. One assumes that the consumption of cigarettes might be different during the week and at weekends. The questionnaire consisted in total of eight items. This question was based on the questionnaire about smoking behaviour developed by Heatherton, Kozlowski, Frecker and Fagerström (1991).

To measure the smoking behaviour of a patient, the item 4 which asks for the cigarette consumption must be added. Item 4 distinguishes between smoking behaviour on weekdays and on weekends. From these numbers one number is made. The formula for calculating a weighted average

score for cigarettes per day is *(Cigarettes per day on weekdays x 5 + Cigarettes per day on the weekend x 2)/7*.

2.5 Selection of the participants

To answer the research questions, four intervention group participants were selected and analysed separately. Two of them stopped smoking during the intervention (randomization number 301 and 309) while the other two did not stop smoking (randomization number 310 and 367). Participant 309 has meanwhile stopped smoking but had a relapse during the intervention. All of the selected participants had the same reason to participate in the REDUQ II-study, at first they wanted to reduce and then completely stop smoking. These participants were chosen because of the expectation that their degree of self-efficacy in relation to reducing smoking or stopping smoking might be different if they are following different goals. In order to visualize the participants' scores on the two relevant variables, graphs were created. The selected participants are described below.

2.5.1 Participant 301

Participant 301, who successfully quit, is a 71-year-old man who is married or living with a partner. In the last three years, he tried two times unsuccessfully to quit. His baseline self-efficacy scores were high with eight on 50% smoking reduction and ten on cessation. At the time of the baseline measurement this participant smoked on average eight cigarettes per day. Figure 2 shows the daily average number of cigarettes participant 301 smoked as well as his degree of self-efficacy towards smoking cessation during the intervention.

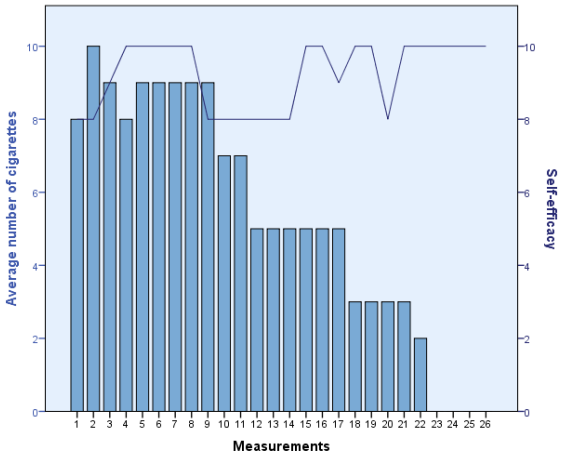

Figure 2. Participant 301: Self-efficacy towards smoking cessation and smoking behaviour

2.5.2 Participant 309

Another participant who quit smoking during the intervention has randomization number 309. This participant relapsed during the intervention and started smoking again. He is a 77 years old man who is married or living with a partner. Participant 309 smoked in average 16 cigarettes daily at baseline. He answered five to the question in the baseline measurement how much confidence he has to smoke 50% less and eight to permanently stop smoking. Figure 3 shows the daily

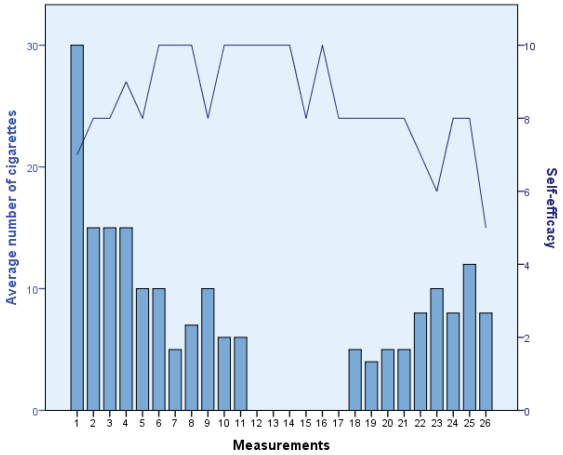

Figure 3. Participant 309: Self-efficacy towards smoking cessation and smoking behaviour

average number of cigarettes participant 309 smoked and his degree of self-efficacy towards smoking cessation during the intervention.

2.5.3 Participant 310

The third selected participant with randomization number 310 is a 48 years old men who is married or living together. He smoked on average 22 cigarettes daily at baseline. This participant tried once to stop smoking in the last three years. He answered the question how confident he is to be able to smoke 50% less with an eight and to permanently stop with a six at baseline. Figure 4 shows the two relevant variables within participant 310 over 26 weekly measurements.

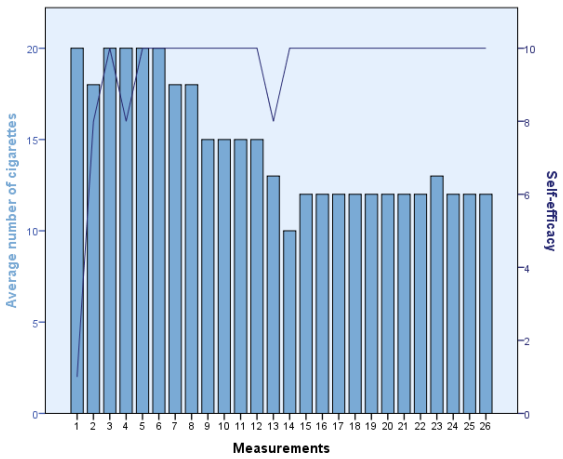

Figure 4. Participant 310: Self-efficacy towards smoking cessation and smoking behaviour

2.5.4 Participant 367

The fourth selected participant is the participant with randomization number 367. This participant is a 58 years old man who is married or living with a partner. He smoked on average 25 cigarettes daily at baseline and did not try to stop smoking in the last three years. Nonetheless he is confident in being able to smoke 50% less, which he answered with a nine, and to completely stop smoking, which he answered with a seven. In Figure 5 the two relevant variables within participant 367 are shown. Table 2 gives an overview over relevant characteristics of the selected participants.

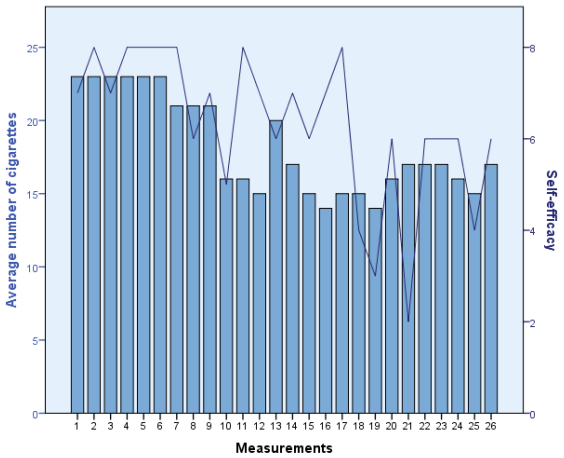

Figure 5. Participant 367: Self-efficacy towards smoking cessation and smoking behaviour

Table 2. ***Characteristics of the selected participants at baseline measurement.***

Participants	Average number of cigarettes	How much confidence do you have that you are able to… a) smoke 50% less	b) permanently stop smoking	Earlier quit attempts
301	8	8	10	2
309	16	5	8	He did not know
310	22	8	6	1
367	25	9	7	0 in the last three years

2.6 Data analysis

2.6.1 Missing data

There are missing values in the data of the participants 301, 309 and 310. Imputation of missing data was performed by using the average score of the measurement before and after the missing value. This value was then rounded.

2.6.2 Research question 1. Change in self-efficacy during the intervention phase (B)

One dataset for the intervention group and for the control group to answer the first research question was created. Nine of the 22 participants were in the intervention group. Two of them stopped earlier and did not answer the questions of the phase B and A' phase anymore. Because of this only the data of seven participants of the intervention group were used. The participants of both, the intervention- and the control group, had a different number of measurements in phase A and A' as explained earlier. To be able to execute the analyses that are necessary for answering the research question, the missing values for both groups were filled in. This was done by using the average of the phase concerned for each participant. After that a repeated-measures ANOVA for both groups was executed. The averages of each phase were compared to see if there was a change in the degree of self-efficacy towards smoking cessation in the intervention phase B in comparison to the other phases. This analysis was done for both the control and the intervention group, for all phases (A, B, A'). With the repeated-measures ANOVA there was also investigated to what extent the difference in the degree of self-efficacy towards smoking cessation over time can be explained by the programme (intervention- or control group). Then an independent sampled t-test for both groups was executed to investigate whether the change between the phases is significant.

2.6.3 Research question 2- Correlation between self-efficacy and smoking behaviour

In order to answer the second research question, a lag 1 variable for self-efficacy towards smoking cessation and one for smoking behaviour were created to take autocorrelation into account. This was done for each of the four selected participants. A lag variable is a transformation that brings past values of a series into the current case (IBM, 2012). The lag 1 variables of self-efficacy towards smoking cessation and smoking behaviour are serving as a control for the autocorrelations. An autocorrelation is a standard for the relationship between current and past series values that indicates which past series values are most useful in predicting future values. An autocorrelation can have a value between -1 (a perfect negative autocorrelation) and 1 (a perfect positive autocorrelation). 0 means that there is no autocorrelation (IBM, 2012). This is why the first step to answer the second and the third research question is, to determine the autocorrelations for each of the selected participants with the statistic programme SPSS.

After that a linear regression analysis for each of the four participants was executed. This was done to investigate if there is a significant correlation between the variables self-efficacy towards smoking cessation and smoking behaviour within the selected subjects and also if this correlation is

positive or negative. A correlation can be between -1 and 1. At a value between 0.10 and 0.29, there is a low positive correlation. A moderate positive correlation will be on hand if the value is between 0.30 and 0.49 and a high positive correlation if the value is between 0.50 and 1.00 (van der Linden & Holtkamp, 2010). The expectation was that there is a negative correlation between self-efficacy towards smoking cessation and smoking behaviour within each of the selected individuals. This means that a person who smokes less at one measurement has a higher degree towards smoking cessation at the same point of measurement. The dependent variable in this case is self-efficacy towards smoking cessation and the independent variables are smoking behaviour and the lag 1 variables of self-efficacy and of smoking behaviour. Each measurement of all phases is relevant for this question. The correlation was investigated with a within-subject design. The level of significance is 95% ($\alpha \leq .05$.).

2.6.4 Research question 3- Causal relation between self-efficacy and smoking behaviour

For the third research question for each of the four participants a lag 2 variable of self-efficacy towards smoking cessation and a lag 2 variable of smoking behaviour were created to control the autocorrelation for the lag 1 variables. The lag 1 variables in this case are measuring the effect. Then two different regression analyses for each of the selected participants were executed. The dependent variable of the first regression analysis for each participant was self-efficacy towards smoking cessation and the independent variables were the lag 1 and lag 2 variables of smoking behaviour. The second linear regression analyses for each of the selected participant were executed with smoking behaviour as dependent and the lag 1 and lag 2 variables of self-efficacy towards smoking cessation as independent variables. Then one investigated if self-efficacy towards smoking cessation or smoking behaviour is more predictive for the other variable. This was also done for each of the selected participants.

3. Results

3.1 Research question 1: Intervention group

The average score of self-efficacy towards smoking cessation is $\bar{x}$=7.12 within the intervention group. The degree of self-efficacy towards smoking cessation changed during the intervention but no significant linear trend can be recognized. It is noticeable that the lowest degree of self-efficacy is at the beginning of the measurements (A2) and the highest degree in the middle of the B-phase (B7). The level of self-efficacy towards smoking cessation varies between 5.43 and 8. The average of the A-phase is $\bar{x}$=7.12 (min. 5.43; max. 7.57) of the B-phase $\bar{x}$= 7.23 (min. 6.57; max. 8) and of the A'-phase $\bar{x}$= 6.75 (min. 6.14; max. 7.14).

3.2 Research question 1: Control group

The average score of self-efficacy towards smoking cessation is within the control group $\bar{x}$= 6.41. The lowest degree of self-efficacy towards smoking cessation is at the measurement A4 with 5.58 and the measurement with the highest degree is A5 with 7.00. The averages of the different phases do not

differ strongly from one another. The average of the A-phase is $\bar{x}$= 6.49 (min. 5.58; max. 7) of the B-phase $\bar{x}$= 6.36 (min. 5.83; max. 6.92) and of the A'-phase $\bar{x}$=6.40 (min 6.17; max. 6.5).

3.3 The effect of the intervention group in comparison to the control group

The average of the degree of self-efficacy towards smoking cessation is within the intervention group 9% higher than within the control group. The results of the repeated measures ANOVA are shown in Table 3, Table 4, Figure 6 and in tables in the appendix B and C. The conclusion is therefore, that there is no significant change of self-efficacy towards smoking cessation in the intervention phase B in comparison to the A- and A'-phase neither in the intervention nor in the control group. The results are shown in Table 4.

Table 3. ***Repeated measures ANOVA to investigate the influence of the programme on self-efficacy during three phases.***

Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Measurements (Time)	Sphericity Assumed	46.90	28	1.68	1.12	.306	.06
Measurements* Programme	Sphericity Assumed	41.26	28	1.47	.99	.486	.06
Error (Measurements)	Sphericity Assumed	710.62	476	1.49			

Table 4. ***T-test to investigate the significance of the difference between the three phases***

		Levene's Test for Equiality of Variances		T-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Phase A	Equal variances assumed	.76	.396	.67	17	.509	.62	.92
Phase B	Equal variances assumed	.49	.492	.70	17	.493	.88	1.25
Phase A'	Equal variances assumed	.77	.392	.26	17	.799	.35	1.37

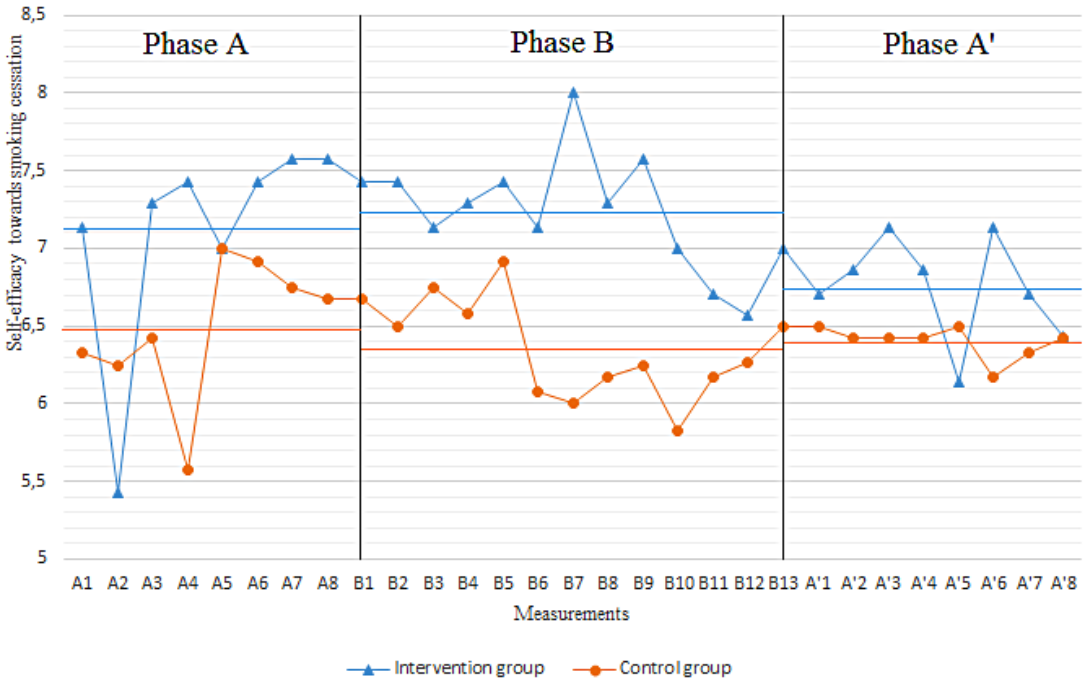

Figure 6. The degree of self-efficacy towards smoking cessation and smoking behaviour within the intervention and the control group during all phases of the intervention.

3.4 Autocorrelations

The autocorrelation was estimated for 16 lags. The autocorrelations of the variables self-efficacy towards smoking cessation and smoking behaviour for participant 301 are shown in the Figures 7 and 8.

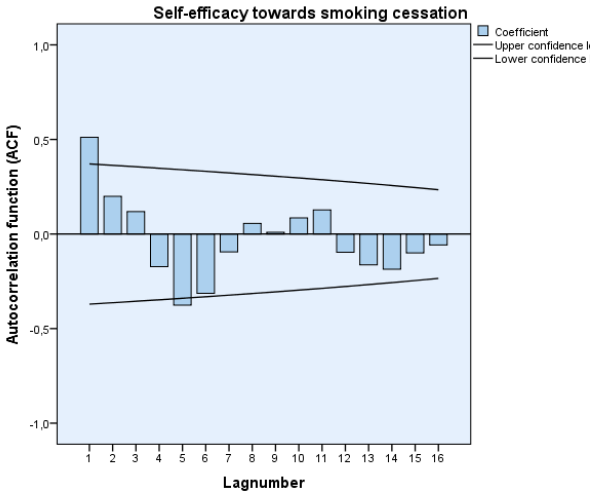

Figure 7. Participant 301: Autocorrelation of Self-efficacy towards smoking cessation

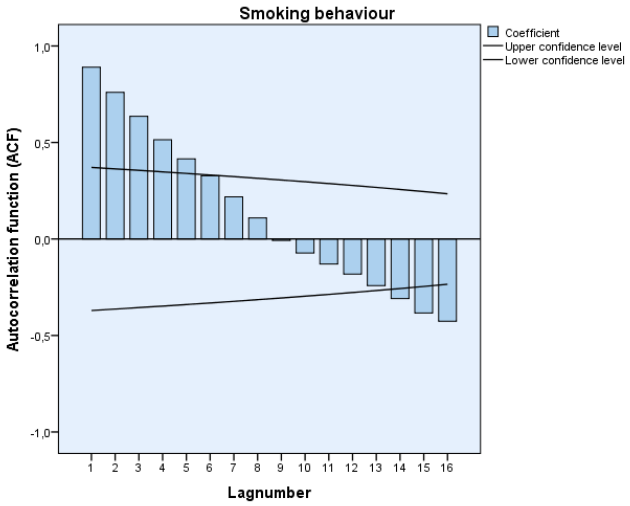

Figure 8. Participant 301: Autocorrelation of Smoking behaviour

The Figures 7 and 8 show that the autocorrelations of the two variables differ within participant 301. The autocorrelation of self-efficacy towards smoking cessation varies more and lies between 0.51 in lag 1 and -0.38 in lag 5. In lag 1 and in lag 5 there is a significant autocorrelation. The figures show that the measurements of self-efficacy are less auto-correlated than the measurements of smoking

behaviour. Smoking behaviour shows a high autocorrelation between 0.89 in lag 1 and -0.43 in lag 16. The degree of self-efficacy within one person fluctuates more independently of the measurement one week before. The other selected participants have similar results, the measurements of self-efficacy towards smoking cessation are less auto-correlated. Participant 310 has no significant autocorrelation and participant 367 has nearly no significant autocorrelation in the measurements of self-efficacy. These results are shown in the Figures 9 to 14.

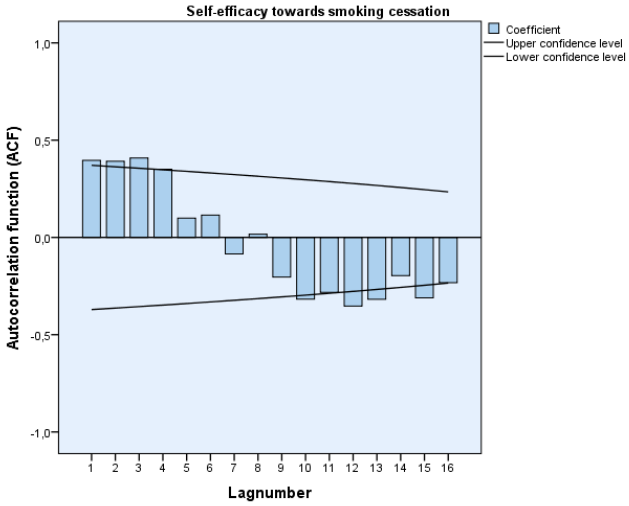

Figure 9. Participant 309: Autocorrelation of self-efficacy towards smoking cessation.

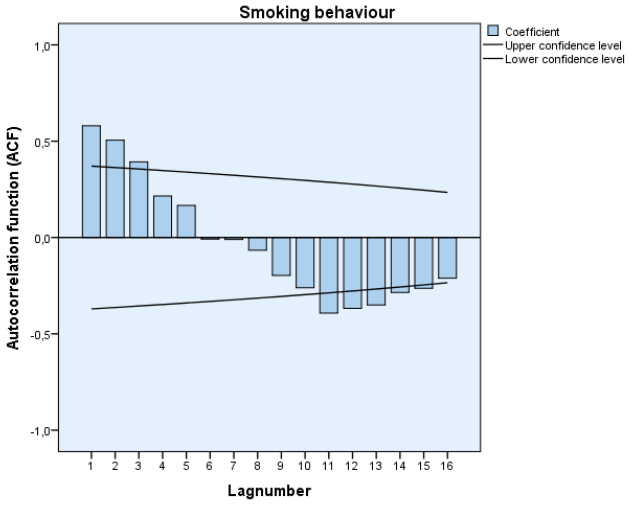

Figure 10. Participant 309: Autocorrelation of smoking behaviour.

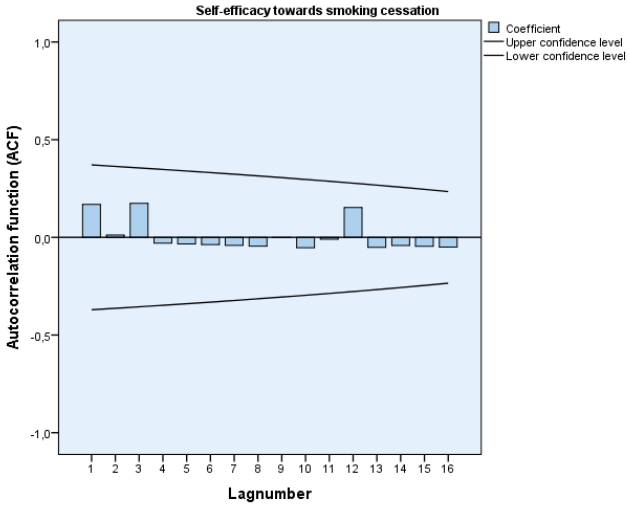

Figure 11. Participant 310: Autocorrelation of self-efficacy towards smoking cessation.

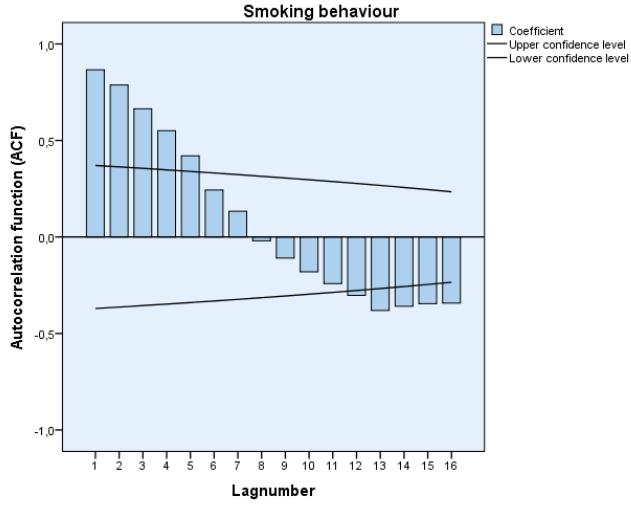

Figure 12. Participant 310: Autocorrelation of smoking behaviour.

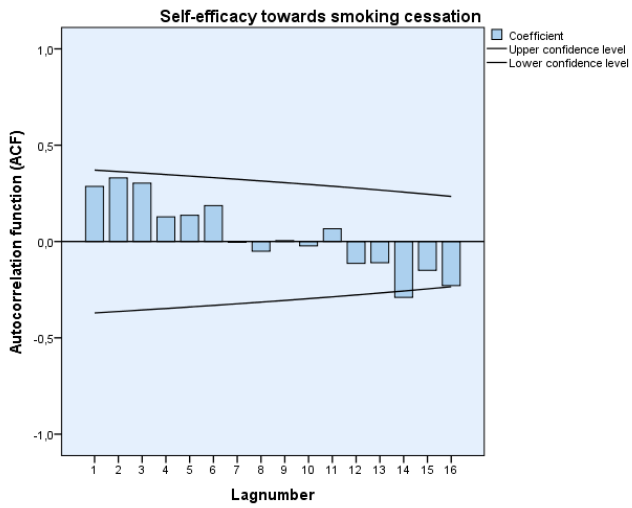

Figure 13. *Participant 367: Autocorrelation of self-efficacy towards smoking cessation.*

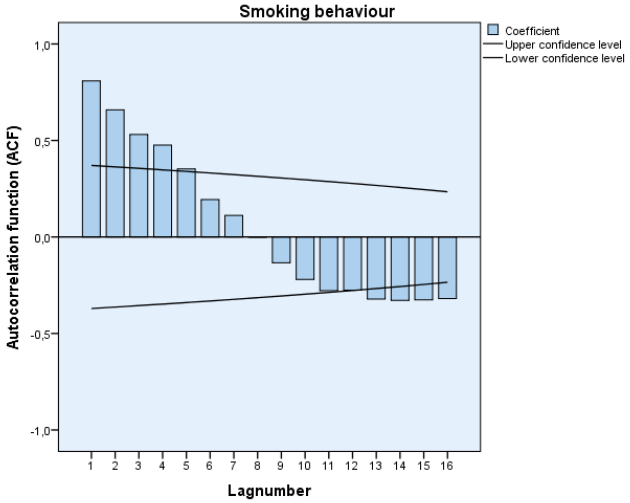

Figure 14. *Participant 367: Autocorrelation of smoking behaviour.*

3.5 Research question 2

Participant 301

The multiple regression analyses show that the adjusted R squared is $\bar{R}^2$ = .23, F(3, 21) = 3.33, ρ= .039. The results show no significant relation between self-efficacy and smoking behaviour (ρ=.602). This means, that the results can only give the indication, that the direction of the relation between self-efficacy towards smoking cessation and smoking behaviour is negative. For participant 301, the lag 1 variable of self-efficacy was the only significant predictor (ρ=.015). This is in line with Figure 7.

Table 5. ***Multiple linear regression analysis for participant 301***

Coefficients[a]					
	Unstandardized Coefficients		**Standardized Coefficients**		
Model	**B**	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	4.96	1.84		2.69	.013
Smoking behaviour	-.10	.18	-.34	-.53	.602
Self-efficacy Lag 1	.49	.19	.51	2.66	.015
Smoking behaviour Lag 1	.05	.19	.17	.26	.797

a. Dependent variable: Self-efficacy

Participant 309

The adjusted R squared is $\bar{R}^2$ = .14, F(3, 21) = 2.35, ρ= .102. The multiple regression analyses show that there is no significant relation between self-efficacy and smoking behaviour (ρ= .362). The results can therefore only give an indication of the direction of the relation between the two relevant variables, which is negative.

Table 6. ***Multiple linear regression analysis for participant 309***

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
	(Constant)	4.74	2.43		1.95	.065
	Smoking behaviour	-.09	.09	-.31	-.93	.362
	Self-efficacy Lag 1	.47	.25	.41	1.84	.080
	Smoking behaviour Lag 1	.05	.06	.23	.73	.476

a. Dependent variable: Self-efficacy

Participant 310

The multiple regression analyses for participant 310 show that there is no significant relation between self-efficacy towards smoking cessation and smoking behaviour (ρ= .456). The results can only give the indication that the direction of the relation between the two relevant variables is positive. The adjusted R squared is $\bar{R}^2$ = .20, F(3, 21) = 3.02, ρ= .052.

Table 7. ***Multiple linear regression analysis for participant 310***

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
	(Constant)	9.19	1.04		8.81	.000
	Smoking behaviour	.08	.10	.38	.76	.456
	Self-efficacy Lag 1	.13	.07	.36	1.79	.088
	Smoking behaviour Lag 1	-.12	.10	-.61	-1.16	.258

a. Dependent variable: Self-efficacy

Participant 367

The adjusted R squared is $\bar{R}^2$ = .17, F(3, 21) = 2.66, ρ= .075. The multiple regression analyses for participants 367 show that smoking behaviour is not a significant predictor for self-efficacy towards smoking cessation (ρ=.320). The results give the indication that the relation between self-efficacy towards smoking cessation and smoking behaviour is positive.

Table 8. ***Multiple linear regression analysis for participant 367***

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
	(Constant)	1.31	1.80		.73	.476
	Smoking behaviour	.18	.18	.36	1.02	.320
	Self-efficacy Lag 1	.05	.22	.05	.24	.814
	Smoking behaviour Lag 1	.08	.18	.16	.42	.676

a. Dependent variable: Self-efficacy

3.6 Research question 3

The results of the multiple regression analyses for each of the selected participants with the lag 2 as control variable and the lag 1 as effect variable are shown in Table 8 and 9.

Table 9. ***Results of the linear regression analysis with self-efficacy towards smoking cessation as dependent and the lag 1 and 2 variables of smoking behaviour as independent variables.***

	Self-efficacy	**Lag 1 Smoking behaviour Beta**	**Lag 2 Smoking behaviour Beta**
Participant 301		.14	-.43
Participant 309		-.69*	.60
Participant 310		-1.02**	.80
Participant 367		-.101	.65**

**significant*
***marginal significance*

Table 10. ***Results of the linear regression analysis with smoking behaviour as dependent and the lag 1 and 2 self-efficacy towards smoking cessation variables as independent variables.***

	Smoking behaviour	**Lag 1 Self-efficacy**	**Lag 2 Self-efficacy**
Participant 301		-.11	-0.14
Participant 309		-.25	-.45*
Participant 310		-.06	-.46*
Participant 367		.34	.33

**significant*

With these analyses, the causal relationship of the two relevant variables was investigated. For participant 309 smoking behaviour appears to result in higher self-efficacy towards smoking cessation rather than the reversed causality (r= -0.69; ρ= 0.053). This means that smoking behaviour is a stronger predictor for self-efficacy than the other way around. Also for participant 310 this correlation seems to be stronger (r= -1.02; ρ= 0,071). This predictor is marginal significant. The participants 301 and 367 show no significant correlation. The hypothesis, that there is more often a rise of self-efficacy towards smoking cessation after the reduction of cigarettes, cannot be confirmed. This hypothesis is held. One further indication is that self-efficacy towards smoking cessation is not a strong predictor for smoking behaviour.

4. Discussion

One aim of the REQUD-II SCED study was, to understand the negative results of the earlier executed REDUQ study. This was done by looking specifically at behavioural and psychosocial predictors of behavioural change, related to smoking behaviour. The present study aimed to achieve various objectives. The variables used in the present study were self-efficacy towards smoking cessation and smoking behaviour, measured in the SCED study of the REDUQ II study. One aim was,

to use a within-subject approach based on the TPB, to understand the cognitions and processes within one person. To investigate the reciprocal relation of cognitions and behaviour mentioned earlier (Prenger et. al, 2013), was another aim. These aims lead to the three research questions of the present study.

The results show that there was no significant change in the degree of self-efficacy towards smoking cessation in the intervention phase B in comparison to the other phases (A and A'), in neither the intervention group nor in the control group. The first hypothesis, self-efficacy towards smoking cessation within the intervention group significantly increases, can therefore be rejected. The second hypothesis, self-efficacy towards smoking cessation does not significantly change within the control group during the intervention phase, can be confirmed. In contrast to a study by Prenger et al. (2013) in which the intention to quit and self-efficacy were found the strongest time varying predictors for smoking cessation, no such a result was found in the present study. One possible explanation is that the absence of changes in self-efficacy towards smoking cessation is responsible for the non-effect of the REDUQ-study. Another possible explanation is that self-efficacy, which maintained during all phases within both groups relatively high is not important at all, related to smoking cessation.

The second question had to be answered to investigate whether there is a correlation between self-efficacy towards smoking cessation and smoking behaviour over time. For this, a within-subject approach was used. In none of the selected participants a significant correlation was found. The results of the present study can only give an indication of the direction of the correlation. These indications suggest that the two participants who stopped smoking (at least in the meanwhile) during the intervention have a negative correlation, and the two participants who did not stop smoking have a positive correlation between the two relevant variables. The hypothesis that people who have a high degree of self-efficacy towards smoking cessation are more likely to reduce their smoking behaviour over time, cannot be confirmed or rejected. This hypothesis is held. The second hypothesis, whereupon people who successfully reduced their smoking behaviour become more self-efficious about smoking cessation over time, is also held.

Based on these results several conclusions can be drawn. One conclusion is that the variable self-efficacy towards smoking cessation predicts behavioural change related to smoking behaviour differently in individuals. A study by Gwaltney, Metrik, Kahler et al. (2009) found that self-efficacy judgements vary over time, in response to challenges to abstinence and perceptions of coping resources. An explanation for this was given by Shiffman et al. (1997). According to him, self-efficacy towards smoking cessation varies in response to relevant events like smoking lapses or to situational circumstances as present mood or craving intensity (Shiffman et al., 1997). These circumstances differ in individuals and therefore, self-efficacy towards smoking cessation is not in everybody an even strong predictor for smoking behaviour. This could be an explanation that some interventions that are focused on self-efficacy are for some individuals more successful than for others or may be even counter-effective for some of them, as shown in the result section.

The results showed that the correlation between self-efficacy towards smoking cessation and smoking behaviour can have different directions in individuals. In conclusion this means that self-efficacy towards smoking cessation is a stronger predictor for smoking cessation in individuals that are more ready to quit smoking than in those that are less ready to quit, yet. This is in line with a study proposed by Prochaska and DiClemente (1992). According to them, self-efficacy evaluations towards the addictive behaviour are predictable and related to the individual stages of change. They conclude that using self-efficacy in the context of the stages of change can be useful (Prochaska & DiClemente, 1992). One possibility to deal with these individual differences in the stages of change can be to provide different types of interventions that focus on different stages. This means for example that participant 301, who smoked on average eight cigarettes daily at baseline, would get another intervention than participant 367, who smoked on average 25 cigarettes daily at baseline. It can be assumed that these two participants are at different stages of change and therefore need different kind of interventions.

The third aim was to investigate the nature of the reciprocal relationship between self-efficacy towards smoking cessation and smoking behaviour. Therefore, a third research question was set up. The third research question investigates in which direction this reciprocal relation is stronger. In two of the selected participants a (marginal) significant stronger negative correlation was found for self-efficacy as dependent, and the lag 1 and lag 2 variables of smoking behaviour, as independent variables. This means that in two of the participants, smoking behaviour was a stronger predictor for self-efficacy towards smoking cessation than the other way around. The results of the present study are not in line with earlier studies in which self-efficacy was found to be useful as a consistent statistically significant predictor of cessation (Gwaltney et al., 2009). The findings of the present study suggest that self-efficacy towards smoking cessation is not a significant predictor related to smoking cessation. The present study gives more indications therefore, that the reduction in smoking behaviour predicts self-efficacy towards smoking cessation.

4.1 Strengths of the study

This study had different strengths which are important to mention. One of the strengths was that the variable self-efficacy towards smoking cessation, was observed over time. By observing self-efficacy over time it was possible to investigate its trend. Another strength was that possible autocorrelations that are common in time-series data were taken into account. Through taking the autocorrelations into account, the estimation of values is more precisely.One strength was also that in the present study a within-subject approach was used. Within-subject approaches have several advantages. One advantage is that the internal validity of a within-subject design does not depend on random assignment. According to Charness, Gneezy and Kuhn (2012), another advantage of such a design is a substantial boost in statistical power in many frameworks. They are also more aligned with the most theoretical mind-sets (Charness, Gneezy & Kuhn, 2012). In this case, a within-subject design was used as it was not only important to know why the intervention was not successful but also for

whom it was successful and for whom not.

Another strength is related to the topic of the study. The sample of the present study consisted of COPD patients that were at baseline not ready to quit. COPD is the fifth leading cause of chronic morbidity and mortality as mentioned earlier, but there are still not many interventions to aid smoking cessation that are focused on COPD (van Laar, 2015). This and the increasing number of people with COPD lead to the conclusion that more effective smoking cessation interventions for COPD patients must be developed.

4.2 Limitations of the study

Next to the strengths there are also some limitations. One limitation that should be mentioned is that for measuring the variable self-efficacy towards smoking cessation, only one item was used which makes it possibly less valid. Still, the item was clear and distinct therefore, it is presumed that this did not have much influence.

Another limitation was that only self-reported measurements were used in the present study and therefore the results of smoking behaviour may suffer from a lack of validation. The patients had to answer the questions how much they smoke on weekdays and on weekends. Biases such as social desirability could have influenced their answers. Some of the participants may over- or underestimate their smoking behaviour and thus its validation is disputable.

Another limitation was that the sample size, which was with four selected participants and for each of them 26 measurements, relatively small. This is why one chose to operate with a marginal level of significance ($p < .075$). One can assume that if the sample size had been bigger the level of significance would have been lower. In the present study, four participants were included to investigate on an individual level their degree of self-efficacy towards smoking cessation in regard to their smoking behaviour. Besides the earlier mentioned disadvantages, the within-subject approach also suffers from the flaw that the external validity is limited. Additional to that all of the selected participants for the within-subject design were male. The reason for this were the criteria the selected participants were chosen on. For the present study two participants who stopped smoking during the intervention and two who did not, were chosen out of the intervention group. All of these participants had the same reason for participation: To first reduce their smoking behaviour and then to quit smoking. There was only one female participant within the intervention group that had another reason for participation: To reduce smoking, but not to quit smoking. It was chosen for participants with the same reason to participate in the study, to reduce the possible variation in their motivation of getting ready to quit.

4.3 Suggestions for further research

The results of the present study lead to several suggestions for further research. These suggestions will be discussed in the following. Based on this study, self-efficacy was found not significant as a predictor for smoking cessation. There are only indications for both negative and

positive correlations between smoking behaviour and self-efficacy towards smoking cessation. These results were not significant and therefore further research is necessary. Further research should take individual differences in the degree of self-efficacy towards smoking cessation into account, which is possibly dependent on the stage of change, one is in.

Another suggestion is to not just trust on self-reported measurements but to include objective measurements as cotinine values in further research. Cotinine values are more accurate than CO values and are not affected by environmental influences (Gorber, Schofield-Hurwitz, Hardt, Levasseur & Tremblay, 2009). These objective measurements could help, to minimize possible biases. One further suggestion is to take care that among the selected participants there are also women. This would simplify the generalization of the results.

The individual differences in psychosocial predictors are still an interesting topic for which further research is necessary. Important on this topic is to investigate, how strong certain psychosocial predictors in certain participants are. The stage of change of the participants should also be taken into account. The results of this could make the creation of cluster types possible. With these cluster types, tailored interventions could be set up, with each of them having a different focus and being divided into different stages. This means on the one hand that someone for whom social support was a strong predictor would obtain another intervention than someone for whom self-efficacy towards smoking cessation was a strong predictor. On the other hand, this means for example that someone who smokes less than 10 cigarettes daily and has less strong craving thoughts, would obtain another intervention than someone who smokes more than 20 cigarettes daily and has strong craving thoughts. In order to create those interventions, an advantage would be to measure the smoking-related cognitions and behaviours during the process of smoking reduction daily, instead of weekly. By having daily measurements, smaller changes in self-efficacy towards smoking cessation and smoking behaviour could be detected which are missed otherwise.

At the present study self-efficacy was not found a significant predictor related to smoking cessation in contrast to other studies. There was indication that smoking behaviour can predict self-efficacy. Another recommendation for future intervention is therefore to influence the smoking behaviour and this way to rebuild self-efficacy which in turn may influence the smoking behaviour.

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6. Appendix

6.1 B: Table. Self-efficacy during all phases within the intervention group

Table. ***Degree of self-efficacy towards smoking cessation during the phases A, B and A' within the intervention group***

Measurements	N	Mean	Standard deviation
A1	7	7,14	,553
A2	7	5,43	1,212
A3	7	7,29	,644
A4	7	7,43	,896
A5	7	7,00	,951
A6	7	7,43	,948
A7	7	7,57	,997
A8	7	7,57	,869
B1	7	7,43	2,440
B2	7	7,43	2,936
B3	7	7,14	2,795
B4	7	7,29	2,430
B5	7	7,43	2,637
B6	7	7,14	2,193
B7	7	8,00	2,309
B8	7	7,29	3,302
B9	7	7,57	3,101
B10	7	7,00	3,512
B11	7	6,71	3,904
B12	7	6,57	2,878
B13	7	7,00	3,055
A'1	7	6,71	1,267
A'2	7	6,86	1,243
A'3	7	7,14	1,204
A'4	7	6,86	1,280
A'5	7	6,14	1,243
A'6	7	7,14	1,204
A'7	7	6,71	1,267
A'8	7	6,43	1,192

6.2 C: Table. Self-efficacy during all phases within the control grou

Table. ***Degree of self-efficacy towards smoking cessation during the phases A, B and A' within the control group***

Measurements	N	Mean	Standard deviation
A1	12	6,33	2,015
A2	12	6,25	2,006
A3	12	6,42	2,109
A4	12	5,58	2,875
A5	12	7,00	2,132
A6	12	6,92	2,065
A7	12	6,75	2,006
A8	12	6,67	2,015
B1	12	6,67	2,229
B2	12	6,50	2,505
B3	12	6,75	2,527
B4	12	6,58	2,466
B5	12	6,92	2,234
B6	12	6,08	2,678
B7	12	6,00	3,275
B8	12	6,17	2,918
B9	12	6,25	2,667
B10	12	5,83	2,887
B11	12	6,17	2,758
B12	12	6,27	3,019
B13	12	6,50	2,686
A'1	12	6,50	2,714
A'2	12	6,42	2,539
A'3	12	6,42	3,288
A'4	12	6,42	2,875
A'5	12	6,50	2,844
A'6	12	6,17	2,691
A'7	12	6,33	2,535
A'8	12	6,42	2,610