It takes two: the role of a non-smoking partner in a quit attempt

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Daily Support and Negative Control During a Quit Attempt in Single-Smoking Couples

Anne H. Buitenhuis, Marrit A. Tuinman, Gertraud Stadler, Mariët Hagedoorn

Abstract

Objective: Research has shown a beneficial influence of partner support on smoking cessation. Previous studies mainly focused on support and neglected negative behaviors. Less is known about differences in support perceptions between partners. This study aims to examine how supportive as well as negative control behaviors relate to smoking and relationship satisfaction in single-smoking couples during a quit attempt.

Method: Smokers and their non-smoking partners (n = 170 cohabiting couples) participated in an intensive longitudinal study over 21 days with end-of-day diaries. A dyadic score model was used, emphasizing couple levels and differences for the explanatory variables (i.e., support and negative control) and the outcome variables (smoking (for smokers only); relationship satisfaction).

Results: Smokers whose partner showed more supportive and less negative control behavior had a lower probability of smoking, and both partners had higher relationship satisfaction. On days with more supportive and less negative control behavior than usual, smokers had a lower probability of smoking and both partners had higher relationship satisfaction. For smokers who reported more support than their partner reported providing, the couples’ relationship satisfaction was higher and the smokers’ relationship satisfaction was higher than their partners’. Differences between received and provided support/control at the between-couple and daily level were unrelated to smoking.

Conclusions: Support seems important during a quit attempt as it was related to a lower probability of smoking and higher relationship satisfaction in couples, while negative control behaviors should be avoided as they were associated with higher probability of smoking and lower relationship satisfaction.

Keywords: Dyadic score model, social support, negative control, daily diary, smoking cessation
Introduction

The influence of partner support on health behavior change is widely studied (Arden-Close & McGrath, 2017). However, in light of recent studies on partner support for health behavior (e.g., Lüscher et al., 2015), it is becoming difficult to ignore the importance of differences in support perceptions between partners. In the context of smoking cessation, research on differences is in its infancy. Support provision and receipt are only loosely correlated (Haber et al., 2007) and there is evidence that the differences are meaningful. Since the introduction of invisible support (i.e., more support is provided than received; Bolger, Zuckerman, & Kessler, 2000), researchers became more aware of the existence of differences in the reports of support between partners and how it might influence behavior and well-being. However, research thus far seems to focus solely on one side of support visibility, namely the invisibility of support for the receiver, instead of the full extent of these differences, including, for example, imagined support. Additionally, negative behaviors could co-occur with supportive behaviors and show meaningful differences between partners. This daily diary study explores the ways in which supportive and negative behaviors and differences in the reports of these behaviors are associated with smoking and relationship satisfaction in single-smoking couples during a quit attempt.

Several studies have pointed out the important contribution of partner support to successful smoking cessation. For example, bringing a support partner to cessation therapy enhanced abstinence (Key et al., 2004), and daily support interactions with a non-smoking partner were associated with a decrease in the number of cigarettes smoked during an unaided quit attempt (Scholz et al., 2016). Roughly 35% of the smokers have a non-smoking partner (Margolis & Wright, 2016). These smokers with a non-smoking partner try to quit more often (Dollar et al., 2009), and are more likely to be successful when they try to quit (Margolis & Wright, 2016). Perhaps these smokers are more successful because their non-smoking partners are more willing to support a quit attempt than smoking partners (VanDellen et al., 2016) and non-smoking partners’ support is more effective in preventing a relapse compared to smokers’ support (Pollak & Mullen, 1997).

Besides offering support, partners might also engage in negative behaviors (e.g., nagging, conflicts) during a quit attempt which are ineffective (Lewis & Butterfield, 2007) and might even hamper the efforts to quit smoking (Tucker et al., 2006). These negative partner behaviors are currently considered less in diary research but do play a role in smoking cessation (Park et al., 2004). While forms of positive support (e.g., complimenting on not smoking, calming down) show benefits for smoking cessation, negative behaviors (e.g., expressing doubt in ability to remain quit, criticize smoking) have the opposite effect as they are predictive of not quitting (Palmer et al., 2000). Negative control might even
result in hiding the behavior and a reluctance to make the desired behavior change (Tucker et al., 2006). In addition to complicating a quit attempt, experiencing conflicts was found to be related to a lower relationship satisfaction, while receiving support was related to a higher relationship satisfaction (Cramer, 2006). To fully understand what couples are going through on a daily basis when experiencing a quit attempt, negative control behaviors should be reported as well, as they might counter the beneficial effects of support and negatively influence the relationship.

In contrast to the effects of partner behaviors, less is known about the effects of differences in partners’ perspectives on these behaviors. Recipients might not always report support receipt although the provider reports giving it (i.e., invisible support). For example, recipients may not be present to witness supportive behaviors (e.g., completing chores), or supportive behaviors are enacted during interpersonal interactions and are therefore not interpreted as support (Zee & Bolger, 2019). To examine the differences between partners is relatively new in research on smoking cessation. However, there is evidence that the differences in the reports of support are meaningful. For example, invisible support was related to lower levels of negative affect in smokers with a non-smoking partner (Lüscher et al., 2015) and contributed to a higher relationship satisfaction the next day (Girme et al., 2018). However, the effect of invisible support is not that clear-cut. In couples’ daily lives, it was related to worse well-being in support providers (Biehle & Mickelson, 2012) and a daily increase in cigarettes smoked in smokers during a quit attempt (Lüscher et al., 2015). Thus, on the one hand, invisible support might be beneficial for receivers, while on the other hand it can be detrimental for providers. This stresses the importance of examining the possibly unwanted effect that differences between partners in support could have on both partners’ relationship satisfaction. Some supportive behaviors could facilitate a quit attempt, but it might come at the cost to relationship satisfaction. The same holds for negative control: what happens when the partner criticizes the smoker, but this goes unnoticed? This could be very frustrating for the partner, while the smoker might be better off being unaware of their partners’ criticism. The effects of differences between partners need further examination to fully grasp their potential implications for health behavior: examining this using a dyadic perspective is key.

**Aim of the Study**

This study provides one of the first investigations of associations between support and negative control, and smoking and relationship satisfaction, looking at couple means and differences in reports. Our study focuses on the first 21 days of a quit attempt, capturing the difficult first weeks in which most relapse occurs (Hughes et al., 2004). Overall, we expect that on days when non-smoking partners provide more support there is a lower probability
of smoking and higher couple relationship satisfaction, while on days with more negative control there is a larger probability of smoking and lower couple relationship satisfaction. The effect of differences in reports on smoking cessation and relationship satisfaction will be explored.

**Method**

This study is part of a larger single-blind randomized controlled trial, consisting of a baseline measurement, a planning intervention, a three-week diary period and a follow-up measurement after three months. For a detailed description of the study protocol see Buitenhuis et al. (2018). The effectiveness of the intervention was previously reported in Buitenhuis, Tuinman, & Hagedoorn (2021), indicating comparable quit rates for both interventions (individual planning: 30%; dyadic planning: 33%). As both intervention groups are comparable, the current study uses data from both groups. The study was approved by the Ethical Committee of Psychology of the University of Groningen (16237-O) and complies with the Dutch law on Medical Research involving human subjects. The trial was registered in the Netherlands Trial Register (www.trialregister.nl/trial/5999).

**Participants**

Couples participating in this study consisted of a regular smoker (i.e., smoking cigarettes every day or multiple days per week) and their non-smoking partner, who were in a relationship for at least one year and cohabiting. Exclusion criteria were age younger than 18 years, not owning a mobile phone with access to internet, and pregnancy. Couples were recruited from April 2017 to July 2018 by the use of flyers and social media.

In total, 352 individuals (176 couples) started the diary. The participating couples showed a completion rate of 76% (n = 5611 [smokers: n = 2751; partners: n = 2860] of 7392 possible diary days). Participants missed on average 5.06 of 21 diary days. To be entered into the analyses, both partners were required to fill in the predictor and outcome variables on at least one day to be included in the model. Therefore, 2360 cases of 170 couples (84%) could be included in the analyses (Table 1). Henceforth, the term ‘partner’ refers to the non-smoking partner, and ‘smoker’ refers to the other partner who joined the study as a smoker.
Table 1. Mean baseline characteristics for participating couples.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Smokers (n = 170)</th>
<th>Partners (n = 170)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>61%</td>
<td>38%</td>
</tr>
<tr>
<td>Age (years)</td>
<td>39.1 (10.8, 18-63)</td>
<td>39.1 (11.6, 19-69)</td>
</tr>
<tr>
<td>Relationship duration (years)</td>
<td>12.9 (10.2, 1.1-42.3)</td>
<td>12.8 (10.2, 1.1-42.8)</td>
</tr>
<tr>
<td>Number of cigarettes smoked*</td>
<td>16.3 (8.6, 1-50)</td>
<td>--</td>
</tr>
<tr>
<td>Relationship satisfaction</td>
<td>6.9 (1.0, 2.3-8.0)</td>
<td>6.9 (1.0, 2.3-8.0)</td>
</tr>
</tbody>
</table>

Note. * N = 163. Standard deviations and ranges are in brackets. The sample consisted of 163 different-sex couples and 7 same-sex couples (2 male, 5 female).

Procedure

Details regarding the recruitment process are available elsewhere (Buitenhuis et al., 2018). Briefly, couples could sign up for the quit-smoking study through our website where they were informed that they would create a quitting plan under telephone supervision and had to fill in daily questionnaires. After signing up, eligibility was checked. Couples were randomized to the individual and dyadic planning condition and invited to fill in a baseline questionnaire. When both partners completed the baseline questionnaire, an appointment was made for the telephone planning intervention. By mail, couples received a package including an information letter, diary instructions, and a (dyadic or individual) planning sheet. After the intervention, one of the researchers gave instructions about the diary measurements and the smartphones were registered (on www.surveysignal.com) to receive text messages with the survey link. The day after the intervention was the quit date, and at the end of that day, the first diary survey was sent. Couples received text messages for 21 days, and a follow-up questionnaire by email three months later.

Measures

Smoking

Smoking behavior was assessed daily. Participants were asked whether they had smoked that day: ‘Did you smoke today (including one puff)? (Lüscher et al., 2017).
Supportive Partner Behaviors

Participants were asked to what extent they provided (for partners) or received (for smokers) support that day. Three items were included in the support scale (adapted from the Partner Interaction Questionnaire1; Cohen & Lichtenstein, 1990): ‘Today my partner calmed me when I was feeling stressed or irritated’, ‘Today my partner motivated me to remain abstinent’, ‘My partner noticed that I was doing well’. The items for the partner were framed in the I-version (e.g., ‘I noticed that my partner was doing well’). The answer scale ranged from not at all (1) to very much (7).

Negative Social Control

Participants were asked about negative behaviors that occurred that day. The scale consisted of two items: “Today my partner and I had a fight about the quitting plan” and “I/my partner showed some doubt about whether I/my partner could remain quit” (adapted from the Partner Interaction Questionnaire; Cohen & Lichtenstein, 1990). The answer scale ranges from not at all (1) to very much (7).

Relationship Satisfaction

Relationship satisfaction can be measured by one item in a valid and reliable way (Fülöp et al., 2020). In the diary, relationship satisfaction was measured by asking participants how satisfied they were with their relationship, at that moment (Müller et al., 2019). The scale ranged from unhappy (1) to very happy (10).

Statistical Analyses

All models in this study use a longitudinal dyadic score model (extending the cross-sectional model proposed by Iida et al., 2018) and take into account means and differences for partner behaviors on the daily level (the daily fluctuations around each couple’s mean) and on the couple level (centered at the grand mean) for dyadic predictors (support, negative control) and outcomes (relationship satisfaction). Because only one partner smoked, smoking was treated as an individual outcome. Since no intervention effect was found (Buitenhuis et al., 2021) and frequency of partner behaviors did not differ between the groups, intervention group was merely added as a covariate to all models (coded -0.5/0.5). We used one line per day per couple in the analyses. Time was included in all analyses. We rescaled time so that 0 represents the first diary day and 1 the change over the three-week diary period. We used a generalizability approach to calculate reliabilities for all constructs measured with two or more items (Cranford et al., 2006).

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1 The original version of the Partner Interaction Questionnaire was designed before the distinction between social support and social control was made (Mermelstein et al., 1983).
**Couple Means and Differences**

Couple means were calculated by averaging the score of both partners. Couple differences were calculated by subtracting the non-smoking partner’s score from the smoker’s score and dividing the score by two to ensure the same range for couple differences and couple means. Thus, differences of zero indicate the same score for both partners, positive values in the difference score indicate that the smoker is higher than the non-smoking partner while negative values indicate that the smoker is lower than the non-smoking partner. To facilitate interpretation, predictors were divided by the standard deviation of the between-couple variable (e.g., both daily fluctuations and between-couple level in couple means were divided by the standard deviation of between-couple level couple means). The unstandardized analyses can be found in Appendix A and the random effects of the models can be found in Appendix B.

**Smoking**

A Generalized Estimated Equation model was applied to the smoking data with a binary outcome measure (smoking yes/no) and partner behaviors as predictors, using a logit link function. We are using a generalized robust sandwich estimation with AR working correlation to address the potential issue of overdispersion (Fitzmaurice et al., 2011). To calculate an increase in the probability, the estimate and intercept were added up and exponentiated to calculate the OR. Probabilities were calculated by using OR/(1+OR).

**Relationship Satisfaction**

Couple means and differences for relationship satisfaction were analyzed with two separate mixed models with a normal distribution and an identity link. The outcome variables (couple levels and differences) were divided by their own standard deviation.

**Sensitivity Analyses**

We investigated predictors of missingness, indicating that number of cigarettes smoked at follow-up predicted missingness, which was then included as a covariate in sensitivity analyses for the multilevel models. Sensitivity analyses were run including the number of cigarettes smoked at baseline and follow-up, and gender, age and education of smoker and partner in all models. Number of cigarettes smoked at follow-up was positively related to smoking and smokers’ education was negatively related to the couples’ relationship satisfaction, but both did not change the pattern of results. Therefore, the more parsimonious model was reported to make full use of the available data (including 2360 cases instead of 2044 cases). Regarding the dichotomous smoking outcome, we conducted an additional sensitivity analysis, as the GEE model does not necessarily account for missing data. We used multiple imputation to create and analyze 30 multiple imputed datasets using IBM SPSS statistics 26. The sensitivity analysis with the pooled dataset showed that the pattern of results remained unchanged. Therefore, the unimputed results were reported.
Results

Variability and Reliability of Predictors and Outcomes

Regarding the question how much variability is on the couple or daily level (and error), we found that only up to half of the variability was on the couple level while the remaining substantial variability speaks for the importance of studying daily fluctuations (Table 2). Half or more of the variation in supportive and negative control behaviors was in daily fluctuations, emphasizing the importance of understanding these constructs on a daily level. For example, a large proportion of the variation in couple means of support was attributable to daily fluctuations and error (44% daily fluctuations to 56% at the between-couple level). Only couples’ relationship satisfaction showed relatively low variation in daily levels (i.e., a high ICC of 0.71).

All partner behavior scales showed very high reliabilities on the between-couple level ($R_{KF}$) ranging from 0.94 to 0.99 and satisfactory to high reliabilities on the daily level ($R_C$) ranging from 0.61 to 0.77 with the exception of couple differences in negative control which was somewhat lower (see Table 2) yet still showed predictive utility (see Table 3).

Table 2. Available Time Points and Descriptives of Raw Couple Means and Differences.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>ICC</th>
<th>$R_{KF}$</th>
<th>$R_C$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supportive behavior</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Couple means</td>
<td>2360</td>
<td>3.66</td>
<td>1.46</td>
<td>1.00 – 7.00</td>
<td>0.56</td>
<td>0.99</td>
<td>0.77</td>
</tr>
<tr>
<td>Couple differences (/2)</td>
<td>2360</td>
<td>0.12</td>
<td>0.91</td>
<td>-3.00 – 3.00</td>
<td>0.44</td>
<td>0.98</td>
<td>0.67</td>
</tr>
<tr>
<td><strong>Negative control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Couple means</td>
<td>2360</td>
<td>1.53</td>
<td>0.76</td>
<td>1.00 - 6.75</td>
<td>0.34</td>
<td>0.97</td>
<td>0.61</td>
</tr>
<tr>
<td>Couple differences (/2)</td>
<td>2360</td>
<td>-0.00</td>
<td>0.55</td>
<td>-3.00 - 2.50</td>
<td>0.28</td>
<td>0.94</td>
<td>0.39</td>
</tr>
<tr>
<td><strong>Relationship satisfaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Couple means</td>
<td>2360</td>
<td>8.38</td>
<td>1.30</td>
<td>2.00 – 10.00</td>
<td>0.71</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Couple differences (/2)</td>
<td>2360</td>
<td>-0.04</td>
<td>0.91</td>
<td>-4.50 – 4.00</td>
<td>0.58</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note. ICC = intraclass correlation; $R_{KF}$ = between-couple reliability; $R_C$ = daily reliability. One line per day per couple.
**Associations of Support and Negative Control with Smoking**

The intercept of the GEE model indicated the probability of smoking for a typical smoker on an average weekday in the diary period, which was 51% (OR = 1.06, see Table 3). There was no significant effect of time nor intervention group.

On the between-couple level, smokers in couples with higher mean levels of support were less likely to smoke (OR = 0.66, \( p < .001 \)). Smokers with one standard deviation higher level of support showed a probability of smoking of 41% (i.e., 0.70/1.70), compared to 51% for a smoker with average support. On the daily level, on days when couples had higher support means than usual, the probability of smoking was lower (OR = 0.80, \( p < .001 \)). On days with one standard deviation higher support than usual, smokers reported a probability of smoking of 46%, compared to 51% on a typical day.

Regarding negative control, on the between-couple level, smokers with higher mean levels of negative control had a higher probability of smoking (OR = 2.02, \( p < .001 \)). Smokers with one standard deviation higher level of negative control, showed a 68% probability of smoking, compared to 51% with average negative control. On the daily level, on days when couples had higher negative control means than usual, the probability of smoking was higher (OR = 1.20, \( p < .001 \)). On days with one standard deviation higher negative control than usual, smokers reported a 56% probability of smoking, compared to 51% on a typical day. A difference between partners in their perspectives on supportive or negative control behaviors was not related to smoking.
### Table 3. Daily support, negative control, relationship satisfaction couple means and differences (SD) and smoking (yes/no) (n = 170).

**Note.** *p < .05, **p < .001. To facilitate interpretation of results we scaled all predictors and outcomes in between-couple standard deviation. Values in bold indicate statistically significant and relevant results.*

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Smoking (yes/no)</th>
<th>Rel. Satisfaction Means</th>
<th>Rel. Satisfaction Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>b</strong></td>
<td><strong>SE</strong></td>
<td>OR</td>
</tr>
<tr>
<td><strong>Intercept</strong></td>
<td>0.06</td>
<td>0.18</td>
<td>1.06</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>-0.21</td>
<td>0.20</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>Weekend-day</strong></td>
<td>-0.07</td>
<td>0.08</td>
<td>0.93</td>
</tr>
<tr>
<td><strong>Dyadic intervention group</strong></td>
<td>-0.19</td>
<td>0.25</td>
<td>0.83</td>
</tr>
<tr>
<td><strong>Supportive behaviors</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Couple means</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-couple level</td>
<td>-0.42**</td>
<td>0.13</td>
<td>0.66</td>
</tr>
<tr>
<td>Daily level</td>
<td>-0.22**</td>
<td>0.05</td>
<td>0.80</td>
</tr>
<tr>
<td><strong>Couple differences</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-couple level</td>
<td>-0.01</td>
<td>0.13</td>
<td>0.99</td>
</tr>
<tr>
<td>Daily level</td>
<td>0.02</td>
<td>0.03</td>
<td>1.02</td>
</tr>
<tr>
<td><strong>Negative control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Couple means</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-couple level</td>
<td>0.70**</td>
<td>0.14</td>
<td>2.02</td>
</tr>
<tr>
<td>Daily level</td>
<td>0.18**</td>
<td>0.04</td>
<td>1.20</td>
</tr>
<tr>
<td><strong>Couple differences</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-couple level</td>
<td>0.01</td>
<td>0.14</td>
<td>1.01</td>
</tr>
<tr>
<td>Daily level</td>
<td>0.00</td>
<td>0.03</td>
<td>1.00</td>
</tr>
</tbody>
</table>
**Associations of Support and Negative Control with Couples’ Mean Relationship Satisfaction**

Couples displayed, on average, high relationship satisfaction \( (b = 5.48, p < .001) \), that slightly went up over 21 days \( (b = 0.17, p < .001) \), see Table 3). On the between-couple level, couples with higher mean levels of partner support showed higher relationship satisfaction \( (b = 0.28, p < .001) \). This effect and the following can be interpreted as indicating that a one standard deviation higher level of support was related to a 0.28 standard deviation higher relationship satisfaction (for an illustration see Figure 1, upper left panel). On the daily level, on days when couples had higher support means than usual, they showed higher relationship satisfaction \( (b = 0.12, p < .001) \); see Figure 1, lower left panel). Exploratory locally estimated scatterplot smoothing (LOESS) curves indicated a linear effect for both panels.

Interestingly, differences in support between partners were also related to relationship satisfaction, on the couple level and the daily level. Couples with larger differences in support showed higher relationship satisfaction \( (b = 0.19, p < .001) \). This effect indicates that when the smoker reported higher support than their non-smoking partner across the study period, the couple showed higher relationship satisfaction, and vice versa when the smoker reported lower support than their non-smoking partner the couple showed lower relationship satisfaction. Furthermore, on days when couples had a larger difference in support than usual they moved towards higher relationship satisfaction \( (b = 0.03, p = .003) \). In other words, on days when the smoker reported higher support than their partner, the couple showed higher relationship satisfaction means, and on days when the smoker was lower than their non-smoking partner, the couple’s relationship satisfaction was lower.

On the between-couple level, couples with higher mean levels of negative control, showed lower relationship satisfaction \( (b = -0.20, p < .001) \). On the daily level, on days when couples had higher negative control means than usual, they showed lower relationship satisfaction \( (b = -0.05, p < .001) \).
Daily support and negative control

Figure 1. Scatterplots of the association between means (left graphs) and differences (right graphs) of support and relationship satisfaction on the between (upper graphs) and daily level (lower graphs), including exploratory LOESS curves (fitting 20% of the points).

1. **Couple means**
   - Between-couple level
   - Relationship satisfaction
   - Couple means in support between-couple level

2. **Couple differences**
   - Smoker more than partner
   - Partner more than smoker
   - Smoker more than partner
   - Couple differences in support between-couple level

3. **Daily level**
   - Relationship satisfaction
   - Couple means in support daily level

4. **Couple differences**
   - Smoker more than partner
   - Partner more than smoker
   - Smoker more than partner
   - Couple differences in support daily level

**Note.** The curve in graph 1 follows a linear curve, indicative of a symmetrical association, while the curve in graph 2 is not linear, indicative of an asymmetrical association. LOESS = locally estimated scatterplot smoothing.

**Associations of Support and Negative Control with Couple Differences in Relationship Satisfaction**

At the beginning of the study, partners showed a small difference in relationship satisfaction (intercept $b = -0.12$ for the typical couple), indicating slightly lower relationship satisfaction in the smoker compared to the non-smoking partner. Couples’ mean levels of supportive and negative control behaviors were not related to differences in relationship satisfaction.
satisfaction. However, differences in smokers’ and partners’ perceptions of supportive and negative control behaviors were associated with differences in relationship satisfaction. On the between-couple level, couples with larger differences in support showed larger differences in relationship satisfaction. Couples with the smoker reporting higher support than their partner across the study period also reported higher relationship satisfaction than their partner ($b = 0.25, p < .001$, indicating that for a one standard deviation larger difference in support, partners differed by 0.25 standard deviation in relationship satisfaction). Smokers who reported higher support than their partner, had higher relationship satisfaction than their partner, while smokers who reported lower support than their partner had lower relationship satisfaction than their partners. An exploratory LOESS curve indicated that the effect was carried mostly by the latter (i.e., invisible support, see Figure 1, upper right panel). On the daily level, on days when smokers reported higher support than their partner, they also reported higher relationship satisfaction, but taking the slightly negative intercept into account, it was still negative but closer to zero. Therefore, it remained lower than the satisfaction of their partner ($b = 0.04, p = .014$, Figure 1, lower right panel with LOESS line indicating a linear effect).

On the between-couple level, couples with larger differences in negative control showed larger differences in relationship satisfaction. Couples with the smoker reporting higher negative control than their partner across the study period also reported lower relationship satisfaction than their partner ($b = -0.22, p < .001$). On the daily level, on days when smokers reported higher negative control than their partners, they reported lower relationship satisfaction than their partner ($b = -0.03, p = .008$).

**Discussion**

This study is the first to examine both supportive and negative control behaviors, in single-smoking couples during a quit attempt, where we focused on couple levels and differences between partners and their association with smoking and relationship satisfaction. Our results stress the importance of using a daily diary: there was a lot of potential for meaningful daily fluctuations next to substantial variability between couples, which were found reliable on both levels. Couples with higher support and on days with higher support means showed higher relationship satisfaction and a smaller probability of smoking for smokers. In contrast, couples with higher negative control and on days with higher negative control means showed lower relationship satisfaction and a higher probability of smoking for smokers. Couples with larger differences in support and on days with larger differences in support, showed higher mean relationship satisfaction. In other words, when the smoker reported higher support than their partner the couple reported higher mean relationship satisfaction. Differences in support and negative control behaviors on the between-couple and daily level were related to differences in relationship satisfaction. Specifically, in couples
with the smoker reporting higher support than their partner, they also reported higher relationship satisfaction than their partner. When smokers reported higher negative control than their partner, they also reported lower relationship satisfaction than their partner.

**Associations of Support and Negative Control with Smoking**

Our findings broadly support the findings of other studies linking support to smoking cessation (Key et al., 2004; Scholz et al., 2016). Supportive partner behavior seems beneficial during a quit attempt: smokers who have a partner who is more supportive than the typical partner in our sample, had a smaller probability of smoking. Additionally, smokers had a smaller probability of smoking on days when partners provided more support than usual. Therefore, not only more stable support matters, but also daily fluctuations in support show important contributions to successful smoking cessation. One way support could avert relapse, is by preventing and reducing stress that can result from withdrawal symptoms (stress-buffering support; Cohen, 1986; Creswell et al., 2015). Previous research mainly focused on the importance of partner support for smoking fewer cigarettes (Scholz et al., 2016). This study extends these findings to the prevention of relapse: partner support can reduce the probability of falling back to smoking, also on a daily basis.

Confirming our hypothesis, negative control can complicate a quit attempt. The current study sheds more light on the relatively understudied concept of negative control during a quit attempt, such as fighting or expressing doubt in the smokers’ ability to remain abstinent. As reported in literature, negative control might result in a reluctance to make the desired behavior change, as these strategies might make the target person feel bad (Tucker et al., 2006). This might explain why smokers who experienced more negative control from their partner in general, had a higher probability of smoking. Even on days when partners showed more negative control than they usually do, the probability of smoking was higher. These results show the importance of taking into account other partner behaviors besides support. Partners can be supportive, but if they also show negative behaviors, the benefit of support might disappear. Partners should be aware of the fact that all types of daily interactions could have important implications for a successful quit attempt, even for couples that are supportive in general.

This study did not find an association between differences in supportive or negative control behavior and smoking. To our knowledge, a difference in negative control reports has not been studied before. Our study showed that, with regard to smoking behavior, couple levels of negative control do hinder a quit attempt, but it does not matter whether smokers and their partners perceive these behaviors differently. Apparently, it is the occurrence of the behavior itself that is important, regardless of who reported this behavior more. Previous research on differences in support was not clear-cut. For example, invisible support (i.e.,
when support is not reported, but the partner does report providing it) might be more effective in adjusting to a major stressor, such as an important examination, than visible support (Bolger et al., 2000). However, invisible support was also found to be related to an increase in daily cigarettes (Lüscher et al., 2015). We did not find an association between differences in perspective of support and smoking. A possible explanation might be that invisible support can be beneficial for some stressors, but in the case of a quit attempt, support should be more pronounced. Perhaps smokers want to perceive support, as some sort of recognition of how difficult their quit attempt is. On the other hand, invisible support is thought to improve recipients’ perceptions of their own personal resources to cope with challenges (Zee & Bolger, 2019). Therefore, a positive effect of invisible support could be expected during a quit attempt. This issue needs further attention in future research.

**Associations of Support and Negative Control with Relationship Satisfaction**

As reported in the literature, receiving partner support is related to higher relationship satisfaction (Cramer, 2006), while negative control is related to lower relationship satisfaction (Craddock et al., 2015). The data of our study supports these findings. In line with our hypotheses, couples who reported more partner support, had higher relationship satisfaction, while negative control was related to lower relationship satisfaction. Relationship satisfaction is often considered to be a quite stable couple trait. Therefore, it is interesting to note that the same associations were also visible in daily fluctuations. Our results indicated that daily fluctuations in relationship satisfaction occurred, based on whether partners provided either more supportive or negative control behaviors. Therefore, for couples it is important to focus on daily interactions, to maintain a good relationship and facilitate the quit attempt, even for generally highly satisfied couples.

In contrast to smoking, differences in the perception of support did seem to matter with regard to couples’ relationship satisfaction. The couples in which smokers reported more support than their partner reported providing (i.e., imagined support), showed higher relationship satisfaction. This indicates a possible beneficial association of imagined support for couples’ satisfaction. Patients who expect their partner to be more involved in their health, react more positively to their involvement/partner control (Rook et al., 2011). Perhaps when smokers report higher levels of support, this was driven by their expectation, resulting in a higher satisfaction. Figure 1, graph 1 shows the association between support and satisfaction. The curve seems to follow a linear curve, indicating a symmetrical association. Therefore, the result could likely also be framed the other way around: when smokers reported less support than their partner reported providing, the couple reported lower relationship satisfaction. That is, invisible support seems unfavorable for the relationship satisfaction of the couple.
Next to couples’ relationship satisfaction, differences in satisfaction between partners were examined. Smokers who reported more support than their partners reported providing seemed to be more satisfied with their relationship than their partners. In other words, when smokers reported less support than their partner reported providing (i.e., invisible support), smokers reported lower satisfaction. However, we don’t know whether the effect of a difference was driven by a positive effect of imagined support, a negative effect of invisible support or both. An exploratory LOESS curve gave the impression that the effect was mostly present on the side of invisible support (Figure 1). This would indicate a possible negative association of invisible support with relationship satisfaction not only for the whole couple as we discussed above, but probably more specifically for the receiver. However, this result should be interpreted with caution as it is likely limited by the size of our sample. This finding would contradict previous research, that found invisible support to be related to higher relationship satisfaction the next day (Girme et al., 2018). A possible explanation for a negative effect of invisible support on relationship satisfaction of smokers is that previous measures of support often focused on practical or emotional support, or help to solve a problem, while our measures of support were related to the quit attempt. Receiving support, without reciprocating it can negatively impact one’s mood (Gleason et al., 2003). Even though support might be reciprocated in other areas (e.g., household chores), support related to the quit attempt can not be compensated by smokers. Furthermore, couples were included and participated together, which might have created expectations about partner involvement. Hence, invisible support could be interpreted as no contribution to the team effort, or a lack of interest in the quit attempt. Larger differences in negative control were also related to a larger difference in relationship satisfaction. When smokers received more negative control than their partners reported giving, their relationship satisfaction was lower than their partners’ satisfaction. This sounds intuitive, since it is understandable that the partner who reports the highest level of negative control is the least satisfied, and that receiving these behaviors might be worse than providing them.

**Limitations**

An inherent problem in diary studies is diary reactivity (Bolger and Laurenceau, 2013). That is, participation in a diary could create awareness of the behaviors studied, possibly resulting in an overestimation of the beneficial effect of support or the unfavorable effect of negative control. However, diary reactivity seems to stabilize after one week for addictive behaviors (Buu et al., 2020). Moreover, the use of daily measurements has several advantages such as a reduction in recall bias (Shiffman, 2009), which improves the accuracy of reported behavior. However, the results are based on self-report and not biochemically verified, although self-reports of smoking are accurate in most studies (Patrick et al., 1994)
Additionally, all couples received a planning intervention, thereby possibly complicating the generalizability of our findings to couples experiencing an unaided quit attempt.

A problem that is commonly addressed in research concerning partner support is the temporal order of events. It might be the case that partners are more supportive when smokers succeed in remaining abstinent; therefore, it is not the support that results in smoking less, but the other way around. And, negative control or conflicts might be the result of a relapse. For relationship satisfaction, this reversed causation is difficult to entangle as well. It is very likely that couples who are more satisfied, are therefore more supportive towards their partner. Daily fluctuations do bring us one step closer to unravelling the temporal order of events as they represent the link between variables on a daily basis as opposed to a baseline questionnaire linked to a follow-up over a longer period of time, thereby giving less room for other possible confounders. Nevertheless, more research is needed to disentangle partner behaviors and their influence on relationship satisfaction and health behavior change.

Conclusion

This was the first study to examine support and negative control and differences in the reports of these behaviors during a quit attempt, and its associations with smoking and relationship satisfaction. Partner support was related to a lower probability of smoking and higher relationship satisfaction, while negative control was related to a higher probability of smoking and lower relationship satisfaction. Differences between partners in their reports of support and negative control were not associated to smoking. However, invisible support seems to be related to lower relationship satisfaction in the couple, and specifically, for the receiver. However, more research is needed to unravel the direction and implications of these discrepancies. Interventions should focus on making couples, and specifically partners, aware of the fact that all types of daily interactions can have important implications for a successful quit attempt as well as their relationship satisfaction, even for couples who are supportive in general.

Author Note

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Daily support and negative control


