Moderators of the mediated effect of intentions, planning and saturated fat intake in obese individuals.

ABSTRACT

Objective: The present study aimed to advance our understanding of health-related theory, that is, the alleged intention-behavior gap in an obese population. It examined the mediating effects of planning on the intention-behavior relationship and the moderated mediation effects of age, self-efficacy and intentions within this relationship.

Method: The study was conducted over a five week period. Complete data from 571 obese participants were analyzed. The moderated mediation hypothesis was conducted using multiple regression analysis. To test our theoretical model, intentions (week 2), action self-efficacy (week 2), maintenance self-efficacy (week 5), planning (week 5) and saturated fat intake (week 1 and 5) were measured by self-report.

Results: As hypothesised planning mediated the intention-behavior relationship for both perceived (two-item scale) as well as percentage saturated fat intake (measured by a food frequency questionnaire). Age, self-efficacy and intentions acted as moderators in the above mediation analysis. In specific, younger individuals, those with stronger intentions and people with higher levels of maintenance self-efficacy at higher levels of planning showed greater reductions in their perceived saturated fat intake.

Conclusions: For successful behavior change knowledge of its mediators and moderators is needed. Future interventions targeting planning to change saturated fat intake should be guided by people’s intentions, age and self-efficacy levels.

Keywords: intention, self-efficacy, age, planning, moderation, mediation
INTRODUCTION

Dietary habits are difficult to change. Most social-cognitive theories assume that an individual's intention to change is the best direct predictor of actual change. However, people do not always behave according to their intentions. To understand why some people succeed in translating their dietary intentions into behaviors while others do not, individual differences and the mechanisms of behavior change need to be considered (Abraham, Sheeran, & Johnston, 1998).

Planning as a Mediator of the Intention-Behavior Relation

The current study is based on the Health Action Process Approach (HAPA) model (Figure 1; Schwarzer, 2008). The theory behind the HAPA model suggests that in the volitional part of behavior change, planning acts as a mediator in the relationship between intention and behavior. Some research has supported the mediational properties of planning (Gutierrez-Dona, 2009; Norman & Conner, 2005, Study 2; Scholz et al., 2008, Schwarzer et al., 2007, Studies 1-3), suggesting that individuals who have higher intentions are more likely to plan and these plans are more likely to translate good intentions into action. There are, however, studies that have failed to find mediating effects of planning on the intention-behavior relationship (Norman & Conner, 2005, Study 1; Schwarzer et al., 2007, Study 4).

These inconsistent findings suggest that the mediating mechanism of change might differ between subgroups of participants. The degree to which planning acts as a mediator in the intention-behavior relationship may depend on a number of moderators such as a person’s age (Reuter et al, 2009; Renner et al, 2007; Amireault et al., 2008; Hagger et al., 2002), level of intention (Nooijer et al., 2006; Wiederman et al., 2009) or self-efficacy beliefs (Gutierrez-Dona, Renner et al., 2009; Schwarzer et al., 2010, Lippke et al., 2009).

Age as a Moderator of the Planning-Behavior Relation

A number of studies have tested the moderating effects of age on the intention-behavior relationship (Renner et al., 2000, Amireault et al., 2008; Hagger et al., 2002) with only a few studies focusing on the moderating effects of age on the planning-
behavior relationship (Reuter et al., 2010; Scholz et al., 2007; Renner et al., 2007). Renner et al (2007) examined the HAPA model in younger, middle-aged and older adults from South Korea and found a good model fit within the middle-aged and older adult population but a poor model fit in the younger adult sample. In a study on physical activity conducted by Reuter et al (2010) it was reported that at higher levels of planning, physical activity increased more for older people (60 years old), while the reverse relationship was true for younger individuals (29 year olds). Scholz et al (2007), examined the differential age effects of action planning (when, where and how) and coping planning (anticipation of barriers) on physical activity. No age differences were reported in terms of action planning. The authors found that at pre-intervention older adults showed higher initial levels of coping planning, while at the end of the study younger individuals were the ones with the highest increase in their coping planning.

With only few published studies and rather inconsistent results, it is unclear for which age group planning is most beneficial. Also, most of the above mentioned studies have been conducted in one specific health domain; that of physical activity (Reuter et al., 2009, Renner et al., 2007; Amireault et al., 2008).

Perceived Self-Efficacy as a Moderator of the Intention-Planning-Behavior Relation

Three recent studies in the dietary behavior domain (Gutierrez-Dona, 2009; Schwarzer et al., 2010) and one within the physical activity domain (Lippke et al., 2009) have found evidence of the moderating effects of self-efficacy in the intention-planning-behavior relationship. In the study on physical activity, Lippke et al (2009) found that planning had a greater impact on behavior at higher levels of self-efficacy. In the dietary domain, some studies suggested that self-efficacy acts on the motivational side of behavior change by moderating the intention-planning relationship (Gutierrez et al., 2009, Study 2; Schwarzer et al., 2010, Study 1). Other studies found that self-efficacy acts on the volitional side of behavior change by moderating the planning-behavior relationship (Gutierrez-Dona, 2009, Study 1; Schwarzer et al., 2010, Study 2; Richter et al., 2010).

A pitfall of the above studies is that the type of self-efficacy in operation has not been clearly defined. This might have further weakened the consistency in findings. In accordance with the HAPA model the present study identified two types of self-
efficacy, namely action and maintenance self-efficacy (Schwarzer 2008, Schwarzer et al., 2007). The rationale for the distinction between several phase-specific self-efficacy beliefs is that during the course of health behavior change, different self-efficacy beliefs are required to master tasks successfully. Action self-efficacy is focused on the motivational phase of behavior change. Individuals high in action self-efficacy imagine success and are more likely to initiate a new behavior. Maintenance self-efficacy, acts on the volitional phase of behavior changes, and represents optimistic beliefs about one’s capability to deal with barriers. Once an action has been taken, individuals with high maintenance self-efficacy invest more effort and persist longer than those who are less self-efficacious. Based on the HAPA model, in this study the two types of self-efficacy are envisioned to act differently on the intention-planning-behavior relationship.

**Intention as a Moderator of the Planning-Diet Relationship**

Another potential moderator of the planning-behavior relationship is intention itself. High intentions can increase the encoding of situational cues, the representativeness of cue-response links and therefore the likelihood of turning an ‘if...then’ plan into action (Sheeran et al., 2005). Nooijer et al. (2006) reported that committed participants were more likely to carry out their implementation intentions and increase their fruit intake. In two longitudinal studies described by Wiedemann et al. (2009), which focused on interdental hygiene and physical activity as the outcome behaviors, the effect of planning on behavior was moderated by intentions. By considering the moderating effects of intentions in the planning-behavior relationship we could indeed advance our knowledge on bridging the intention-behavior gap (Conner et al., 2007). Our conceptual model of the intention, age and self-efficacy moderation on the intention-planning-saturated fat relationship is shown below in Figure1.
Objectives

The aims of the present study were to: a) test the mediating effects of planning on the relationship between intention and saturated fat intake; b) assess the moderating effects of intentions, self-efficacy and age on the relationship between intention, planning and saturated fat intake.

We hypothesised first that the strength of the relationship between planning and behavior is higher in individuals who have a higher intention to change their saturated fat intake, and second, that self-efficacy moderates the intention-planning-behavior relationship at two different levels: (a) People showing a high degree of action self-efficacy could translate their intentions into plans, and (b) people with a high level of maintenance self-efficacy could potentially resolve or be more persistent to obstacles and therefore more easily translate plans into behavior. Taking into account the rather mixed evidence on the moderating effects of age, we also investigated its moderating role in the planning-behavior relationship.
METHODS

Design and Procedures
A recruitment agency invited online 1187 obese participants to participate in the study. No face to face participant-experimenter contact was present. Each participant had to go through a number of screens and received online instructions how to complete them.

At baseline (week 1), 1027 participants were recruited and signed an online consent form (Varnhagen et al., 2005). The aim of the first week was to familiarise participants with the study focus and to gather information on their self-reported saturated fat intake. At week 2, 781 participants, who returned to the website, were asked to fill out a shorter questionnaire on action self-efficacy and intention to reduce saturated fat intake. Next, participants were randomly allocated by a computer generated programme into one of four conditions: a) a control group (CG); b) an implementation intention condition; c) a CVD risk message condition; and d) a combined implementation intention plus CVD risk message condition. Allocation of the participants in the four conditions was stratified by age group (30-45 years or 46-60 years), gender and smoking status. The effectiveness of the interventions has been described in more detail elsewhere (Soureti A et al., 2010). For the purpose of this paper, we controlled for the effects of experimental conditions. Each participant was allowed on the intervention site once and no repeat visits were permitted. At week 5 571 participants, who returned and completed a follow-up assessment on their saturated fat intake, planning, maintenance self-efficacy, and intentions, were included in the statistical analysis. Participants received £15 upon study completion and were entered in a prize draw for vouchers (£200).

This study was approved by an independent research ethics committee in the South of England. All research was conducted in accordance with the World Medical Association Declaration of Helsinki (2000).

Participants

The self-report eligibility criteria included; age (30-60 years), Body Mass Index (BMI) >29, not being diagnosed with a heart-condition or cancer, not being pregnant. We
chose obese participants because they were assumed to benefit most from heart-health information (Renner et al., 2000).

We found no significant differences in baseline characteristics such as age, BMI and smoking status between intervention conditions. The mean percentage saturated fat intake at baseline was 15.4%, which is above the recommended levels of the United Kingdom (BBC Health, 2010). Participants’ baseline characteristics are shown below in Table 1.

**Table 1.** Participant baseline characteristics

<table>
<thead>
<tr>
<th>Overall F statistic (P-value)</th>
<th>Control Group</th>
<th>Planning Heart-Age</th>
<th>Planning plus Heart-Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGE (years)</td>
<td></td>
<td>46.89 (8.26)</td>
<td>47.05 (8.48)</td>
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<tr>
<td>(years) a</td>
<td>0.15 (0.929)</td>
<td>47.06 (8.11)</td>
<td>46.56 (8.52)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>35.71 (5.71)</td>
<td>35.72 (5.40)</td>
<td>35.51 (6.15)</td>
</tr>
<tr>
<td>(kg/m²) a</td>
<td>2.10 (0.099)</td>
<td>35.64 (6.44)</td>
<td></td>
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<tr>
<td>Smokers (%)</td>
<td>25.61 (0.991)</td>
<td>25.13 (0.991)</td>
<td>25.26 (0.991)</td>
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<tr>
<td>Note: a No significant between group differences found in participants’ baseline characteristics (P&gt;0.05)</td>
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</table>

**Measurement of Outcomes**

**Saturated Fat Intake** was assessed by: (a) A food frequency questionnaire (FFQ; Margetts et al., 1989), which records the frequency of consumption of 63 common foods. This questionnaire has acceptable test-retest reliability (r=0.62, p<0.01) and validity when compared with 10-day weighed records (Armitage & Conner, 1999; Thompson & Margetts, 1993). (b) A two item scale (TIS; r=0.78, p<0.001), in which participants were asked to report their agreement in consumption of low saturated fat foods ('I have eaten foods low in saturated fat...') followed by frequency in consumption of these foods ('How often did you eat foods low in saturated fat').

**Action and maintenance self-efficacy** items were modified from previous research (Schwarzer, 2008; Sniehotta et al., 2005; Schwarzer et al., 2003; Renner & Schwarzer, 2005). Action self-efficacy (Cronbach’s Alpha= 0.84) consisted of four items (e.g., "I’m confident I could reduce my saturated fat intake, even if I will have to overcome my
different high fat habits”). *Maintenance self-efficacy* (Cronbach’s Alpha=0.89) consisted of 11 items (e.g., “I am certain I could overcome difficulties related to maintaining reductions in my saturated fat intake even if...I feel tensed, bored, I eat out” etc). They were both measured on a 4-point scale (not at all, barely true, mostly true, exactly true). To test the discriminant validity of both action and maintenance self-efficacy all 15 items were factor analyzed. The four items of action self-efficacy differentiated well from maintenance self-efficacy as all four loaded into one factor. Maintenance self-efficacy was split into two factors with the second (consisting of 3 items) explaining only 8% of the variance. Due to the high Cronbach’s Alpha of maintenance self-efficacy the mean score of the 11 items was used. Similarly, the mean of the four items was used for action self-efficacy.

**Intentions to reduce saturated fat intake** were measured on a 7-point Likert scale (strongly agree- strongly disagree) via 10 items (e.g., “Over the next two weeks, I intend to...replace high fat with lower fat alternatives, eat smaller portions of food, reduce the amount of saturated fat in my diet”), which were highly inter-correlated (Cronbach Alpha =0.92) and analyzed as a composite score.

**Planning items** were adapted from previous research (Renner & Schwarzer, 2005; Schwarzer et al., 2003; Schwarzer, 2008; Sniehotta et al., 2005) and measured on a 4-point scale. A total score was created of the two planning items: “I have my own plan regarding (1) when, and (2) how to reduce my saturated fat intake”.

The means and standard deviations, and inter-correlations of the measures are displayed below in Table 2.
Table 2. Means and inter-correlations between intention, planning, self-efficacy, perceived saturated fat intake (SAFA) and % SAFA.

<table>
<thead>
<tr>
<th></th>
<th>Intention</th>
<th>Planning</th>
<th>Action Self-efficacy</th>
<th>Maintenance Self-efficacy</th>
<th>SAFA Week 1</th>
<th>SAFA Week 5</th>
<th>% SAFA Week 1</th>
<th>% SAFA Week 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>1-7</td>
<td>1-4</td>
<td>1-4</td>
<td>1-7</td>
<td>1-7</td>
<td>1-7</td>
<td>1-100</td>
<td>1-100</td>
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<tr>
<td>Mean</td>
<td>5.35</td>
<td>2.74</td>
<td>2.87</td>
<td>2.74</td>
<td>4.73</td>
<td>5</td>
<td>15.4</td>
<td>14.6</td>
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<td>SD</td>
<td>1.26</td>
<td>0.88</td>
<td>0.7</td>
<td>0.62</td>
<td>1.51</td>
<td>1.34</td>
<td>3.23</td>
<td>3.16</td>
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<td>Intention</td>
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<td>Planning</td>
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<td>Maintenance Self-efficacy</td>
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<tr>
<td>SAFA Week 1</td>
<td>0.00*</td>
<td>0.20*</td>
<td>-0.28</td>
<td>0.19*</td>
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<td></td>
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<tr>
<td>SAFA Week 5</td>
<td>0.23*</td>
<td>0.38*</td>
<td>0.06</td>
<td>0.22*</td>
<td>0.41*</td>
<td></td>
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<tr>
<td>% SAFA Week 1</td>
<td>-0.18*</td>
<td>0.21*</td>
<td>0.06</td>
<td>0.13*</td>
<td>-0.32*</td>
<td>-0.26*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% SAFA Week 5</td>
<td>-0.27*</td>
<td>-0.29*</td>
<td>-0.08**</td>
<td>-0.18*</td>
<td>-0.21*</td>
<td>-0.29*</td>
<td>0.67*</td>
<td></td>
</tr>
</tbody>
</table>

Note: Correlations are significant at *p<0.01 or **p<0.05, for all other correlations p>0.05.
Statistical Methods

We used multiple regression analysis (SPSS v17). The simple mediation model was tested by the product of coefficients method with bootstrapping to test significance of the indirect effect (Preacher & Hayes, 2004; Preacher et al., 2007; 2008). An exact normal distribution may only be found in large samples, but bootstrapping overcomes several problems with non-normally distributed variables such as low power. Three steps were followed: 1) the relationship between intentions and saturated fat intake was assessed (c); 2) the relationship between intentions and planning was assessed (a); 3) the relationship of planning (b) and intentions (c’) with saturated fat intake was analyzed, taking into account relevant covariates, to test for indirect effects. The indirect effect was quantified as the product of the mean bootstrapped sample estimates (n= 5000) of the regression coefficients. Bootstrap confidence intervals were generated for the indirect effect. The model was run with perceived saturated fat intake and % saturated fat intake as dependent variable, respectively.

Then, we examined the moderating effects of intention, age and self-efficacy on the intention-planning-behavior relationship. Each moderator was tested separately. Linear Regression analysis was conducted with perceived saturated fat intake and percentage saturated fat intake as dependent variables. Planning, the moderator (e.g. age, intentions or self-efficacy) and the interaction between the moderator and planning were entered as independent variables. Baseline perceived saturated fat intake and dummy coded condition (1=experimental conditions, 0= control group) were added as covariates in the analysis. To test the model centred variables were used. If an interaction between a moderator and planning was significant (p<0.10; Stone-Romero et al., 2002), it was further decomposed as specified by Aiken and West (1991). The p value for moderation was increased from the typical 0.05 to 0.10 to increase statistical power for detecting moderation. Simple slopes for planning were divided at three levels of the moderator (+1SD, mean and -1SD) using Modgraph-I (Jose, 2008). No missing variables were detected at week 5, as participants (n= 571) were prompted by the system to fill out any missing items.
RESULTS

Mediation: Planning as a mediator in the intention-behavior relationship.

Percentage saturated fat intake: Results from bootstrapping yielded a significant mediating effect of planning ($\beta = -0.12$; SE = 0.04; 95% CI: -0.19, -0.54). The initial relationship between intentions and % saturated fat intake ($\beta = -0.41$, 95% CI: -0.56; -0.25) was reduced but remained significant ($\beta = -0.29$, 95% CI: -0.45, -0.12) after controlling for planning. Planning partially mediated the intention-behavior relationship explaining 29% of the variance between intention and percentage saturated fat intake.

Two item scale (TIS): The same procedure was followed for the two perceived saturated fat intake items. Results from bootstrapping showed a significant mediating effect of planning ($\beta = 0.13$; SE = 0.03; 95% CI: 0.08, 0.18). The initial relationship between intentions and the mean of the two perceived items ($\beta = 0.19$, 95% CI: 0.11; 0.27) became non-significant ($\beta = 0.071$, 95% CI: -0.01; 0.15) after controlling for planning. Planning partially mediated the relationship between intentions and TIS explaining 63% of the model variance. Figure 2 presents the beta and significance values for the mediation for both % saturated fat intake and TIS.

Figure 2 Planning as a mediator in the relationship between intention and saturated fat intake

Note: In brackets are the beta values for % saturated fat intake analysis. ***p<0.001, **p<0.05, *p>0.05
Moderation of the Mediated Effect: Action and Maintenance Self-Efficacy Moderate the Intention-Behavior Relationship

**Percentage saturated fat intake:** Maintenance self-efficacy was no moderator of the relationship between planning and % saturated fat intake ($\beta =0.11$, 95% CI: -0.19; 0.40). Action self-efficacy was no moderator of the relationship between intention and planning ($\beta =0.02$, 95% CI: -0.04; 0.08).

**TIS:** Next, we tested the moderating effects of maintenance self-efficacy on the relationship between planning and the two item self-perceived scale. TIS was predicted by planning ($\beta =0.46$, 95% CI: 0.33; 0.59), past TIS ($\beta =0.31$, 95% CI: 0.25; 0.37) and intentions ($\beta =0.09$, 95% CI: -0.00; 0.17). Maintenance self-efficacy ($\beta =-0.70$, 95% CI: -0.22; 0.08) was not a significant predictor of TIS. Maintenance self-efficacy was indeed a moderator of the relationship between planning and TIS ($\beta =0.18$, 95% CI: 0.05; 0.31). The behavioral variance explained by this model was 27.7%. Figure 3 below presents the beta and significance values for the above model.

**Figure 3.** Moderation of maintenance self-efficacy on the planning-perceived saturated fat intake (TIS) relationship.

Planning mediated the effect of intentions on TIS at all levels of self-efficacy (simple slope $+1SD= 0.58$), mean levels of self-efficacy (simple slope= 0.46) and low levels of...
self-efficacy (simple slope -1SD= 0.34) with p<0.001. All slopes were significantly different from zero with the slope +1SD being the steepest.

The interaction between maintenance self-efficacy and planning has been plotted below in Figure 4. The significant interaction effect supported the hypothesis that the relationship between planning and TIS was moderated by maintenance self-efficacy. For conditions of high planning, individuals with high levels of self-efficacy reported the highest reductions in the two item self-perceived saturated fat scale. Contrary to our expectations, people low in self-efficacy reported higher reductions of their TIS under conditions of low planning.

**Figure 4.** Interaction between planning and maintenance self-efficacy on TIS.

![Figure 4](image)

**Moderation of the Mediated Effect: Intention Moderates the Planning-Behavior Relationship**

**Percentage saturated fat intake:** Intention was not a moderator of the relationship between planning and % saturated fat intake (β =0.16, 95% CI: -0.84; 1.16).

**TIS:** There was an initial significant relationship between intention and TIS (β =0.29, 95% CI: 0.25; 0.35). Subsequently, TIS was predicted by planning (β =0.45, 95% CI: 0.33; 0.57), past TIS (β =0.30, 95% CI: 0.23; 0.36), intentions (β =0.08, 95% CI: 0.00; 0.17) and the intention*planning interaction (β =0.08, 95% CI: 0.00; 0.15) accounting for 27.3% of the model’s behavioral variance.
Planning mediated the effect of intention on TIS at all levels of intention (simple slope +1SD= 0.55), mean levels of intention (simple slope= 0.45) and low levels (simple slope -1SD= 0.35) with p<0.001 and all slopes being significantly different from zero. The interaction between intentions and planning is shown in Figure 5. At higher levels of planning, individuals who were more motivated to change evidenced the highest perceived reductions in TIS than those with lower levels of intention.

**Figure 5.** Interaction between planning and intentions on TIS.

![Graph showing the interaction between planning and intentions on TIS.](image)

**Moderation of the Mediated Effect: Age Moderates the Planning-Behavior Relationship**

**Percentage saturated fat intake:** The relationship between intention and planning was significant ($\beta =0.29$, 95% CI: 0.25; 0.35). Then the effect of intentions, age and the age*planning interaction was tested. The age*planning interaction was not significant ($\beta =-0.01$, 95% CI: -0.03; 0.02).

**TIS:** The most significant predictor in this model was planning ($\beta =0.45$, 95% CI: 0.33; 0.58), followed by past TIS ($\beta =0.30$, 95% CI: 0.24; 0.37). Reductions in TIS did not differ between age groups ($\beta =0.001$, 95% CI: -0.01; 0.01), but age was a significant moderator of the planning-behavior relationship (age*planning; $\beta =-0.14$, 95% CI: -0.15; 0.13). The model accounted for 27.2% of the behavioral variance. The interaction is shown below in Figure 6 for three different age ranges (+1SD, mean, -1SD). The crossover nature of the interaction is critical; at higher levels of planning younger
individuals (−1SD= 37.55 years old) had greater reductions in perceived saturated fat intake, while at lower levels of planning older individuals (+1SD= 54.55 years old) had greater reductions in perceived saturated fat intake.

Simple slope analysis indicated that planning mediated the effect of intentions on TIS at all age ranges (simple slope +1SD= 0.33), mean age levels (simple slope= 0.45) and younger age levels (simple slope -1SD= 0.56). In the present study, all slopes were significantly different from zero (all p’s <0.001) with the slope for younger participants being the steepest.

**Figure 6.** Interaction between planning and age on TIS.

![Graph showing interaction between planning and age on TIS](image)

**Moderation of the Mediated Effect: Maintenance Self-Efficacy, Age and Intention as Moderators of the Planning-Behavior Relationship**

**Percentage saturated fat intake:** When all moderators were entered in the same model, the age*planning, intention*planning and maintenance self-efficacy*planning interaction remained not significant.

**TIS:** When all moderators were entered in the same model, the age*planning (β =-0.01, 95% CI: -0.03; 0.004) and intention*planning interaction (β =0.06, 95% CI: -0.03; 0.15) became non-significant. The maintenance self-efficacy*planning interaction (β =0.14, 95% CI: -0.02; 0.29) remained significant (p=0.085).
DISCUSSION

In this study, planning was a mediator in the intention-behavior relationship; more motivated individuals were more likely to plan and planning was linked to changes in both the two item scale (TIS) and in the percentage saturated fat intake. Age, intention and self-efficacy acted as moderators of the planning-TIS relationship.

The mediating effects of planning in the relationship between intention and behavior are in line with the HAPA model suggesting that people who form an intention and engage in planning are more likely to change their behavior in the desired direction (Norman & Conner, 2005, Reuter et al., 2008, Schwarzer et al., 2007). Most previous studies have been criticised for using observational data when exploring mediating effects (Spencer et al., 2005). Only few studies have tested experimentally the causal link between intention-planning-behavior (Reuter et al., 2010). Our study is one of the few that has experimentally manipulated the effects of planning and thereafter adjusted for it in the statistical mediation analysis. The fact that planning acted as a partial mediator in the intention-behavior relationship -with varying levels of variance explained between the two outcome measures- attests to the importance of conducting future studies, in which the existence of additional mediators such as maintenance self-efficacy (Scholz et al., 2007) is explored in multiple mediation models.

As an extension of previous research on health behaviors (e.g., interdental hygiene, fruit and vegetable consumption and physical activity), the moderating effects of intentions on the planning-saturated fat intake relationship were examined. In line with our hypothesis and previous work, the higher people’s intentions the more likely they were to enact on their plans and report a reduction in their perceived saturated fat intake (De Vet et al., 2009, Wiedemann et al., 2010, Noojier et al., 2006). This advancement in our knowledge may help explain previous inconsistent findings in the role of planning as a mediator between intentions and behavior (Norman & Conner, 2005). Planning may act as a mediator only under specific conditions such as higher levels of intention or self-efficacy. Also, the magnitude of changes in intentions necessary to help people enact on their plans might differ depending on the complexity of behavior. Wiedemann et al (2009) found that intentions had to exceed a higher threshold in physical activity than in interdental hygiene.
A practical implication of the above is that future interventions would benefit from (a) taking into consideration the complexity of the behavior to be changed and (b) increasing motivation of low intenders before promoting the creation of specific plans on how to change behavior. Future research would also benefit by defining the context, in which plans would maximise their effects. For example, De Vet et al (2009) found that repeated use of plans worked better for people with strong intentions. In a similar vein, use of plan reminders (Hurling et al., 2007, Prestwich, Perugini, & Hurling, 2010) might work best for those with high levels of intention, but this assumption needs to be further tested.

In the present study, we also found that younger individuals with higher levels of planning evidenced greater perceived saturated fat reductions than older individuals. The reverse was true for older individuals (i.e., older individuals showed greater perceived saturated fat reductions than younger adults with lower levels of planning). Our findings are in line with some previous studies (Scholz et al., 2007; Renner et al., 2000). An explanation is that older individuals have a more prescribed routine with existing plans that are more resistant to change in the introduction of new ones. In contrast, younger people are more likely to need some guidance with their hectic lives and therefore be more welcoming on planning strategies on how to deal with their unhealthy dietary patterns. Another possible explanation of the present results is related to the population under study (obese). Being overweight and obese has been linked to a less positive relationship between intention and behavior (Renner et al., 2000). This may be especially true in older obese individuals who have been disappointed by previous failed attempts to change their dietary behavior. Younger obese participants, who are less likely to have had so many failures, are more likely to welcome and benefit from the introduction of a planning regime to change their behavior.

A counter-argument to our findings is that under the right circumstances planning could be of value for older adults, since it could enact as a mnemonic to overcome age-related cognitive problems (Reuter et al., 2010). Also health messages are more relevant to older age groups (Hooker & Kaus, 1994; Renner et al., 2000) as getting older is likely to be accompanied with a number of physical changes (e.g. decline in muscle strength) and this makes people become more aware of their susceptibility towards disease.
Researchers need to be more careful in designing planning instruments that are sensitive to the population they are targeting.

Maintenance self-efficacy but not action self-efficacy also moderated the mediated effect. Conditions of high planning evidenced the highest perceived reductions in saturated fat, especially for individuals with high levels of self-efficacy. These results support the Social Cognitive Theory by Bandura (1997) and show that strong self-efficacy beliefs are necessary for behavior change. Similar findings have been reported before in the domain of dietary behavior and physical activity (Lippke et al., 2009; Gutierrez-Dona, 2009, Study1; Schwarzer et al., 2010, Study2; Richter et al., 2010; Luszczyńska & Haynes, 2009). Contrary to our expectations, at low levels of self-efficacy people were better off with low levels of planning. This latter result may appear odd to begin, but may imply a need for these individuals to receive less pressure to achieve a target. It also suggests that people with low levels of self-efficacy may be going through a different set of behavioral regulation mechanisms (e.g., social support) to achieve change.

To the best of our knowledge this is the first study that identified and tried to distinguish between different types of self-efficacy (e.g., action or maintenance) and their moderating role on behavior. Maintenance self-efficacy, the ability to cope with maintenance of a low fat diet, was more important than action self-efficacy at explaining the processes of change in the intention-behavior relationship. The present study’s failure to replicate previous findings on the role of action self-efficacy on the intention-planning relationship (Gutierrez et al., 2009, Study2; Schwarzer et al., 2010, Study1) needs to be further investigated. More research is needed to investigate the potential moderating effects of both types of self-efficacy in different domains of health behavior.

Despite the inconsistent findings between action and maintenance self-efficacy, the conclusion remains that self-efficacy operates as a moderator in the self-regulation process. Moreover, maintenance self-efficacy was the only variable that remained a significant moderator of the relationship between planning and behavior when all moderators were entered in the same regression model. The practical implication of the above findings is that interventions need to focus on helping individuals gain confidence in their ability to maintain a healthy diet when barriers prevail. Self-
efficacy can be improved by direct mastery experience or modeling. Thus, interventions should improve both maintenance self-efficacy and planning skills (Luszczynska, Tryburcy, & Schwarzer, 2007).

The selection of population in the present study is also important. The focus was on obese individuals, an at risk population for developing health related problems such as cardiovascular disease in the future. The inclusion of these participants was deliberate. It is believed that these participants, though at no immediate risk of disease, will be more likely to benefit from planning and saturated fat reductions than normal weight individuals. These people are also expected to take more consideration of their weight when making health-related judgements (Renner et al., 2000).

A limitation of the present study is the use of self-report measures of fat intake. The moderation of the mediated effects for age, intention and self-efficacy was inconsistent between the two saturated fat intake measures with significant effects for the two item scale (TIS) but not for the percentage saturated fat intake based on the food frequency questionnaire (FFQ). In specific, all variables (age, self-efficacy, intention) moderated the planning-behavior relationship for perceived saturated fat but not for the percentage fat intake.

The assessment of dietary intake is rather difficult and both the TIS and FFQ used in this study come with limitations. However, TIS was better at differentiating between different levels of age, intention and self-efficacy, perhaps as the TIS has been designed to detect changes in experimental studies (Chapman, Armitage & Norman, 2009). On the other hand, some have claimed that perceived items such as TIS are influenced by social desirability (Faith et al., 1998), as participants in more active conditions may be more aware of the study aims, and so may respond differently. Two previous studies counter the argument of social desirability by showing no difference between conditions for awareness of the study’s hypothesis or feelings of obligation to comply (Chapman et al., 2010; Budden & Sagarin, 2007).

FFQs have been considered by some to be the gold standard when measuring dietary intake. However, FFQs were initially designed to estimate individual intake and may not be sufficiently sensitive to detect small changes in behavior (Margetts et al., 1989; Cade et al., 2004). Under-reporting of food consumption is also a recurrent challenge for FFQs and is most pronounced among overweight and obese (Garriguet, 2008).
Most importantly, the current FFQ did not account for individual variation in portion sizes but instead assumed the average portion taken by the population of the United Kingdom. This dynamic might cause a skew in results, especially considering the nature of our current sample (i.e., obese).

Another limitation of the present study is the short duration follow-up. To determine the genuine nature of our results, a sample should be followed over longer periods of time. Despite limitations, the present findings are innovative because they further extend the behavior change mediator model by providing evidence of moderating processes.

CONCLUSIONS

In conclusion, the present study has advanced our knowledge in health related theory by providing further evidence of the mediating role of planning in the intention-behavior relationship in the domain of saturated fat intake in an obese population. This mediating relationship was further moderated by three variables namely age, maintenance self-efficacy and intentions. Our results indicate that younger individuals, high intenders and people with higher levels of maintenance self-efficacy and higher levels of planning show greater perceived reductions in their saturated fat intake.