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General discussion
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The aim of this thesis was three-fold: (1) to examine conflicts and attitudes towards smoking in single-smoking relationships, (2) to establish the effectiveness of partner support in the form of dyadic planning to quit and (3) to gain insight into partner behaviours and cognitions that play a role during a quit attempt. In the present chapter, I discuss the main findings of the studies, address methodological considerations and present directions for future research.

1: Conflicts and attitudes towards smoking in a single-smoking relationship

It is known that a non-smoking partner can influence smoking behaviour and could facilitate smoking cessation. However, there are couples in which smokers do not quit despite of this beneficial environment. Some couples may have found a way to live with the smoking behaviour to maintain a long-term relationship, while others might still hold a negative attitude and engage in conflicts. In Chapter 2, we examined how 70 single-smoking couples, who had been together for an average of 22 years, think about smoking and how this affected their relationship. The results showed that in the majority of couples, smoking was still a topic that causes conflict. Almost all partners wanted the smoker to quit, and both partners reported having conflicts about smoking. Non-smokers had a more negative attitude towards smoking than their smoking partners did. This negative attitude of the non-smoking partner was associated with the couple experiencing more conflicts. Therefore, it seemed that the non-smoking partners’ opinion on smoking was leading when it comes to conflicts. Non-smoking partners who hold a very negative attitude towards smoking might try harder to change their partner’s behaviour, thereby causing conflicts. However, relationship satisfaction seemed unaffected by both partners’ attitude. This seems to support the thought that couples, in which the smoker does not quit, might have found a way to live with their different attitudes towards smoking and their conflicts without it negatively affecting their relationship. Nevertheless, most non-smokers wanted their partner to quit and these couples experienced conflicts. Therefore, the next aim was to examine how these smokers can be supported in a quit attempt and which behaviours and cognitions of the non-smoking partner could play a role during such an attempt.

2: The effectiveness of partner support in the form of dyadic planning to quit

Implementation intentions have been found successful in decreasing smoking habits and reducing the number of cigarettes smoked (Armitage, 2016). The current study was the first to expand this existing intervention by involving non-smoking partners in the smokers’ quit attempt. Chapter 3 describes the randomized controlled trial, which was designed to examine whether involving a non-smoking partner in a planning intervention to quit could...
increase its effectiveness. Single-smoking couples participated in an intervention in which smokers either created their quitting plan alone (individual planning) or with their partner (dyadic planning). The intervention was based on the use of implementation intentions and followed by 21 end-of-day diaries and a follow-up questionnaire three months later.

Three months after receiving the intervention, both groups showed similar quit rates (33%, dyadic; 30%, individual) and a similar decline in the number of cigarettes smoked (more than 50% decline, Chapter 4). Smoking patterns that became visible with the diary data (e.g., relapse, intermittent smoking and quitting) appeared in the same manner in both intervention groups and seemed indicative of smoking behaviour at follow-up. The involvement of a non-smoking partner did not directly increase the effectiveness of the intervention. However, couple participation and daily measurements might have increased the effectiveness as compared to previous interventions using implementation intentions aimed at individual smokers which usually show quit rates of 8% to 14% (McWilliams et al., 2019). The next step was to examine partner behaviours and cognitions that follow both interventions and were studied in detail using a daily diary.

3: Partner behaviours and cognitions that play a role during a quit attempt

It is well established that certain partner behaviour, such as support, can have a beneficial influence on smoking cessation (e.g., Key et al., 2004; Scholz et al., 2016). However, less is known about negative control behaviours and a discrepancy in the reports of behaviours between smokers and their partners. Support provision and receipt are loosely correlated (Haber et al., 2007) and these differences can be meaningful. In Chapter 5 the 21 end-of-day diaries following the planning intervention were further investigated, to gain insight into partner behaviours that played a role in the quit attempt. Using innovative multilevel models (e.g., dyadic score models), this study examined how supportive as well as negative control behaviours related to smoking and relationship satisfaction in single-smoking couples during a quit attempt. It was hypothesized that dyadic planning might change the way partners act during a quit attempt, and the way smokers perceive their partners behaviours to influence them. However, the individual and dyadic planning group did not show differences in effectiveness nor partner behaviours, allowing the groups to be studied as one.

Results showed that smokers who experienced more supportive and less negative control behaviour from their partners compared to the average smoker, had a lower probability of smoking, and the couple had a higher relationship satisfaction. The results also showed meaningful daily fluctuations: on days with more supportive and less negative control behaviour than usual, smokers had a lower probability of smoking and the couple had a higher relationship satisfaction. For smokers who reported receiving more support than their partner reported providing, the couples’ relationship satisfaction was higher and the
smokers’ relationship satisfaction was higher than their partners’. However, when partners provided more support than the smokers reported receiving, this seemed to be related to a lower relationship satisfaction in the couple, and specifically, for the receiver. Differences between received and provided support at the between-couple and daily level were unrelated to smoking. It has to be noted that the directions of all difference scores cannot be interpreted from these results, because a larger difference could both be positive (smoker higher than partner) or negative (partner higher than smoker). Therefore, these results are indications, and more research is needed to unravel the direction and implications of these discrepancies.

Supportive and negative control behaviours are not the only relevant social predictors that play a role in smoking cessation. Research has well established the predictive role of smokers’ self-efficacy in smoking cessation (e.g., Clyde et al., 2019; Ockene et al., 2000; Perkins et al., 2012). However, less is known about the role of non-smoking partners’ efficacy beliefs (i.e. other-efficacy). Confidence of a partner in their partner’s health behaviour, next to ones’ own self-efficacy, seems predictive of beneficial health outcomes over time. Therefore, Chapter 6 examined how non-smoking partners’ other-efficacy related to same- and next-day smoking, over and above smokers’ own self-efficacy. Results showed that smokers who had a higher self-efficacy than others had a lower probability of smoking, regardless of successful abstinence the previous day. This seems to indicate that high self-efficacy throughout the quit attempt might be important to overcome a lapse. On days with higher self-efficacy and with higher other-efficacy levels from the partner than usual, smokers had a lower probability of smoking. However, with this study design, it was difficult to disentangle whether efficacy beliefs precede smoking abstinence, or are the result of success as both efficacy and smoking were measured in the evening. Both directions have been shown to be possible (e.g., Gwaltney et al., 2009; Perkins et al., 2012). Further studies on the temporal order of other-efficacy and smoking will need to be undertaken.

Study design and sample

Strengths

A major strength of this thesis is the combination of a randomized controlled trial, including daily diary questionnaires and a follow-up, and a dyadic approach. With 176 couples participating in either the individual or dyadic planning intervention, we were able to test the efficacy of involving the partner in implementation planning. The follow-up measurement provided data to draw conclusions on the longer term. Moreover, the diary allowed us to examine how the quit attempt unfolds daily after the intervention was received, thereby not only looking between-persons but also into relevant daily fluctuations. The diary gave us insights into weekly drop-out, but also how a lapse on one day might influence
smoking the next day. Additionally, the follow-up smoking status (e.g., I did not smoke since the intervention) could be checked using the diary data, providing more insight into the reliability. The results in the diary period seemed a good predictor of follow-up smoking.

An important strength of this thesis is the use of couple data. When variables are studied that concern dyadic constructs (e.g., support, relationship satisfaction), collecting data of both individuals creates a more comprehensive reflection of the situation. In Chapter 2, results showed that only the attitude of non-smoking partners mattered with regard to conflicts. When this same conclusion would be drawn from smokers’ responses only, it might seem as if smokers themselves do not take responsibility for the conflicts and blame their partner. Now both partners are included, the results likely provide a more complete picture as both perspectives are taken into account. As shown in Chapter 5, reports of the same behaviour could also differ between partners, and these differences can be meaningful. Therefore, only taking into account one individual per couple might create bias.

**Limitations**

A general limitation in couple research is that recruiting couples is more difficult and time-consuming than recruiting individuals. Both partners have to be willing to participate and analysis wise, diary data can often not be used when only one partner responded that day. Additionally, the recruitment of couples might cause potential bias regarding generalizability (Park et al., 2020). Couples who participate in research together are happier (Hagedoorn et al., 2015) and are less likely to experience break-up over time (Park et al., 2020), suggesting a possibly different relationship dynamic compared to couples who do not participate in research together. This might complicate generalizability of our sample and result in a ceiling effect. Therefore, the possibility should be considered that the results found pertain to couples with partners who have a higher relationship satisfaction, are more supportive, and work more as a team compared to the general couple. This might also be an explanation for the fact that no differences in outcomes were found between the intervention groups. It is possible that the involvement of the partners in the individual and dyadic intervention group was too similar to result in significantly different outcomes between the groups. Additionally, the non-smoking partner could also be the one who signed up to participate in the study, which might have been an indication of their high commitment. Moreover, next to the fact that all couples might already be highly supportive, all partners filled in daily questionnaires, which could have created a high involvement in the study and awareness of their behaviour, regardless of their absence during the intervention itself. Another remark with regard to generalizability is that all smokers in the study received a guided cessation intervention and filled in a diary. There are also many smokers that try to quit without assistance. It is unclear how generalizable our results regarding partner behaviours and cognitions are to single-smoking couples who
attempt to quit on their own.

A possible limitation concerning the study design, is that no group was included that did not receive an intervention or did not fill in a diary. To examine whether the effects found can be attributed to the intervention, the diary or the combination of the two, a randomized controlled trial should be conducted that consists of, ideally, six groups: (1) diary plus individual or (2) dyadic planning, (3) diary only, (4) individual or (5) dyadic planning only and (6) no diary nor intervention. Evidently, such a research design would be difficult to implement. First, it is difficult and very time consuming to recruit enough couples with a smoker who is willing to quit. Second, half of the groups would not provide diary data and results can therefore only be compared in follow-up measures. As the effectiveness of individual planning (without a diary) has previously been established, we did not include a group without an intervention and diary. However, before applying planning interventions in clinical practice, research needs to be undertaken on the impact of a daily diary to see if it is worthwhile to include it as part of the treatment.

To participate in a daily diary can be burdensome (Bolger et al., 2003) and slow down recruitment, therefore, it should only be used when daily fluctuations are of interest, or when it increases the effectiveness of the intervention. Additionally, when behaviour is measured, participants can become more aware of that behaviour. Diary reactivity might occur, which is a common issue in diary research that should be taken into account (Bolger and Laurenceau, 2013). Diaries are sometimes even specifically used as self-monitoring tools and are associated with behaviour change, for example in weight loss (Burke et al., 2011). Therefore, filling in a diary might act as an intervention on its own. However, diary reactivity seems to stabilize after one week for addictive behaviour (Buu et al., 2020) or might not occur at all (Stone et al., 2003). It is still difficult to distinguish whether effects found in this thesis are truly caused by the intervention, the keeping of a diary or a combination of the two. As the intervention effects found in this thesis were much higher compared to other studies (McWilliams et al., 2019), it is important to examine what might have resulted in this increased effectiveness. Even though comparing groups on a daily basis would not be possible, it would be interesting to compare the effectiveness of the dyadic intervention with and without a diary. Future research might consider additional measurement points (e.g., one per week), next to the follow-up, that is less burdensome than a daily diary, to still gain some insight into the trajectory of the no-diary group.
Dyadic data and research methods

Studying dyads comes with new challenges, as dyadic data requires different types of analyses. Given that persons in the same dyad are often more similar to each other than individuals from a different dyad, dyadic data is interdependent. Therefore, models that use dyadic data should account for this interdependence. This thesis used two different dyadic models: The Actor Partner Interdependence Model (APIM) and the Dyadic Score Model. In Chapter 2, the APIM model allowed to examine how attitude is related to one’s own outcome (actor-effect) and also the outcome of the other partner (partner-effect; Kenny et al., 2006). The APIM model provides insight into individual, interdependent processes within couples. For example, in Chapter 2, our research question concerned how smokers’ and partners’ attitude towards smoking were related to their own or their partners’ relationship satisfaction. This attitude towards smoking is an individual characteristic, hence, it makes sense to look at individual pathways. For example, results showed that the attitude of the non-smoking partner, and not of the smoker, played an important role in the frequency of conflicts. In Chapter 5 a Dyadic Score Model (Iida et al., 2018) is reported. This model examined the couple as a unit and how partners differ in their reports on the same behaviour. For example, how do couples who have a high average level of support or a large difference in their report on support rate their relationship satisfaction? As for support both partners reported on the same behaviour, it was more sensible to study the couple as a whole and examine potentially meaningful differences in their reports. So, both dyadic models offer different perspectives into relationship processes and researchers should choose the model that best fits their conceptual framework (Iida et al., 2018).

A limitation regarding our data is that results are solely based on self-report. In smoking research, a biochemical verification of cessation is not uncommon. However, self-reports of smoking are accurate in most studies (Patrick et al., 1994). To not increase methodological complexity and research costs, we decided to rely on self-report. For psychological measures however, relying on self-report is unavoidable and might result in social desirability. To admit to negative behaviours could be confronting for partners and therefore underreported, and likewise, supportive behaviours might be overestimated. On the other hand, for such psychological constructs it might be the subjective interpretation of the participant that is of interest. Support, for example, could be objectified by specifically inquiring about the frequency of behaviours. However, the number of behaviours required for a partner to be deemed supportive will differ a lot between smokers. Researchers should consider whether the subjective interpretation or actual frequencies are of interest.
Assessment of smoking behaviour (cessation)

Smoking behaviour might seem as an easy to interpret binary outcome variable (yes or no). However, there are different ways to draw conclusions with regard to successful smoking cessation. In Chapter 4 the distinction was made between prolonged abstinence and point prevalence. Prolonged abstinence implies that the participant remained abstinent since the intervention, whereas point prevalence only looks at abstinence at a certain point in time (Hughes et al., 2004). The distinction between the two measurements has been subject of debate. The review by Hughes et al. (2004) recommends researchers to report both measures of abstinence, and that prolonged abstinence might be the preferred measure. As we saw in Chapter 4, the outcomes of these measures differed considerably and showed higher success rates for point prevalence. This is not surprising, given that our sample also consisted of a considerable number of intermittent smokers who did not show prolonged abstinence. However, of these intermittent smokers, 19% had quit smoking at the follow-up measure. Of the participants who relapsed during the diary period 15% quit at follow-up. This raises the question whether prolonged abstinence really gives a realistic image of a successful quit attempt, as it seems that a quit attempt is not an easy trajectory without setbacks. As also suggested by Hughes et al. (2004), reporting both measures is likely the best solution.

A second point to consider is missing data, which in smoking cessation research can be complex as missingness might not be completely random. It is likely that participants, perhaps out of guilt feelings, did not fill in the diary on days that they smoked. There are different ways to handle this missing smoking data besides listwise deletion. An often used sensitivity analysis (see also Chapter 4) is missing = smoking (i.e., conservative imputation; McPherson et al., 2012). Depending on the research question, missing values are replaced by failure or success. In the case of a smoking cessation intervention, on all missing days the smoker is assumed to have lapsed. This conservative method is used to avoid overestimation of intervention effects (Peeters et al., 2015). Another method is last observation carried forward, in which the missing value is replaced by the last reported one (McPherson et al., 2012). However, both single imputation methods might result in biased parameter estimates (McPherson et al., 2012). In Chapter 5 & 6 we applied multiple imputation as this method also allows for missing values in predictors. Multiple imputation uses regression analysis in which complete variables predict the missing variables (McPherson et al., 2012) and is found a more accurate approach compared to single-imputation methods (Peeters et al., 2015). The analysis is repeated several times to generate multiple datasets. The final data analysis is run on the pooled estimates thereby creating the most reliable estimation. Future research should consider the potential impact of missing data, and try to prevent participants from dropping out. For example, participants could receive stimulating messages or rewards during the
study period, to motivate them to keep filling in the diary.

**Temporal order of events**

A problem that is commonly addressed in research concerning smoking, partner support and self-efficacy is the temporal order of events. In Chapter 5 we discussed the associations between partner behaviours, smoking and relationship satisfaction. It was difficult to draw conclusions related to the temporal order of events based on the data presented. Specifically, partner support might result in a day without smoking, but successful abstinence could also lead to the partner being more supportive. The same can be said about negative control. These behaviours could be a response to a lapse (e.g., as an expression of frustration of the partner), or could result in a lapse (e.g., the smoker might feel discouraged). Relationship satisfaction was studied as an outcome variable, but it is also likely that more satisfied partners provide more support. In Chapter 6 we discussed this issue regarding self- and other-efficacy and smoking behaviour. In short, self-efficacy might increase due to previous success, but, high self-efficacy could also be the predictor of future success (e.g., Gwalney et al., 2009; Perkins et al., 2012). Both directions might also be visible for other-efficacy, however, other-efficacy has never been studied as an outcome variable yet.

In the recent years, research has also started to examine the reciprocal relationship between partner support (Chapter 5) and self-efficacy (Chapter 6). Specifically, the temporal order of these constructs is debated; whether self-efficacy cultivates or enables partner support. The *cultivating hypothesis* postulates that high self-efficacy facilitates partner support (Hohl et al., 2019), whereas the *enabling hypothesis* states that higher levels of partner support might enhance the recipients’ self-efficacy (Banik et al., 2017). This thesis examined both construct separately, but did include the novel construct of other-efficacy, which has not been considered yet in this area of research. As self-efficacy and partner support are related, a likely conclusion is that other-efficacy is related to partner support as well. Specifically, partners who have more confidence in the smokers’ quit attempt will probably be more likely to provide support. Therefore, couple research on self-efficacy should consider including other-efficacy of partners as well, as this might be the underlying predictor of provided support. It is interesting to examine how the enabling or cultivating hypotheses play a role in the association between other-efficacy and partner support. Multiple measurements per day might capture these processes better compared to a retrospective measure at the end of the day. More reliable conclusions might be drawn regarding the temporal order and daily fluctuations in efficacy and smoking when a measurement in the morning is included.
General Conclusion

Tobacco smoking is still an important health issue worldwide and its current prevalence rate indicates a need for effective intervention programs. Research and interventions aimed at smoking cessation often target individuals and do not involve their romantic partner, despite their important influence on health behaviour. Understanding partner behaviour and its role during a quit attempt can be of important added value to existing research and interventions for smoking cessation. This thesis provided insight into the role of smoking in single-smoking couples, and how partner involvement and couple interactions could support or hinder a quit attempt. First, Chapter 2 showed that non-smoking partners have a more negative attitude towards smoking than their smoking partners, and that this still relates to conflicts about smoking. However, given that relationship satisfaction remains unaffected, these long-term couples might have found a way around the potential negative consequences. Second, the results of Chapter 4 demonstrated that involving a partner in a planning intervention (i.e., dyadic planning) does not directly increase its effectiveness. However, to involve a partner in the study, and not necessarily the intervention, might be enough to encourage their commitment to their partners’ quit attempt. Third, the mechanisms through which partners might facilitate or hinder a quit attempt were examined using a daily diary method (Chapter 5 & 6). Results showed that smokers who had a more supportive partner and high self-efficacy had a lower probability of smoking, while more negative controlling behaviour was related to a higher probability of a lapse. Next to between-couple differences, daily fluctuations in support and negative control matter too. On days when smokers receive more support than usual their probability of smoking is lower, while more daily negative control might counter these effects as it relates to a higher probability of smoking. On days when smokers and partners are more confident in the quit attempt than usual, the chance of a lapse is smaller.

On the whole, with this thesis I hope to inspire new and existing interventions to acknowledge the important role of a non-smoking partner and his or her daily behaviour during a quit attempt. When smokers want to quit, their non-smoking partners could be involved in the process and informed about the type of behaviours that might be helpful (e.g., support, show confidence) and which ones might be better to avoid (e.g., negative control, low confidence levels). This could not only increase the chance of a successful quit attempt, it could also prevent worsening of the relationship of the couple going through this stressful endeavour.
References


