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Research report

Saturated fat consumption and the Theory of Planned Behaviour: Exploring additive and interactive effects of habit strength

Gert-Jan de Bruijn [a,b,*], Willemieke Kroeze [b], Anke Oenema [b], Johannes Brug [b,c]

[a] Department of Communication Science, Amsterdam School of Communications Research ASCoR, Kloveniersburgwal 48, 1012 CX Amsterdam, The Netherlands
[b] Department of Public Health, Erasmus Medical Centre, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands
[c] EMGO Institute, VU University Medical Centre, Van der Boechorststraat 7, 1081 BT Amsterdam, The Netherlands

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ABSTRACT

The additive and interactive effects of habit strength in the explanation of saturated fat intake were explored within the framework of the Theory of Planned Behaviour (TPB). Cross-sectional data were gathered in a Dutch adult sample ($n = 764$) using self-administered questionnaires and analyzed using hierarchical regression analyses and simple slope analyses. Results showed that habit strength was a significant correlate of fat intake ($\beta = -0.11$) and significantly increased the amount of explained variance in fat intake ($R^{2\text{-change}} = 0.01$). Furthermore, based on a significant interaction effect ($\beta = 0.11$), simple slope analyses revealed that intention was a significant correlate of fat intake for low levels ($\beta = -0.29$) and medium levels ($\beta = -0.19$) of habit strength, but a weaker and non-significant correlate for high levels ($\beta = -0.07$) of habit strength. Higher habit strength may thus make limiting fat intake a non-intentional behaviour. Implications for information and motivation-based interventions are discussed.

Introduction

In most Western countries, intake of saturated fat is higher than recommended (World Health Organization, 2003), posing a threat to public health, especially because of its relation with cardiovascular disease risk (Hu, Manson, & Willett, 2001). Therefore, there is a need to develop effective behavioural change interventions aimed at decreasing saturated fat intake. Those interventions are likely to be more successful when they target theory-based determinants (Brug, Oenema, & Ferreira, 2005; Green & Kreuter, 1991). The Theory of Planned Behaviour (TPB) (Ajzen, 1991) has been used extensively to identify correlates and determinants of health behaviour (Bogers, Brug, van Assema, & Dagnelie, 2004; De Bruijn, Kremers, Schaalma, van Mechelen, & Brug, 2005), including fat consumption (Armitage & Conner, 2002). According to the TPB, behaviour is primarily determined by intention, i.e. a motivational state towards engagement in that behaviour. In turn, intention is theorised to be predicted by three social–cognitive variables, namely attitude, subjective norm, and perceived behavioural control. Attitude refers to the degree to which the performance of the behaviour is positively or negatively valued, in which both cognitive and affective evaluations are relevant (e.g. Armitage & Conner, 2002). Subjective norm is defined as perceived social pressure from significant others to perform the required behaviour, while perceived behavioural control measures the extent to which performance of the behaviour is considered to be easy or difficult.

Despite the validity of the theoretical assumptions of the TPB, demonstrated in systematic reviews and meta-analyses (Godin & Kok, 1996; Hagger, Chatzisarantis, & Biddle, 2002), and in its usefulness for intervention development (Hardeman et al., 2002), calls have been made for the inclusion of additional variables in the TPB (Conner & Armitage, 1998) to further our understanding of health behaviour. One such variable is habit strength (Conner & Armitage, 1998; De Bruijn et al., 2007; Trafimow, 2000), which relates to behavioural factors such as unawareness of performing the behaviour, difficulty in controlling the behaviour, as well as mental efficiency in performing the behaviour. Initially, habit strength was measured by assessing how often an individual had performed a particular behaviour in the past: behaviours that were performed frequently and/or repeatedly were thought to be guided by habits, rather than by intentions (Aarts, Verplanken, & van Knippenberg, 1998; Ouellette, 1996; Triandis, 1980). Indeed, when included in a regression analyses, a measure of past behaviour tends to diminish or nullify the effect of intention on behaviour (De Bruijn et al., 2006; Hagger, Chatzisarantis, Biddle, & Orbell, 2001; Hagger et al., 2002). However, statistical associations between past and future behaviour have been described as empty constructs with little explanatory value (Ajzen, 2002; Eagly & Chaiken, 1993; Verplanken & Aarts,

* Corresponding author at: Department of Communication Science, Amsterdam School of Communications Research ASCoR, Kloveniersburgwal 48, 1012 CX Amsterdam, The Netherlands.
E-mail address: g.j.debruijn@uva.nl (G.-J. de Bruijn).

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1999). Because equating habit with past behaviour faces several methodological and theoretical problems, a measure of habit strength that has discriminant validity over behavioural frequency is needed (Bamberg, Ajzen, & Schmidt, 2003; Ronis, Yates, & Kirscht, 1989). Based on earlier discussions (Bargh, 1994; Trafimow & Wyer, 1993; Verplanken & Aarts, 1999), Verplanken and Orbell (2003) argued that habit strength is a psychological construct rather than past behavioural frequency and developed a 12-item script-based measure to assess the habitual strength of a particular behaviour, the so-called Self-Reported Habit Index (SRHI). This measure is thought to be suitable for the further development of research and theory on habit (Verplanken & Orbell, 2003), for instance by combining measures of habit strength with variables from the Theory of Planned Behaviour.

Often, researchers rely on hierarchical regression analyses and $R^{2\text{-change}}$ statistics to study the potential usefulness of an additional variable in the TPB (e.g. Trafimow, 2004). Using such analyses, several recent studies have shown that adding a measure of habit strength using the SRHI significantly increased the amount of explained variance in childrens' (Reinaerts, De Nooijer, Candel, & De Vries, 2007) and adult fruit consumption (Brug, De Vet, De Nooijer, & Verplanken, 2006) after TPB variables were accounted for. In addition to studying increments in explained variance using hierarchical regression analyses, several authors have proposed that studying the interaction of a new variable within the postulated relations of the TPB are of additional theoretical use (Kremers et al., 2006; Sutton, 1998; Trafimow, 2004). This is particularly relevant for studying the role of habit strength. Because habits originate from repeated behaviour in similar contexts, behaviours that are strongly habitual are presumed to be goal-directed behaviours that are automatically triggered by situational cues, rather than by cognitive intentions (Aarts, Paulussen, & Schaalma, 1997; Ouellette & Wood, 1998). A similar notion is acknowledged in Triandis' attitude–behaviour theory (Triandis, 1977, 1980), which postulates that habit strength interacts with intention in the explanation of behaviour. More specifically, when habit strength for a particular behaviour increases, the association between intention and behaviour should diminish. Thus, a strong intention–behaviour relationship should be expected when habit is weak, but a weak intention–behaviour relationship should be expected when habit strength is strong. In line with this reasoning, De Bruijn et al. (2007) found that the SRHI indeed moderated the intention–behaviour relationship with regard to fruit consumption. In this latter study, it was found that for those with a strong habitual fruit intake, intention was a weak and non-significant predictor of actual fruit intake 5 weeks later, whereas for those with a non-habitual fruit intake, intention was a stronger and significant predictor.

To date, empirical evidence of the additive effect of habit strength, assessed with the SRHI, in the explanation of saturated fat intake within the framework of the TPB is lacking. Additionally, the proposed moderating role of habit strength in the intention–behaviour relationship in the explanation of saturated fat intake has also gone largely unattended. Nevertheless, demonstration of the effects of habit strength may provide further evidence for the usefulness of incorporating a measure of habit strength in theoretical models aiming to explain and predict dietary behaviours. In the present study, we therefore explored the additive effect of habit strength in the explanation of saturated fat intake, and the moderating role of habit strength in the intention–behaviour relationship in a cross-sectional sample of Dutch adults. In line with empirical evidence (Brug et al., 2006; De Bruijn et al., 2007; Reinaerts et al., 2007) we hypothesised that (1) habit strength would increase the amount of explained variance in saturated fat intake and that (2) habit strength would moderate the association between intention and saturated fat intake, with a weaker association for those with higher habit strength.

Methods

Design and procedure

The present study used cross-sectional baseline data from participants in an intervention trial aimed at testing computer-tailored nutrition education to reduce saturated fat intake. Approval for this research project was obtained from the Medical Ethics Committee (MEC) of the Erasmus University Medical Centre Rotterdam. Participants received written information regarding the intervention trial and gave written informed consent. The information packages contained an invitation letter, an application and informed consent form, the declaration of the approval of the study by the MEC, and the bylaw on health insurance for participants. Furthermore, an information leaflet was included in which information on the aim of the study (comparing different types of nutrition information) was provided, as well as eligibility criteria, and a global description of the study procedure like type of measures (e.g. questionnaires), frequency of measures, length of the study and confidentiality. Recruitment was conducted using two strategies: recruiting employees at large companies and door-to-door advertising in two neighbourhoods in the Rotterdam area. Rotterdam is the second largest city in the Netherlands, with approximately 600,000 inhabitants. Criteria for eligibility in the study were: between the ages of 18 and 65; sufficient understanding of the Dutch language, currently not on a diet prescribed by a dietician or physician, and currently not being treated for hypercholesterolemia.

Participants

Of the 31 companies approached, 9 agreed to distribute the information packages among their employees ($n = 4118$). Common reasons for non-participation of the approached companies were 'no answer received' ($n = 7$), 'no time/not interested' ($n = 6$), and reorganisation of the company ($n = 5$). Of these 4118 employees, 574 agreed to participate in the present study. Furthermore, some 9000 information leaflets were distributed door-to-door among inhabitants in the two neighbourhoods. Those who expressed their interest ($n = 224$) (by pre-stamped response card, telephone or e-mail) were sent the information package, resulting in a total sample size of 798. Of these 798 participants, 764 completed the baseline questionnaire (mean age = 44.30 (S.D. = 10.20); 45.3% males ($n = 346$)).

Fat consumption, cognitions and habit strength

Saturated fat intake was assessed with a validated food frequency questionnaire (FFQ) (van Assema, Brug, Ronda, & Steenhuis, 2001). Pearson correlation with a 7-days diet record for this FFQ was 0.70 (van Assema et al., 2001). The FFQ consists of 35 questions covering 19 categories of food items that contribute most to saturated fat intake in the Dutch diet. Respondents were asked how often, how much, and which type of these 19 food items was usually consumed in the reference period of the last 4 weeks. For each of the 19 categories, a fat score, ranging from zero (lowest fat intake) to a maximum of five points (highest fat intake) was computed. The total fat score of an individual is calculated by adding up the 19 fat scores, which ranges from 0 to 80,[1] with a

[1] Scores for separate categories ranged to a maximum of five points; for several categories the maximum score was 3 or 4, hence the maximum score is not $19 \times 5 = 95$.

higher fat score indicating a higher fat intake (for a computation of fat scores, see van Assema et al., 2001). Mean scores of 14 (women) and 17 (men) correspond with the upper levels of recommended dietary saturated fat intake in the Netherlands.

Intention was assessed with the items 'I intend to watch the amount of fat in my diet' (+2 = yes definitely; −2 = no definitely not) and 'How certain are you will watch the amount of fat in your diet?' (+2 = very certain; −2 = very uncertain) (Cronbach alpha = 0.85). Instrumental attitude was assessed with the item 'Watching the amount of fat in my diet is' with answering categories healthy (+3)–unhealthy (−3). The same item with answering categories pleasant (+3)–unpleasant (−3) measured affective attitude. The item 'most persons who are important to me believe I should watch the amount of fat in my diet', with answering categories anchored by +3 (yes definitely) and −3 (no, definitely not) was used to assess subjective norm, while perceived behavioural control was assessed with the item 'I find watching the amount of fat in my diet' easy (+3)–difficult (−3).

Habit strength towards watching the amount of fat in one's diet was assessed with 12 items derived from the SRHI (Verplanken & Orbell, 2003). Participants were asked to indicate on five-point scales (+2 = totally agree; −2 = totally disagree) whether or not they agreed with the following statements regarding the stem 'Watching the amount of fat in my diet, is something' (1) I do regularly, (2) I do automatically, (3) I do without having to consciously remember, (4) that makes me feel strange if I do not do it, (5) I do without thinking, (6), that would require effort not to do it, (7) that belongs to my routine, (8) I start doing before I realise I am doing it, (9) I would find hard not to do, (10) I have no need to think about doing, (11) that is typically me, (12) I have been doing for a long time (Cronbach alpha = 0.94).

Statistical analyses

Initially, all associations between the study variables were analyzed using Pearson's correlations. In order to test our first hypothesis that habit strength would increase the amount of explained variance in saturated fat intake, hierarchical regression analyses were performed using forced entry with intention and PBC entered in Step 1, subjective norm and instrumental and affective attitude entered in Step 2, and habit strength entered in Step 3. In order to test our second hypothesis that habit strength moderates the association between intention and saturated fat intake, an interaction term intention*habit was computed and entered in the final step of the regression equation. Because interaction terms are likely to be highly correlated with their constituent variables, we followed the recommendation by Aiken and West (Aiken & West, 1991) to centre these constituent variables in order to eliminate potentially problematic multicollinearity. In case of a significant interaction term, simple slope analyses (Aiken & West, 1991) were used to examine the regression coefficient of the intention–behaviour relationship across three levels of the moderator (low habit strength: mean − 1 S.D.; moderate habit strength: mean; high habit strength: mean + 1 S.D.). Because of the low amount of missing values (<2%), missing data were mean-imputed. A significance level of $p < 0.05$ was employed. Furthermore, effect sizes were used as an informational source using Cohen's (1988) guidelines for correlational analyses (r) and regression analyses (f^2). Regarding correlational analyses, effect sizes are small when r is equal to or larger than 0.10, medium when r is between 0.30 and 0.50, and large when r equals or exceeds 0.50. With respect to regression analyses, effect size f^2 was computed by dividing the amount of explained variance (r^2) by the amount of error variance ($1 - r^2$): effect sizes were regarded as small when f_2 was between 0.02 and 0.15, medium when f^2 was between 0.15 and 0.35 and large when f^2 was equal to or larger than 0.35 (Cohen, 1988).

Results

Mean fat score for men was 19.77 (S.D. = 5.74): 65.3% had a fat intake higher than the recommended dietary saturated fat intake of 17 points. Regarding women, mean fat score was 16.03 (S.D. = 5.65), with 58.4% having a fat intake higher than the recommended dietary saturated fat intake of 14 points. Table 1 provides descriptives and bivariate correlations for the study variables. Scores for intention and subjective norm were around mid-scale, while mean scores for attitude, perceived behavioural control and habit strength were above mid-scale. Table 1 further shows that those with lower fat scores had a more positive intention, a more positive instrumental and affective attitude towards watching the amount of fat in their diet, and found that watching the amount of fat in their diet was easier. Furthermore, those who had a higher habit strength towards watching the amount of fat in their diet had a lower fat intake. Additionally, those who had a more positive intention towards watching the amount of fat in their diet had a more positive instrumental and affective attitude, found watching the amount of fat in their diet easier, and had a higher habit strength towards watching the amount of fat in their diet. Effect sizes for the associations between saturated fat intake and study variables were small, while associations between TPB variables and intention were medium. A large effect size was found for the association between habit strength and intention, between habit strength and PBC, and between PBC and affective attitude.

Regression analyses

Table 2 shows the standardised regression coefficients resulting from the hierarchical regression analyses. In the first

Table 1
Mean scores, standard deviations, and bivariate correlations between study variables (n = 764) with range in parentheses

Study variables	Mean (S.D.)	1	2	3	4	5	6	7
1. Fat (1.00–36.00)	17.72 (5.99)	–						
2. Intention (−2.00 to +2.00)	−0.96 (0.90)	−0.25***	–					
3. Instrumental attitude (−3.00 to +3.00)	1.85 (1.17)	−0.12**	0.42***	–				
4. Affective attitude (−3.00 to +3.00)	0.17 (1.35)	−0.19***	0.46***	0.29***	–			
5. Subjective norm (−3.00 to +3.00)	0.06 (1.86)	0.06	0.08*	0.17***	0.07	–		
6. Perceived behavioural control (−3.00 to +3.00)	0.46 (1.64)	−0.27***	0.49***	0.24***	0.55***	−0.10**	–	
7. Habit strength (−2.00 to +2.00)	−0.11 (0.99)	−0.26***	0.63***	0.33***	0.48***	0.06	0.61***	–

Small effect size: $r \geq 0.10$; medium effect size: $0.30 < r < 0.50$; large effect size $r \geq 0.50$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 2
Standardized regression coefficients, R^2, and $R^{2\text{-change}}$ statistics from hierarchical regression analyses ($n = 764$) with fat scores as the dependent variable and intention and perceived behavioural control (Model 1), instrumental attitude, affective attitude, and subjective norm (Model 2), habit strength (Model 3) and the intention*habit interaction (Model 4) as the independent variables

	Model 1	R^2	Model 2	R^2	F^{Change}	Model 3	R^2	F^{Change}	Model 4	R^2	F^{Change}
Intention	−0.15***	0.08	−0.14**	0.08	0.957	−0.10*	0.09	4.552*	−0.15**	0.10	7.239**
Perceived behavioural control	−0.20***		−0.18***			−0.14**			−0.12**		
Instrumental attitude			−0.02			−0.01			−0.01		
Affective attitude			−0.03			−0.02			−0.02		
Subjective norm			0.06			0.06			0.07		
Habit strength						−0.11*			−0.09		
Interaction									−0.10**		

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

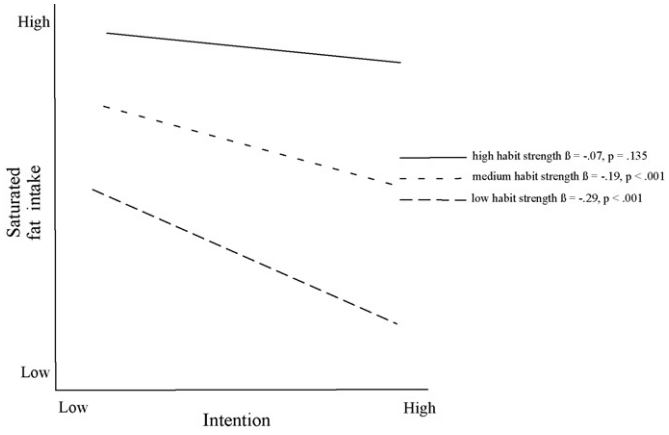

Fig. 1. Association between intention to watch the amount of fat in one's diet and saturated fat intake across three levels of habit strength.

step, intention and PBC were significant negative predictors of fat intake: those who had a more positive intention and perceived more behavioural control towards watching the amount of fat in their diet had a lower fat intake. This model explained eight percent of the variance in saturated fat intake. Adding subjective norm and instrumental and affective attitude in the second step did not significantly increase the amount of explained variance, $R^{2\text{-change}} = 0.00$, $F^{\text{Change}}(3, 758) = 0.956$, $p = 0.413$. Furthermore, subjective norm and instrumental and affective attitude were non-significant predictors of fat intake in this step. Adding habit strength in the third step significantly increased the amount of explained variance, $R^{2\text{-change}} = 0.01$, F^{Change} $(1, 757) = 4.552$, $p = 0.036$. Habit strength was a significant positive predictor of fat intake, while PBC and intention remained significant predictors of fat intake: subjective norm, and affective and instrumental attitude were non-significant predictors of fat intake. The final model explained nine percent of the variance in fat intake, indicating a small effect size ($f^2 = 0.10$)

To test the theorised interaction, the habit*intention term was entered in the final step, which significantly increased the amount of explained variance, $R^{2\text{-change}} = 0.01$, F^{Change} $(1, 756) = 7.239$, $p = 0.007$ and revealed a significant interaction term ($\beta = 0.10$, $p = 0.007$). Decomposing this interaction term by using simple slope analyses showed that intention to watch the amount of fat in one's diet was a significant predictor of fat intake for those with low habit strength ($\beta = -0.29$, $p < 0.001$) and moderate habit strength ($\beta = -0.19$, $p < 0.001$), but a weaker and non-significant predictor of fat intake for those with high habit strength ($\beta = -0.07$, $p = 0.135$)[2] (see Fig. 1).

Discussion

In the present study, we used cross-sectional data to explore the additive effect of habit strength, as well as the hypothesised (Triandis, 1977, 1980) interaction between intention and habit strength, in the explanation of saturated fat intake amongst Dutch adults. Findings supported both our hypotheses. Habit strength significantly increased the amount of explained variance in fat intake scores, while habit strength also moderated the intention–behaviour relationship.

The additive effect of habit strength in the explanation of dietary-related behaviours has been shown in other recent studies, most often with regard to the explanation of fruit consumption (Brug et al., 2006; Reinaerts et al., 2007). Our results add to those studies by showing that habit strength also significantly increases the amount of explained variance in saturated fat intake. Furthermore, habit strength was, after PBC, the strongest correlate of saturated fat intake and, albeit marginally, a stronger correlate than intention, suggesting that saturated fat intake can become (at least partially) habitual behaviour.

In line with the theoretical relations outlined in the TPB, intention was a significant correlate of saturated fat intake, with those with a stronger intention towards watching the amount of fat in their diet consuming less fat. However, simple slope analyses distinguishing three levels of habit strength showed that intention was only significantly associated with fat intake for those with low and medium levels of habit strength. For those with a high-habit strength, intention was a weaker and non-significant correlate of fat intake. Our study adds to a substantial body of evidence (Aarts et al., 1998; De Bruijn et al., 2007; Ouellette, 1996; Ouellette & Wood, 1998; Sheeran et al., 2005; Verplanken, Aarts, Knippenberg, & Moonen, 1998) that indicates that the relation between intention and behaviour may be dependent upon habit strength, with intentions becoming less relevant when behaviour is more habitual.

These latter results may also provide some insight into the limited effectiveness of traditional persuasive mass media campaigns aimed at decreasing saturated fat intake (World Health Organization, 2003). There are two reasons for this proposition.

[2] In the present study, fat intake was assessed regarding the reference period of the past four weeks. Since the SRHI also contains items about past behaviour (items 1 and 12), the relationship between fat intake and habit strength may be artificially inflated. Rerunning our analyses without these two items, however, produced virtually identical results.

First, persuasive messages often transfer information about positive consequences of adopting the recommended health behaviour and/or negative consequences of maintaining an unhealthy behaviour (McGuire, 1989; Wammes, Breedveld, Looman, & Brug, 2005), targeted at the most salient beliefs regarding the behaviour of interest in order to change attitudinal and control beliefs in a more healthy direction (e.g. Van den Putte & Dhondt, 2005). These changed beliefs are then thought to increase one's motivation towards enactment of the desired behaviour. However, even if these messages succeed in changing underlying beliefs and intentions, the weak and non-significant association between intention and behaviour amongst those with strong habits suggests that behavioural change may not occur (De Bruijn et al., 2007; Sheeran et al., 2005). Second, persuasive messages generally necessitate the recipient to pay attention to, and actively process the new information, if their effect on health behaviour change is to be maximised (Cacioppo, Kao, Petty, & Rodriguez, 1986; Eagly & Chaiken, 1993). However, empirical evidence also suggests that those who are guided by strong habits use limited and selective information processing regarding alternative options (Aarts, Verplanken, & van Knippenberg, 1997). Consequently, information commonly transferred in health interventions (such as benefits from a diet low in saturated fat) may go unnoticed and/or unprocessed by those with a strong habitual fat intake because their increased focus on the habitually chosen option may override attentional mechanisms needed to process such information (Aarts, Verplanken, et al., 1997; Verplanken, Aarts, & Van Knippenberg, 1997).

Because habits are triggered by situational or environmental cues, health behavioural change interventions for those guided by strong habits may therefore need to focus on strategies incorporating environmental cues, such as implementation intentions (Gollwitzer, 1999). Whereas the TPB specifies intention in the form of 'I intend to do X', implementation intentions have the structure of 'I intend to do X when situation Y arrives'. Implementation intentions may thus automatically induce behaviour when a suitable selected situation is encountered. An additional strategy is to make environmental changes, such as making unhealthy dietary choices less accessible (Brug & Van Lenthe, 2005). Indeed, both strategies have found to successfully induce behavioural change regarding saturated fat intake (Armitage, 2004; Brug & Van Lenthe, 2005).

A few limitations regarding the present study need to be addressed. First, cross-sectional data were used in which behaviour, cognitions and habit strength were measured contemporaneously. Although cross-sectional data are often used in studies on the TPB (e.g., Godin & Kok, 1996; Hagger et al., 2002), such data present conceptual problems since the causal ordering in the TPB is violated and associations between TPB variables may become artificially inflated (Budd, 1987).[3] Second, we used a self-selected sample of respondents who volunteered to take part in a nutrition education intervention study. Although our sample did not substantially differ from the general Dutch population regarding age and gender distributions, there was an over-representation of highly educated in our sample, so caution is needed in generalizing our findings.

Despite these limitations, our exploratory study is one of the first to show that habit strength is a potentially important determinant of saturated fat intake among adults. Additionally, our study also showed that the association between intention and saturated fat intake may be dependent upon habit strength, with higher habit strength making saturated fat intake a less intentional behaviour. Future research efforts on saturated fat intake, habit strength and TPB should use longitudinal data in order to delineate the causal ordering between habit strength and saturated fat intake more precisely.

[3] We thank an anonymous reviewer for bringing up this issue.

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