# Promotion of low-fat consumption in overweight individuals: Planning compensates for lower cognitive functioning

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Abstract

There is evidence that lower cognitive functioning goes along with lower self-regulated health behaviour. Planning has been shown to be an effective strategy to successfully implement one's behavioural intentions into behaviour. Thereby, planning is assumed to promote automatic behavioural responses and thus unfolding its beneficial effects without drawing on cognitive resources. Thus, the aim of this study was to examine whether participation in a planning intervention would compensate for the potential negative effects of lower cognitive functioning on change in dietary behaviour.

The sample consisted of 144 overweight and obese participants. Half of the sample participated in a planning intervention. Fat consumption and cognitive functioning was assessed at baseline. Six months later, fat consumption was assessed again.

Results indicate that despite an unexpected non-significant effect of the planning intervention on change in fat consumption, a significant interaction between planning intervention and cognitive functioning emerged: Cognitive functioning was unrelated to change in fat consumption in the planning group, but in the control group individuals with lower cognitive functioning were more unsuccessful to reduce their fat consumption.

This study provides first evidence that planning compensates lower cognitive functioning in an experimental field study in the context of dietary change.

## Introduction

The World Health Organization classified overweight and obesity as epidemic diseases as prevalence is increasing rapidly worldwide (WHO, 2000). Increased body weight is related to higher morbidity and mortality and cause enormous costs on both an individual as well as a societal level (WHO, 2000). Even in severe cases of obesity, behavior change (e.g., changing dietary habits, changing physical activity patterns) always constitutes an important part of the therapy. In terms of changing dietary habits, it is usually recommended to follow a low-fat diet (e.g., NIH, 1998). Changing one's dietary habits, however, seems to be of great difficulty for most people (e.g. (Kumanyika et al., 2000).

One factor that has been convincingly demonstrated to facilitate intentional behavior change is planning (also known as action planning or implementation intentions; (Gollwitzer & Sheeran, 2006). Planning can be divided into two subconstructs: action planning and coping planning (Sniehotta, Scholz, & Schwarzer, 2006; Sniehotta, Schwarzer, Scholz, & Schuz, 2005). Action planning refers to when-where-and-how-planning (Leventhal, Singer, & Jones, 1965), that is the when and where constitute situational cues and these are linked to the behavioral outcomes specified in the how-component. Coping planning in contrast refers to the anticipation of barriers and the concrete planning on how to overcome these barriers (Sniehotta, et al., 2006). Here again, the situational cue which is the anticipated barrier is linked to the behavior (i.e., how to overcome the barrier). The latter need not necessarily be the target behavior, but can also be a coping strategy. For example a personal barrier for adhering to a low-fat diet might be the presence of negative feelings which makes a person want to indulge in sweets. The strategy that is planned to overcome this barrier might be to call a friend in order to get distracted.

The effectiveness of planning in the context of dietary change could be demonstrated by several studies so far. These studies focused on change in fruit and vegetable intake (e.g.,(Armitage, 2007; Kellar & Abraham, 2005) changes in fat-intake (e.g.,(Luszczynska, Scholz, & Sutton, 2007; Prestwich, Ayres, & Lawton, 2008) or change in body mass index (Luszczynska, Sobczyk, & Abraham, 2007).

It is assumed that the positive effects of planning on behavior are based on establishing a strong contingency between situational cues and behavioral outcomes with the respective if-then plans (e.g.,(T. L. Webb & Sheeran, 2007). Several mechanisms have been demonstrated to underlie the effectiveness of planning (Gollwitzer & Sheeran, 2006): For example, planning results in an *increased accessibility of the situational cues* that enables better detection and recall which in turn is associated with better performance of the target behavior. Another assumed mechanism is the *automaticity of the behavioral response.* Here it is suggested that the execution of the planned behavior runs immediately after the respective situational cue is encountered and without the need of conscious intent. Within this automaticity assumption it also is postulated that no cognitive effort is necessary to execute the planned behavioral response so that even under attentional distraction (Brandstaetter, Lengfelder, & Gollwitzer, 2001), under high cognitive load (A. L. Cohen, Bayer, Jaudas, & Gollwitzer, 2008) or under high stress (Scholz et al., 2009) stable performance can be shown.

*Cognitive functioning and health behaviour*

Self-regulated health behaviour is assumed to be dependent on cognitive functioning (e.g.,(Hall, Elias, & Crossley, 2006). This assumption is mainly supported by studies focusing on the associations between proxy variables of cognitive functioning or health behavior (cf. (Gottfredson & Deary, 2004). For example there is evidence for the association between socio-economic status and overweight / nutrition (e.g.,(Celi et al., 2003; Martikainen, Adda, Ferrie, Davey Smith, & Marmot, 2003), or the negative association between cognitive abilities and overweight (e.g., (Chandola, Deary, Blane, & Batty, 2006) or the negative association between cognitive ability and morbidity / mortality(Batty, Deary, & Macintyre, 2007).

Research on the direct associations between cognitive abilities and health behaviour is rather rare. There are a few studies reporting a positive relationship in the context of physical activity and dietary behaviour (Hall, et al., 2006), and medication adherence (Stilley, Bender, Dunbar-Jacob, Sereika, & Ryan, 2010). Moreover, a recent study by Hall and colleagues (Hall, Fong, Epp, & Elias, 2008) also demonstrated the moderating function of executive control as indicator of cognitive abilities on the intention-behavior relationship over and above the main effect of cognitive abilities: the higher the cognitive functioning of study participants, the more positively were intentions related to subsequent behaviour.

### *Aim of the present research*

To sum up, there seems to be evidence that self-regulated health behaviour is dependent on an individual's cognitive abilities. As outlined above, however, planning has been shown to be an effective means in promoting self-regulated behaviour without drawing on an individual's cognitive resources. So far, however, no study exists that demonstrates this effect of planning on a relevant health behaviour outside of the laboratory. Thus, this study's aim was to examine whether a planning intervention was able to compensate for potentially negative effects of low cognitive abilities on change in dietary behaviour. In particular, we hypothesized that participants of a planning intervention would be able to decrease their fat consumption over time independent on their cognitive abilities. In contrast, we assumed that control group participants' change in fat consumption would depend on their cognitive functioning in that those with higher cognitive functioning would be more successful in changing their dietary behaviour.

## Method

### *Sample and Procedures*

We conducted a single-blinded randomized controlled trial in order to evaluate the effects of a planning intervention on fat consumption six months (T2) after baseline assessment. The study was advertised in newspapers and on webpages in order to recruit overweight and obese individuals from the general population. Inclusion criteria were to have a Body mass index over 25 and being 18 years or older. Participation in a professional weight-loss program (e.g., weight watchers) and insufficient comprehension of the German language were our exclusion criteria. Random allocation of participants to either the control group (CG) or the planning group (PG) took place as soon as individuals called the information line of the study. For the baseline assessment participants were invited to come to the lab. After giving informed consent, participants received a personal code to match the data of the questionnaires and 24h-recalls to ensure anonymity. Participation was voluntary and individuals received 50 Swiss Francs after completing the final assessment. All participants were treated in accordance with the ethical guidelines of the Helsinki Declaration 2000. For the second point of measurement, six month later questionnaires together with picture books for the 24h-recall for nutrition assessment and stamped return envelopes were sent to participants by ordinary mail. The 24h-recalls for the follow-up assessment were conducted by telephone.

*Experimental conditions*

*Control group.* During the baseline session, all participants irrespective of their experimental group allocation received an information leaflet on principles of and tips for a low-fat diet which was based on recommendations of the Swiss Society of Nutrition. After having read the leaflet, they completed a self-check questionnaire on their knowledge of a low-fat diet (including questions such as "What foods contain a lot of hidden fat? Chocolate, fruits and vegetables, sausages, etc."). Answers of this self-check questionnaire were subsequently discussed with a trained interviewer (see (Stadler, Oettingen, & Gollwitzer, 2009)for a similar procedure). Then, participants completed the baseline-questionnaire. After this, the 24h-recall for the assessment of dietary behavior of the last 24 hours was administered with a trained interviewer. Finally, the test of cognitive functioning was conducted with participants.

*Planning group*. Participants of the planning group (PG) received the same procedure as the CG. In addition to this, they took part in a planning intervention. This planning intervention which was adopted from Sniehotta and colleagues (Sniehotta, et al., 2006) and adapted to the diet-specific setting, took place in a face-to-face situation. Participants formed up to 3 action plans on their low-fat diet. The planning sheet for action plans started with the instruction, ‘Please think about when, where and how you plan to comply to a low-fat diet next week. Please write down your three most important plans in the following table. The more precise, concrete and personally you formulate your plans, the more they can help you.’ The table contained three rows labeled Plan 1, Plan 2, and Plan 3. The columns were headed with ‘when’, ‘where’, and ‘how’. Following this, participants formed up to three coping plans. The planning sheet for coping plans started with the instruction: ‘Please think carefully about any “personal risk situations” that might make it difficult for you to comply with your low-fat diet. Make concrete plans on what to do to overcome these personal risk situations. Please write down your three most important plans in the following table. The more precise, concrete and personally you formulate your plans, the more they can help you.’ The table again contained three rows labeled Plan 1, Plan 2, and Plan 3. The columns were headed with ‘what personal risk situation’, and ‘how do you overcome this situation’. At the bottom of both planning sheets, participants read the statement ‘Visualize the situations and your planned actions and make a firm commitment to act as planned.’

*Sample characteristics*

The sample consisted of 144 participants ($n$ = 105 women, 72.9%) with a mean age of $M$ = 51.34 ($SD$ = 12.74, range = 18-79). The majority of participants were married ($n$ = 93, 64.6%), 28 individuals (19.4%) were divorced, 18 (12.5%) were single and 5 (3.5%) were widowed. Most participants had children (n = 105, 72.9%); and the majority reported having attended nine years of schooling ($n$ = 95, 66.0%), indicating an average educational level of the sample. Mean Body Mass Index was $M$ = 31.43 ($SD$ = 4.56). Of the 144 participants, exactly 72 were in the control group and 72 in the planning group.

*Dropout-analyses*

Overall, 16 individuals (11.1%) dropped out of the study by the follow-up six months after baseline. Analyzing potential differences between dropouts and continuers revealed no differences for fat consumption, social desirability, cognitive functioning, as well as for marital status, educational status, or whether or not participants had children. However, dropouts were younger ($M$ = 43.69, $SD$ = 12.18 for dropouts, $M$ = 51.92, $SD$ = 12.63 for continuers; $F(1, 130) = 5.01$, $p = .03$, eta$^2$ = .04) and had a higher BMI at baseline than continuers ($M$ = 33.57, $SD$ = 5.81 for dropouts, $M$ = 30.84, $SD$ = 4.31 for continuers; $F(1, 141) = 5.26$, $p = .02$, eta$^2$ = .04). Finally, in terms of experimental groups more individuals from the planning group ($n$ = 13) than from the control group ($n$ = 3) dropped out of the study ($\chi^2$ (1) = 7.03, $p$ = .01).

*Measures*

*Fat consumption* was assessed by 24h-recalls (Wolper, Herschka, & Heymsfield, 1995). This assessment of dietary behavior is a valid and accurate method for the purpose of group comparisons, which were aimed at in the present study (e.g., (Kubena, 2000). In this structured interview participants were asked to report everything they ate and drank during the last day from getting up until going to bed. In addition, it was asked whether participants consumed anything after going to bed. In order to further validate the assessment of portion sizes, participants received a standardized picture book with portion sizes at all assessments. Moreover, in order to improve accuracy of reports of food eaten, questions on the context of eating occasions were included in the interview (Armstrong et al., 2000). Data were analyzed with a nutrition analysis program (EBISPro) which resulted in total amount of fat consumed in gram per 24h-recall. The sample mean of fat consumption at baseline was $M$ = 78.89 ($SD$ = 36.91) and at follow-up $M$ = 58.41 ($SD$ = 28.81). In order to test the effects of the intervention and cognitive functioning on change in fat consumption, a difference score between fat consumption at follow-up minus fat consumption at baseline was computed.

*Cognitive functioning* was assessed by the screening instrument COGTEL (Cognitive Telephone Screening Instrument for the Assessment of Cognitive Function Across Adulthood; (Kliegel, Martin, & Jager, 2007). The COGTEL has been demonstrated to be of good reliability and validity. In the present study, the COGTEL was administered in a face-to-face situation at the end of the baseline assessment. Implementation of the COGTEL took between 10 and 15 minutes. It is composed of six subtests: verbal short-term memory, verbal long-term memory, working memory, verbal fluency, inductive reasoning, and prospective memory. The average cognitive functioning as measured by the mean score of the six subscales was $M$ = 31.97 ($SD$ = 9.27). Internal consistency measured by Cronbach's Alpha was with .54 rather low.

*Social desirability* was assessed by the SDS-17 (Stoeber, 2001) and served as control variable. It was assessed at Time 1 only. Answering format was dichotomous (1 no, 2 yes). Higher values indicated higher social desirability. The average score for the total sample was $M$ = 4.49, $SD$ = 2.39. Cronbach's alpha was again rather low with .58.

Data analyses

As dropout turned out to be systematically biased (i.e., missing pattern was at best missing at random, MAR, Little & Rubin, 2002), we accounted for missing data by employing expectation maximization (EM; (Graham, 2009). Univariate and multivariate outliers were routinely screened (Tabachnick & Fidell, 2001).

Our main analysis was a hierarchical regression analysis. Change in fat consumption (as measured by difference score) served as the criterion. In a first step, age, social desirability, experimental group (coded 0 for CG and 1 for PG) as well as mean-centered cognitive functioning was entered. In a second step the interaction term between mean-centered COGTEL and experimental group was entered. To display the interaction effects, low and high values of the COGTEL were generated by using the lowest and highest observed value of the mean-centered variable (J. Cohen, Cohen, West, & Aiken, 2003). To test whether the regression slopes were significant, we ran simple slope analyses (Preacher, Curran, & Bauer, 2006). All analyses were conducted with SPSS 19. For significance testing an alpha level of .05 was used.

## Results

*Randomization Check*

A one-way ANOVA did not reveal any significant mean differences between the control group and the intervention group on T1 fat consumption, cognitive functioning, social desirability, BMI, or age. Likewise, using $\chi^2$ tests, no differences on the demographic variables (sex, marital status, education) were found, indicating that the randomization procedure was successful.

*Descriptive results*

In Table 1, all correlations of the variables included in the study are displayed. Age was negatively associated with cognitive functioning as well as with fat consumption at both times of measurement. Thus, age was subsequently included in the main analyses as control variable. Moreover, cognitive functioning was positively related to social desirability and to fat consumption at Time 1. Social desirability was not associated with fat consumption at either point in time and was thus not included as a control variable.

*Effects of experimental group and cognitive functioning on fat consumption*

In order to test the effect of cognitive functioning on change in fat consumption and to examine whether participation in the planning intervention served as moderator of this relationship, a hierarchical regression analysis was run. Results are displayed in Table 2: no main effects of experimental group or age emerged but cognitive functioning was negatively associated with change in fat consumption. Moreover, the interaction between experimental group and cognitive functioning was significant. The interaction is displayed in Figure 1. Simple slope analyses resulted in a significant slope for individuals in the control group ($t$ = -2.40, $p$= .02), whereas the simple slope for individuals in the planning group did not gain significance ($t = 0.322$, $p=0.75$). Thus, in line with our assumptions, lower cognitive functioning could be compensated for by a planning intervention in terms of change in fat consumption.

## Discussion

This study set out to examine whether an action and coping planning intervention was able to compensate a potentially negative effect of cognitive functioning on self-regulated behavior change. The results confirm the hypothesis that planning enables enactment of behavior independent of an individual's cognitive functioning. For control group participants a negative association between cognitive functioning and change in fat consumption emerged. These results are in line with studies demonstrating that planning promotes behavioral enactment without drawing on cognitive resources (e.g., (Brandstaetter, et al., 2001; A. L. Cohen, et al., 2008; Scholz, et al., 2009; Thomas L. Webb & Sheeran, 2003). This study, however, is the first study to demonstrate this effect outside of the laboratory on the change of a relevant health behavior across six months and thus adds significantly to the literature.

There were, however, also some unexpected results in this study. First, there was no main effect of the planning intervention on behavior change. This is in contrast to the most published studies and the resulting meta-analyses on the effects of planning on health behavior in general (e.g., (Gollwitzer & Sheeran, 2006) and on change in dietary behavior in particular (e.g., (Armitage, 2007; Luszczynska, Scholz, et al., 2007). There are, however, also studies reporting no significant effects of planning on change in diet (e.g., (Jackson et al., 2005). One possible explanation for this lack of an effect is the relatively long time span of six months. Most studies demonstrating positive effects of planning on subsequent behavior change use shorter follow-up intervals. Thus, potentially, the main effect of a single planning intervention on behavior might only be present for a certain time period. Another explanation might be found in the context of the study: the sample of overweight and obese individuals might have a long history of weight problems and in line with this rather strong eating habits. A recent study provides evidence that planning might be less effective when the behavior that a person wants to change is strongly habitual (T. L. Webb, Sheeran, & Luszczynska, 2009).

Another unexpected result of this study was the positive association of cognitive functioning with fat intake at baseline. This is in contrast to recent studies (e.g., (Hall, et al., 2006) as well as to our hypotheses. Moreover, no such association emerged for fat consumption at the six-months follow-up and in the regression analysis, a negative main effect between cognitive functioning and change in fat consumption emerged which was in the expected direction. Furthermore, the 24h-recall method comprised questions on the context of the eating episode in order to enhance recall performance (Armstrong, et al., 2000). Thus, together with the non-significant association at follow-up, explaining this effect by a better memory function in the individuals with higher cognitive performance is rather unlikely.

Besides the study’s strengths that lie in the experimental design, the administration of 24h-recalls and picture books as a valid measure of dietary behavior and the application of a test of cognitive functioning in a non-student sample, this study also had some limitations. These are for example the rather low reliability of the total score of cognitive functioning. A low internal consistency indicates that the measure is potentially not unidimensional and that a total score is thus not the most appropriate method of analysis. As this was the first study to examine the compensating function of planning on potential negative effects of cognitive functioning on self-regulated health-behavior in a field setting, however, we were more interested in the effects of overall cognitive functioning than of the subdimensions. Future studies might want to take on a more differentiated view on these effects (e.g., Allen, Johnston, & Campbell, 2008). Moreover, as outlined above the time span of the study might have been too long to replicate main effects of the planning intervention on health behavior change. Furthermore, due to the field-study design, it was impossible to assess potential mechanisms of the compensating effects of planning. Finally, there was systematic dropout from baseline to follow-up which was among others associated with participation in the planning intervention. Without compensation of this systematic dropout, results could have been seriously biased. In this study, however, we accounted for this systematic dropout by including the missing mechanisms in the background model when running the EM method of missing imputation (Graham, 2009).

Future studies should focus on replication of the present study's results in different sample constellations, different target behaviors and different time intervals between points of measurement. It might be especially interesting to focus on samples with real cognitive constraints (such as people with dementia) in order to examine whether the compensating function of a planning intervention holds in these special cases as well.

Results also point to some practical implications as it seems as if especially individuals with lower cognitive abilities might benefit from forming exact and concrete if-then plans on when, where, and how to implement an intended behavior as well as from forming if-then plans on how to overcome potential personal barriers.

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Footnote

Parts of the data analyzed in the present paper were also used in a paper by Scholz (2011) and by Scholz, Ochsner, Hornung, & Knoll (2011). The paper by Scholz (2011) concerned change in dietary intake and social-cognitive mediators after different kind of interventions. The paper by Scholz et al. (2011) concerned the effects of received social support on change in dietary behavior in addition to individual social-cognitive factors. However, although there is some overlap with the variables used in the present paper, this paper presents the investigation of a unique research questions not yet covered by previous publications from this project as none of the other papers focuses on cognitive functioning.

Table 1. *Correlations of study variables*

| | Age | BMI | SD | COGTEL | Group | FC T1 | FC T2 |
|---|---|---|---|---|---|---|---|
| Gender | -.05 | -.03 | .08 | .08 | -.10 | .13 | .14 |
| Age | | -.08 | -.003 | -.40** | -.06 | -.23** | -.21* |
| BMI | | | -.02 | .13 | -.08 | -.08 | .04 |
| SD | | | | .26** | -.004 | .15 | .14 |
| COGTEL | | | | | -.06 | .23** | .12 |
| Group | | | | | | .16 | .09 |
| FC T1 | | | | | | | .31** |
| FC T2 | | | | | | | |

*Note.* BMI: Body Mass Index; SD: social desirability; COGTEL: Cognitive functioning; Group: 0 = Control Group, 1 = Planning Group; FC = Fat consumption; Gender: 1 = women, 2 = men; # $p < .10$, * $p < .05$, ** $p < .01$.

Table 2: Hierarchical regression analysis for the prediction of change in fat consumption

| | Step 1 | | | Step 2 | | |
|---|---|---|---|---|---|---|
| | B | SE | Beta | B | SE | Beta |
| Age | .03 | .28 | .01 | .04 | .28 | .01 |
| Group | -6.80 | 6.55 | -.09 | -6.77 | 6.48 | -.09 |
| COGTEL | -.54 | .39 | -.13 | -1.24 | .52 | -2.93* |
| Group * COGTEL | | | | 1.40 | .70 | .24* |

*Note.* COGTEL: Cognitive functioning; Group: 0 = Control Group, 1 = Planning Group; * $p < .05$, ** $p < .01$.

Figure 1: Interaction between experimental group and cognitive functioning on change in fat consumption. Slope for low cognitive functioning is significant at $p = 0.025$; slope for high cognitive functioning is not significant.