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Beyond Frequency: Habit as Mental Construct

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Abstract

Progress in habit theory can be made by distinguishing habit from frequency of occurrence, and using independent measures for these constructs. This proposition was investigated in three studies using a longitudinal, cross-sectional, and experimental design on eating, mental habits, and word processing, respectively. In Study 1, snacking habit and past snacking frequency independently predicted later snacking behaviour, while controlling for the theory of planned behaviour variables. Habit fully mediated the effect of past on later behaviour. In Study 2, habitual negative self-thinking and past frequency of negative self-thoughts independently predicted self-esteem and the presence of depressive and anxiety symptoms. In Study 3, habit varied as a function of experimentally manipulated task complexity, while behavioural frequency was held constant. Taken together, while repetition is necessary for habits to develop, these studies demonstrate that habit should not be equated with frequency of occurrence, but be considered as a mental construct involving features of automaticity, such as lack of awareness, difficulty to control, and mental efficiency.

Key Words: Habit; Behavioural Frequency; Past Behaviour; Snacking; Negative Thinking

Beyond Frequency: Habit as Mental Construct

Imagine yourself in a completely new environment. You would probably feel a desperate need for habits and routines. Life is awkward and difficult without them. In the absence of habits, choices and behaviour require awareness, thinking, and a controlled mode of processing, neither of which is something we can maintain for a long time. Only after repetition of behaviours that prove satisfactory, new habits evolve, and life feels normal again. However, it is not repetition per se that matters. What really matters is the smoothness and fluency of behaviour, i.e., the fact that we do not need to think about what we are doing, and can do things in parallel. In other words, whereas repetition of behaviour is a necessary condition for a habit to develop, the defining quality of habit is the automaticity and efficiency of behaviour occurring in stable contexts (Aarts & Dijksterhuis, 2000; Aarts, Verplanken, & van Knippenberg, 1998; Bargh, 1994; Betsch, Fiedler, & Brinkmann, 1998; Betch, Haberstroh, & Hohle, 2002; Ouellette & Wood, 1998; Verplanken & Aarts, 1999; Verplanken & Orbell, 2003; Wood, Quinn, & Kashy, 2002; Wood, Tam, & Guerrero-Wit, in press).

In the behaviourist tradition habit has always been equated with behavioural frequency (e.g., Hull, 1943). This conceptualisation has been adopted by social psychologists (e.g., Ronis, Yates, & Kirscht, 1989; Triandis, 1977). However, there are compelling arguments for why behavioural frequency should not be equated with habit (Ajzen, 2002; Verplanken, Myrbakk, & Rudi, 2005; Verplanken & Orbell, 2003). First and foremost, frequently performing a behaviour does not necessarily result in a habit. A doctor may send numerous patients to the operation table, but, hopefully, this is not a habit, as each new patient requires a careful and deliberate decision. Habit may also vary while frequency remains constant. For instance, a person who is put on medication may conscientiously take a pill every day, but only gradually turn this into a daily habit. In general, there is no theory of how frequency of

behaviour relates to habit strength. Some behaviours turn quickly into habits (e.g., taking a new route to work), whereas others take painstaking practise (e.g., learning to drive a car). Also, simply equating frequency with habit implies the absurd consequence that habit strength keeps increasing with increasing frequency.

If habit cannot be equated with behavioural frequency, how should it then be conceptualised? Habits develop by satisfactorily repeating behaviour in stable contexts (Wood et al., 2002). When a person faces the same behavioural choice time and again in the same situation, and thus repeats his or her previous response, associations build up between the cues that define the context and this person's response. Given that the context remains stable and the response is satisfactory, these associations then acquire a degree of automaticity (cf., Shiffrin & Schneider, 1977). For instance, Wood et al. (2002) conducted diary studies in which participants provided hourly reports of ongoing behaviour and thoughts and feelings that came along with the behaviours. The results showed marked differences between habitual behaviours, which were defined as behaviours that were repeated in stable contexts, versus other, nonhabitual, behaviours. Habitual behaviours were associated with less thoughts and less intense emotions than nonhabitual behaviours. Importantly, habitual behaviours, compared to nonhabitual behaviours, were more accompanied by thoughts that did *not* correspond to the behaviour. This suggests that habitual behaviour can easily occur in parallel with other, unrelated, processes, which is indicative of automaticity. Thus, in addition to the history of repetition and context stability, which are necessary conditions to build up a habit, the Wood et al. (2002) studies demonstrate an important characteristic of habit, namely the psychological experience of automated behaviour.

In line with the conception of habit outlined in the previous paragraphs, Verplanken and Aarts (1999) defined habits as "... learned sequences of acts that have become automatic responses to specific cues, and are functional in obtaining certain goals or end states" (p.104).

Drawing on Bargh's (1994) discussion of automaticity, Verplanken and Orbell (2003) further decomposed the automaticity component into behaviour that is performed without awareness, is difficult to control, and is mentally efficient (i.e., one may do other things in parallel). Thus, developing from successful repetition of behaviour, habit itself is behaviour that acquired these qualities of automaticity. These features can thus be considered as the habitual mindset or psychological experience that comes along with habitual behaviour.[1] In all, there is good reason not to consider habit as mere behavioural frequency, but as a mental construct that consists of a number of facets, i.e., lack of awareness, difficulty to control, and mental efficiency, in addition to the experience of repetition. This, of course should have consequences for the measurement of habit, which I will turn to now.

The measurement of habit

Problematic conceptualisations imply invalid measures. Commenting on the long-standing discussion about the interpretation of residual effects of past on later behaviour, Eagly and Chaiken (1993) wrote: "... the role of habit *per se* remains indeterminate (...) because of the difficulty of designing adequate measures of habit" (p.181) (see also Ajzen, 2002; Verplanken, Myrbakk, & Rudi, 2005). In line with equating habit with behavioural frequency, habit strength is usually quantified by some measure of past behavioural frequency, mostly in the form of a retrospective self-report. Some researchers used a variant of a self-reported frequency measure by asking how often a behaviour was conducted in the past "without awareness" or "by force of habit" (e.g., Wittenbraker, Gibbs, & Kahle, 1983). However, the validity of the latter type of question is compromised by being double-barrelled. Although past behavioural frequency is not a completely unreasonable operationalization of habit, given the fact that a history of repetition is part of the habit concept, it does not capture the mental construct of habit as this was outlined in the previous section.

Some alternative measures of habit have been developed. One is the response frequency measure (e.g., Verplanken, Aarts, Moonen, & van Knippenberg, 1998). This instrument was developed for measuring habit in multiple choice contexts (e.g., choosing between travel mode options). Participants are presented with fictitious choice situations, and, while under time pressure, choose behavioural options. The degree of choice invariance across situations is used as a measure of habit strength. Although the measure shows good psychometric properties and validity, it is limited by being restricted to multiple choice situations and the requirement of making time pressured choices, which makes it unsuitable for self-administered questionnaires. Another measure was used by Knussen, Yule, MacKenzie, and Wells (2004). They asked whether respondents recycled four types of household waste 'because it's a habit'. Habit is thus implicitly considered as a motive underlying these behaviours.

Verplanken and Orbell (2003) presented a generic 12-item measure which is straightforwardly derived from the conception of habit as a form of automaticity, i.e., the Self-Report Habit Index (SRHI). The SRHI assesses meta-cognitions on the history of repetition, lack of awareness, difficulty to control and mental efficiency of the behaviour proper. The measure is reliable and shows content, discriminant, and predictive validity for a variety of habits, including various eating behaviours (Brug, de Vet, de Nooijer, & Verplanken, 2005; Honkanen, Olsen, & Verplanken, 2005; Verplanken, Herabadi, Perry, & Silvera, 2005), physical activity (Kremers & Brug, 2005), dental flossing (Orbell & Verplanken, 2005), social chatting (Verplanken, 2004), negative self-thinking (Verplanken, Friborg, Wang, Trafimow, & Woolf, 2005), transportation mode choice (Verplanken, Myrbakk, & Rudi, 2005), and leisure activities (Verplanken & Orbell, 2003). The availability of a reliable and valid measure of habit thus provides the opportunity to test the proposition that frequency of behaviour should not be equated with habit.

Overview of the studies

The main purpose of the present studies was to investigate whether a measure of habit has discriminant validity over a measure of past frequency of occurrence. This was tested in three studies. The first study was on the habit of eating unhealthy snack food. Taking unhealthy snack food during one week was predicted by previously taken measures of habit, past behavioural frequency, and the variables of the theory of planned behaviour, i.e., attitude, subjective norm, perceived behavioural control, and intention (Ajzen, 1988). The second study was on a mental habit, i.e., negative self-thinking. In this study measures of self-esteem and the presence of depressive and anxiety symptoms were predicted by the habit strength of negative self-thinking and past frequency of negative thoughts. In both studies it was expected that habit had predictive value over and above past frequency (*Hypothesis 1*). In addition, Study 1 allowed for testing a mediating role of habit in the relationship between previous and later behaviour (*Hypothesis 2*). In the third study the complexity of a word processing task was experimentally manipulated. While behavioural frequency was held constant, it was tested whether a task involving a simple rule led to a stronger habit than a task involving a complex rule (*Hypothesis 3).*

Study 1

Method

Participants and design. One hundred and forty-three students participated in exchange for course credit. There were 82 women and 46 men, while 15 participants did not disclose their gender. Participants filled out a questionnaire in the laboratory. They were then given a 'food diary', and were instructed to fill out the diary every day during the following seven days. Complete data were obtained from one hundred and twenty-eight participants.

Questionnaire. Participants were told that the purpose of this study was to document students' eating patterns with a particular focus on eating snack food. Snack food was

described as “all food items such as candy, chocolate, candy bars, cookies, chips, ice-cream, etc., which you may eat between and/or outside regular meals. Excluded are fruit, salad, yoghurt, milk, and sodas”. It was thus suggested that the questionnaire concerned unhealthy snacking. *Past behavioural frequency* of eating snack food was measured by asking how many times participants had eaten snack food items during the previous seven days. The response scale ranged from “not at all” (0), “once” (1), “twice” (2), and so on, to “fourteen times” (14) and “more than fourteen times” (15). *Snacking habit* was measured with the 12-item Self-Report Habit Index (Verplanken & Orbell, 2003), which was slightly adapted in order to accommodate the present behaviour. Three sample items are “Eating snack food is something I do automatically”, “Eating snack food is something I do and forget immediately about”, and “Eating snack food is something I would find hard not to do”. Responses were given on seven-point scales, which were anchored by “disagree completely” (1) to “agree completely” (7). High scores indicate a strong habit. Coefficient alpha was satisfactory, 0.88. The twelve items were averaged. *Attitude* towards eating snack food was indicated on four 9-point semantic differential items, anchored by “favorable-unfavorable”, “positive-negative”, “good-bad”, and “okay-not okay”. The items were coded from 1 to 9, where a high score indicates a positive attitude. Coefficient alpha was satisfactory, 0.86. The four items were averaged. *Subjective norm* was measured by the item “The persons that are important for me are quite okay with me eating snack food”. Responses were given on a seven-point scale, which was anchored by “disagree completely” (1) to “agree completely” (7). *Perceived behavioural control* was measured by two items, i.e., “How much do you feel being in charge when it comes to eating snack food” and “How much do you feel able to leave eating snack food”. Responses were given on seven-point scales, which were anchored by “not at all” (1) to “completely” (7). The items correlated 0.30, $p < .001$, and were averaged. *Intention* to eat snack food was measured by four items. Two items focused on behavioural intention (i.e., “I

intend to take very little snack food during the coming week", and "My intention is to eat snack food during the coming week"), and two items asked for behavioural expectations (i.e., "I expect that I will eat snack food during the coming week", and "It is likely that I will not eat much snack food the coming week"). Note that the time frame corresponded with the period during which the behavioural measure (the food diary) was taken. Responses were given on seven-point scales, which were anchored by "disagree completely" (1) to "agree completely" (7). The items are coded such that high scores indicate a positive intention. Coefficient alpha was acceptable, 0.76. The four items were averaged.

Food diary. Participants were instructed to write down *all* food items they consumed outside regular meals during the next seven days. An extensive instruction was given how and when to do this (e.g., "fill out the diary every day, preferably before you go to sleep"; "in case you are uncertain about something, or something unusual happened, write this down in the remarks section of that day"). The diary contained entries for each day. Two independent judges (who were students themselves) categorised each food item as "healthy", "unhealthy", or "neutral". The proportion of agreement between the two judges on the 1,622 entries was 0.82, Cohen's $\kappa = 0.72$. Differences were resolved by a third independent judge. The number of unhealthy snack items was further used in the analyses.

Results

In Table 1 means, standard deviations, and correlations are presented. As can be seen, the number of unhealthy snacks taken during the week of measurement varied between 0 and 20 with an average of 7.37. The means of attitude, subjective norm, and intention were somewhat favourable towards snacking. The correlations show that unhealthy snacking was significantly associated with all previously measured variables, except subjective norm. Note that the correlation between unhealthy snacking and habit was particularly strong.

[Please insert Table 1 about here]

The number of unhealthy snacks was regressed on habit, past behavioural frequency, and the variables of the theory of planned behaviour in a hierarchical multiple regression. The results are presented in Table 2. Number of unhealthy snacks was regressed on attitude, subjective norm, perceived behavioural control, and intention on Step 1. The theory of planned behaviour was confirmed by independent contributions of perceived behavioural control and intention. Frequency of past behaviour raised R^2 statistically significantly on Step 2, which represents the classic residual variance effect. Intention retained a significant beta weight ($\beta = 0.249$, $p < .03$), while this was not the case for perceived behavioural control ($\beta = 0.166$). As was anticipated, habit raised R^2 statistically significantly on Step 3. Importantly, the beta weights of past behavioural frequency and intention on Step 3 were no longer significant ($\beta = 0.096$), suggesting that habit completely mediated the relationship between past and later behaviour. This mediation effect was statistically significant, $z = 2.72$, $p < .01$ (Kenny, Kashy, & Bolger, 1998). The variance inflation factors varied from 1.449 to 1.999, indicating that there was no reason to suspect multicollinearity problems.

[Please insert Table 2 about here]

Discussion

Study 1 demonstrated that a measure of habit contributed significantly to the prediction of later behaviour over and above a measure of past behavioural frequency, while controlling for the variables of the theory of planned behaviour. Hypothesis 1 was thus confirmed. This suggests that the SRHI has discriminant validity with respect to self-reported past behavioural frequency. Because attitude, subjective norm, perceived behavioural control, and intention were controlled, the effect of habit cannot be attributed to any of these variables.

Habit completely mediated the relationship between previous and later behaviour, which confirms Hypothesis 2. This result suggests that habit, in the present context, is a viable explanation of the residual variance problem (Ajzen, 2002). The residual variance problem

refers to the question why previous behaviour is such a strong predictor of future behaviour, even when controlling for the variables contained in the theory of planned behaviour.

The mediation effect is not to mean that the behaviour during the week previously to the questionnaire 'caused' the development of a habit that did not exist before that week (cf., Sutton, 1994). It can be assumed that the level of habit strength was present on both occasions. Note that the correlations between the habit index and the two frequency measures ($r = 0.609$ and $r = 0.513$) were substantially larger than the intercorrelation between the frequency measures ($r = 0.384$). The mediation analysis presented in the results section may thus not capture the full story. If we forget time for a moment, and consider the two behavioural measures (T1 and T2) as interchangeable frequency measures, the following two pairs of hierarchical regressions may further support my argument. Predicting T2 from T1 frequency (step 1) and habit (step 2), as well as from habit (step 1) and T1 frequency allows to calculate the unique variance accounted for by T1 frequency and habit in the prediction of T2 frequency. These were 1.6% and 11.5%, respectively. Similarly, predicting T1 frequency from T2 frequency (step 1) and habit (step 2), and from habit (step 1) and T2 frequency, yielded unique variances accounted for of 1.4% and 20.7% by T2 frequency and habit, respectively. In both cases habit 'wins' from frequency by great lengths. These additional analyses support the claim that habit, considered as a mental construct, was the driving force of behaviour at both measurements.

Alternative explanations. Some alternative explanations for the present results might be considered. For instance, it can be argued that the effects of habit occur because the habit scale contains items referring to the experience of past frequency. I therefore analyzed the data after removal of the items that straightforwardly referred to frequency ("Eating snack food is something I do frequently", "Eating snack food is something I have been doing for a long time") from the habit scale. Its reliability remained satisfactory, alpha = 0.845.

Importantly, all effects reported in this section remained in tact, thus including a statistically significant weight of habit in the final step of the multiple regression ($\beta = 0.333$, $p < .01$).

It might also be argued that the measure of past behavioural frequency is not optimal, as this consisted of a one-item retrospective estimate. Two things are worth noting here. One is that the majority of studies in the tradition of the theory of planned behaviour use one-item retrospective estimates of behavioural frequency. These are usually of the form "How often did you do behaviour *X* during period *Y*", accompanied by scales such as ranging from "never" to "always". Compared to most of such items, the present item is relatively elaborate. Secondly, the measures of past and later behaviour are qualitatively very different, and it can be argued that the diary measure is the more reliable and valid of the two. Although ideally one would have wanted such a measure for past behaviour as well, the present situation is better than having two retrospective measures. It is important to note that even if the 0.384 correlation between the two measures is considered as modest, such a correlation is hard to obtain had one of the two been notably unreliable or invalid.

There is also the possibility that the diary has made participants more aware of their eating behaviour during the diary period, and avoided or underrreported the consumption of unhealthy snacks. Because both scales measure the number of snacks consumed, the numbers can be compared. This comparison learns that the means and standard deviations of the two measures are very similar (M-previous behaviour = 7.84, SD = 4.13; M-later behaviour = 7.37, SD = 4.62), and do not differ statistically significantly, $t(108) = 0.63$. These results not only support the assumption that completing the diary did not affect snacking frequency, they also may strengthen confidence in the validity of the past frequency measure.

Finally, it could be argued that the time frame of the measures provides an explanation of the findings. Past snacking frequency was assessed with respect to the previous week, whereas the habit index does not refer to a particular time frame. Acknowledging that

prediction is maximized when measures correspond in time frame, it can be argued that a more 'fair' test with respect to past behaviour would be if both measures would have the same time frame, or if both would lack a time frame. The nature of the habit construct put forward in this article is not compatible with a time frame, so the latter option might be interesting to explore. As a matter of fact, one referee suggested an interesting exercise, i.e., to use items in the habit index that measure subjective frequency of behaviour as measure of past behavioural frequency, and test whether the remaining habit items would show the signicicant increase in R^2. In that case both past behavioural frequency and habit would be equal in lacking a time frame. Thus, the items that directly referred to subjective frequency ("Eating snack food is something I do frequently" and "Eating snack food is something I have been doing for a long time") were averaged, and replaced the original measure of past snacking frequency, while the remaining habit index items were combined into a new index. The hierarchical regression of later snacking behaviour on the TPB variables, the new past frequency measure, and the new habit index gave almost similar results. Inclusion of the new past behaviour measure showed the residual variance effect on step 2, although the increase in variance accounted for was marginally significant, R^2-change = 0.027, $p < .06$. However, important for the present argument, including the new habit index on step 3 raised the amount of variance accounted for significantly, R^2-change = 0.054, $p < .006$. This exercise thus strongly suggested that the presence of a time frame in the measure of past behaviour is not a valid alternative explanation (cf., Conner, Warren, Close, & Sparks, 1999).

Study 2

Whereas habit is mostly discussed in the context of overt behaviour, there is no compelling reason why the habit concept would not apply to mental processes (cf., Trafimow & Miller, 1996). On the contrary, because repetition is a core feature of mental life, it seems very much worthwhile to investigate the habit concept in the context of mental processes such

as thinking, rumination, or emotional responding. Study 2 focuses on negative thinking about oneself. Such thinking, when occurring frequently, has been documented as an important marker of depression and cognitive vulnerability to future depression, and is referred to in this literature as negative automatic thinking (e.g., Beck, 1967; Haaga, Dyck, & Ernst, 1991; Hollon & Kendall, 1980; Ingram, Miranda, & Segal, 1998). Similarly to the traditional view of the habit construct, negative automatic thinking is conceptualised and measured as the frequency of occurrence of negative thoughts about oneself. The present study investigated whether an independent measure of habit of negative self-thinking had discriminant validity with respect to a frequency measure of negative thinking, and predicted, in this case, self-esteem and the presence of depressive and anxiety symptoms over and above frequency.

Method

Participants and design. One hundred and ninety-four students participated in this study in exchange for a lottery ticket. There were 123 women and 71 men. They filled out a questionnaire in class or during breaks. Two versions of the questionnaire were randomly distributed. The versions differed in the order in which the frequency and habit measures were included. No order effects were detected, and the two versions were collapsed.

Questionnaire. The *habit of negative self-thinking* was measured by a variant of the Self-Report Habit Index, which has been labeled the Habit Index of Negative Thinking (HINT; Verplanken, Friborg et al., 2005). The HINT is mostly identical to the SRHI with some of the twelve items slightly reworded in order to accommodate to thinking processes. Three sample items are “Negative thinking about myself is something I do automatically”, “Negative thinking about myself is something I start doing before I realize I’m doing it”, and “Negative thinking about myself is something that would require mental effort to leave”. Responses were given on five-point scales, which were anchored by “disagree completely” (1) to “agree completely” (5). High scores indicate a strong negative thinking habit.

Coefficient alpha was excellent, 0.95. The twelve items were averaged. *Past frequency of negative self-thinking* was measured by the Automatic Thoughts Questionnaire (ATQ; Hollon & Kendall, 1980). The ATQ specifies thirty negative thoughts, and asks respondents how often they had each thought during the past week. Three sample items are "My life is a mess", "No one understands me", and "What's wrong with me?". Responses were given on a five-point scale, i.e., "not at all" (1), "sometimes" (2), "moderately often" (3), "often" (4), and "all the time" (5). Coefficient alpha was excellent, 0.95. The thirty items were averaged.[2] *Self-esteem* was measured by the ten items that form the self-liking subscale of the Self-Liking and Competence Scale (Tafarodi & Swann, 1995). Responses were given on five-point scales, which were anchored by "disagree completely" (1) to "agree completely" (5). High scores indicate strong self-esteem. Coefficient alpha was excellent, 0.91. The ten items were averaged. *Depressive and anxiety symptoms* were measured by the Hospital Anxiety and Depression Scale (Zigmund & Snaith, 1983). The original 14 item scale has two subscales measuring anxiety and depression symptoms, respectively. Because internal reliabilities of the subscales were unacceptable, nine items (taken from both subscales) that formed a reasonably reliable scale were used. Coefficient alpha was acceptable, 0.75. The nine items were averaged.

Results

In Table 3 means, standard deviations, and correlations are presented. Negative thinking habit and frequency of occurrence of negative thoughts were equally strongly correlated with self-esteem. Because of the high correlations between negative thinking habit, frequency of occurrence of negative thoughts, and self-esteem, the discriminant validity of these three variables was investigated by conducting a confirmatory factor analysis on the original items of the three scales. In order to keep the ratio of number of free parameters to sample size within acceptable limits (e.g., Kline, 1998, suggests a 1:10 ratio as reasonable), a

parcelling procedure was conducted, i.e., for each scale, items were randomly averaged into three groups of observed variables. Two analyses were conducted. In the first analysis the model was defined by one latent factor, which was represented by the indicators of habit, frequency, and self-esteem. In the second analysis a three-factor model was tested, in which habit, frequency, and self-esteem were defined as latent factors, each represented by their own respective indicators. The one-factor model showed a bad fit, $\chi^2(27) = 515.29$, $p < .001$; χ^2/df ratio = 19.08; comparative fit index (*CFI*) = 0.738; goodness of fit index (*GFI*) = 0.570; adjusted goodness of fit index (*AGFI)* = 0.283; root-mean-square error of approximation (*RMSEA)* = 0.311. On the other hand, the three-factor model showed an excellent fit, $\chi^2(24) = 27.071$, $p = 0.301$; χ^2/df ratio = 1.138; *CFI* = 0.998; *GFI* = 0.969; *AGFI* = 0.941; *RMSEA* = 0.026. These results suggested that the three variables represented correlated but genuinely distinct constructs. The averaged scales were thus used in the further analyses.

Self-esteem was regressed on these habit and frequency in a hierarchical fashion. The results are presented in the left-hand panel of Table 4. As can be seen, habit raised R^2 with 12.7% on Step 2, which is statistically significant. As is shown in the table, both predictors obtained a statistically significant weight. The variance inflation factor was 1.692, indicating that there was no reason to suspect a multicollinearity problem.

In a second regression analysis, the presence of depressive and anxiety symptoms was regressed on negative thinking habit and frequency of occurrence of negative thoughts. The results are presented in the right-hand panel of Table 4. Similarly to the prediction of self-esteem, both habit and frequency of occurrence obtained a statistically significant weight, suggesting independent contributions, although the increase of R^2 was quite small. The variance inflation factor was 1.719, again indicating that there was no reason to suspect a multicollinearity problem.

Similarly to what was done in Study 1, the present analyses were also conducted using a habit scale without the the items referring to frequency items. In this case the scale contained three such items ("Negative thinking about myself is something I do frequently", "Negative thinking about myself is something I do every day", and "Negative thinking about myself is something I have been doing for a long time"). All effects remained in tact, thus including statistically significant weights of habit in the final steps of the multiple regressions (β = -0.414, $p < .001$ for self-esteem, and β = 0.260, $p < .001$ for depressive/anxiety symptoms).

[Please insert Tables 3 and 4 about here]

Discussion

Similarly to the results of Study 1, a measure of habit showed an independent contribution over and above a measure of frequency of past occurrence to the prediction of a third variable, in this case self-esteem and the presence of depressive and anxiety symptoms, respectively. These results show that a distinction between habit and frequency of occurrence is not only viable for overt behaviour, but also for mental processes such as in this case negative self-thinking. This is important for habit theory, but also for theories that link negative thinking to self-evaluation and depression (e.g., Haaga et al., 1991). Given that the Automatic Thoughts Questionnaire measures *content* of negative thinking, the Habit Index of Negative Thinking contributes as a *process* measure, which thus captures unique variance in the self-esteem and depression measures (Verplanken, Friborg, et al., 2005). The finding that both variables obtained a significant regression weight supported the viability of such a distinction. The results were stronger for self-esteem than for depressive/anxiety symptoms. This might be the result of working with a non-clinical sample, in which low self-esteem is more prevalent than the presence of depressive/anxiety symptoms.

Study 3

Although the predicted independent contributions of habit over past frequency were found, the previous two studies have some weaknesses. First and foremost, the studies are correlational. The independence of habit and frequency would be more convincingly demonstrated if differences in habit strength were experimentally induced while controlling for frequency. Second, although the increments in R^2 (particularly the 5.5% in Study 1 and the 12.7% in Study 2) can be considered as sizeable in the hierarchical regression tradition of social psychology, Trafimow (2004) discussed a number of pitfalls of this paradigm. One is that increments in R^2 can be obtained if the previously entered variables lack reliability and validity. Another problem is that the meaning of increments in R^2 depends on the size of the correlation obtained in earlier steps. This correlation was particularly high in Study 2. Although the increments in R^2 were obtained in very different settings, which strengthens the validity of my conclusions, an alternative research paradigm would further corroborate the central proposition of this paper. Thus, taking into account the correlational nature of Studies 1 and 2, together with the potential problems of the R^2 increment paradigm, the present study used an experimental design.

The distinction between frequency of occurrence and habit was investigated by using a conceptual replication of a manipulation developed by Shiffrin and Schneider (1977) in their seminal studies on controlled and automatic information processing. Shiffrin and Schneider experimentally varied the nature of training procedures as part of a detection task. For instance, participants were presented with memory set items, which they had to detect in subsequent trials. The trials contained distracter items and memory set items. In one condition, which was labeled the consistent mapping condition, the distracter items were of a different sort (e.g., consonants) than the memory items (e.g., digits). In the second condition, the varied mapping condition, distracter and memory set items were all from one category

(e.g., consonants), which made the detection task more complicated. Thus, in the consistent mapping condition, participants were presented with a stable performance context, whereas in the varied mapping condition participants were presented with an unstable performance context. Consequently, the consistent mapping conditions resulted in a high degree of automaticity, whereas the varied mapping conditions led to more controlled processing. In terms of the present context, it can be expected that conditions such as present in Shiffrin and Schneider's consistent mapping context will lead to stronger habits compared to a varied mapping context. In the present Study 3, I therefore attempted to create conditions that would lead to such habit strength differences, while keeping behavioural frequency constant. Participants performed a word processing task (underlining words). While behavioural frequency was held constant, habit strength was measured as a function of experimentally manipulated rule complexity. It was expected that, under the condition of constant behavioural frequency, a stronger habit would be formed in a task involving a simple rule compared to a task involving a complex rule.

Method

Participants, design, and procedure. Seventy-six undergraduate students participated in this study in exchange for a lottery ticket. There were 53 women and 23 men. Participants were randomly assigned to an simple rule versus a complex rule condition. The study was conducted during class.

Participants were told that they participated in a study on word image. They were given a text that consisted of 829 words, which, they were told, was a page from the novel *"Dreams in the Mirror"* from the novelist Eleonore Lavish. In fact, the text was written by the present author. Participants were asked to read through the text once. In the simple rule condition participants had to underline the words "She/she" while reading the text. In the complex rule condition participants had to underline all words that indicated either a mammal

or an object that could be moved. The text was constructed such that in each condition 35 words had to be underlined. Thus, while the rules for underlining differed in complexity, the required frequency of underlining was the same in the two conditions.

Dependent variable. Six items were used to measure the degree to which underlining the words had become habitual. The items were taken from the Self-Report Habit Index (Verplanken & Orbell, 2003), and were adapted so as to accommodate the present task. The following items were used: "Once I was on my way, the task went almost automatically", "I could do the task almost without thinking", "Underlining the words felt like a routine", "The underlining went on smoothly", "The task required little mental effort", and "I performed the task almost without realizing I was doing it". Responses were given on seven-point scales, which were anchored by "disagree completely" (1) to "agree completely" (7). High scores indicate a strong habit. Coefficient alpha was satisfactory, 0.82. The six items were averaged.

Two items checked whether the manipulation of rule complexity was successful. Participants were asked to indicate the degree to which they found the task difficult, and the rule they had to follow complicated, respectively. Participants responded on seven-point scales, which were anchored by "disagree completely" (1) to "agree completely" (7).

Results and discussion

Participants in the simple rule condition, compared to participants in the complex rule condition, found the task easier, M-simple rule = 2.54, M-complex rule = 3.90, $t(74) = 3.45$, $p < .001$, and the underlining rule less complicated, M-simple rule = 1.38, M-complex rule = 3.21, $t(74) = 5.33$, $p < .001$. There were no statistically significant differences between the simple rule and complex rule conditions in the number of correctly underlined words, M-simple rule = 32.71, M-complex rule = 31.03, $t(74) = 1.84$. Participants in the simple rule condition underlined on average 2.3 words too few (i.e., missing some of "she" words), while participants in the complex rule condition underlined on average 7.8 words too many (i.e.,

underlining some non-mammals and/or non-movable objects), *M*-simple rule = 32.71, *M*-complex rule = 42.84, $t(74) = 4.52$, $p < .001$. Note that a potential confounding effect of this difference would work against the hypothesis that was tested.

As was anticipated, a stronger level of habit was present in the simple rule compared to the complex rule condition, *M*-simple rule = 3.21, *M*-complex rule = 1.38, $t(74) = 4.71$, $p < .001$, which supported the third hypothesis. There were no statistically significant associations between habit strength and the number of correctly underlined words or the total number of underlined words, $r = 0.133$ and $r = -0.224$, respectively. These correlations confirmed that the habit effect was genuinely independent of behavioural frequency. In all, the results suggested that in the simple rule condition a stronger habit was formed than in the complex rule condition, independently of behavioural frequency.

General discussion

Frequency of occurrence should not be equated with habit. This proposition was tested in three studies using different designs (i.e., longitudinal, cross-sectional, and experimental) in three different domains (i.e., eating, mental habits, and word processing). In Study 1, which had a prospective design, past behavioural frequency of taking unhealthy snacks and snacking habit independently predicted later snacking behaviour, while controlling for the variables of the theory of planned behaviour. In Study 2, past frequency of negative self-thoughts and habit strength of negative self-thinking independently predicted self-esteem and the presence of depressive and anxiety symptoms. In these two studies, habit and frequency of occurrence shared a good deal of variance, i.e., 37% (Study 1) and 42%, (Study 2). This reflects the history of repetition, which is a necessary condition for a habit to develop. However, the regression results demonstrated that habit has an independent contribution in the prediction of the criterion variables in both studies. In addition, habit completely mediated the effect of past on later behaviour in Study 1. While keeping in mind that the study was correlational and thus

did not allow causal conclusions, this finding and the additional regression analyses reported in Study 1, are at least in line with the notion that habit can be the primary driving force of frequent behaviour (Ouellette & Wood, 1998; Verplanken et al., 1998). Study 3 demonstrated that an experimental manipulation of task complexity resulted in differences in habit strength, while this effect was controlled for behavioural frequency. Thus, in addition to conceptual arguments for distinguishing between habit and frequency of occurrence, together the three studies provided strong empirical evidence in favour of this distinction.

The availability of an independent measure of habit opens up possibilities for testing new hypotheses, as well as for better testing old ones. An example of the latter is the debate on the role of previous behaviour in the prediction of later behaviour, i.e., the residual variance problem (Ajzen, 2002). A general finding is that past behaviour predicts future behaviour even when controlled for the variables of the theory of reasoned action or the theory of planned behaviour, which are considered as the most direct antecedents of behaviour. One of the possible explanations of this effect is habit: repeated behaviour may turn into a habit, and thus become a stronger trigger of future behaviour than attitudes and intentions (Ouellette & Wood, 1998; Verplanken et al., 1998). Ajzen (2002) rightly stated that residual effects of past on later behaviour per se are not evidence of habit, and presented alternative explanations of the residual variance effects, such as scale compatibility, the strength of attitudes and intentions, and belief veridicality. Clearly, the role of habit cannot be properly investigated without independent measures of habit and frequency. The complete mediation of the relationship between past and later behaviour by habit found in Study 1 suggested that in this case a habit explanation holds very well indeed.

An independent habit measure allows testing new hypotheses as well. For instance, Orbell and Verplanken (2004) reasoned that the formation of new habits may be facilitated by forming implementation intentions. This hypothesis is built on the assumption that habits and

implementation intentions share a similar mechanism of automatically triggering a particular response upon encountering a specific cue. In the case of habits these cue-response links are based on a history of satisfactory repetition, whereas in the case of implementation intentions these are established by deliberate planning. The hypothesis was supported in a field experiment on dental flossing, as well as in a lab experiment using Stroop responses as behaviour. In both studies the Self-Report Habit Index was the habit measure. Important for the present argument, in the lab study an effect of implementation intentions on habit was found while controlling for behavioural frequency. Again, without an independent measure of habit, this hypothesis would be difficult to test.

Another possibility of the new conception of habit is demonstrated in Study 2. This study showed that the habit concept may be successfully applied to other phenomena than overt behaviour, in this case negative self-thinking. Mental habits can well be described in the terms that I have used to describe the automatic nature of behavioural habits, i.e., the lack of awareness, the difficulty to control, mental efficiency, and often, surely in the case of mental habits, the lack of intention. A frequency conception of mental habits is rather awkward, at least if one takes this literally. For example, it is difficult, if not impossible, to actually 'count' how many times one has a particular thought. The Automatic Thoughts Questionnaire, which was used in Study 2 and is used in clinical psychological research, does not ask for literal frequency, but for the subjective experience of frequency. However, the present studies demonstrated that this is only part of the habit story, and that the automaticity features provide a much richer conception of habit, which perfectly fit mental habits as well (Verplanken, Friborg, et al., 2005).

The present conception of habit stresses its nature as a *process* variable, i.e., the way in which a behaviour or phenomenon occurs. Likewise, the Self-Report Habit Index and its variant the Habit Index of Negative Thinking, can be considered as process measures of the

phenomena under study. A distinction between content and process is important. For example, negative self-thinking is an overwhelming phenomenon during a depressive episode, both in terms of content and process (e.g., Beck, 1967). Once such an episode is over, negative thinking usually disappears. Hence, it is difficult to distinguish formerly depressed from never depressed persons in terms of content, e.g., the presence of negative thoughts. However, under certain conditions such as dysphoric mood, negative self-schemas and negative thinking may quickly and automatically reappear in formerly depressed persons (e.g., Miranda & Gross, 1997). Although anyone may have negative thoughts when in a bad mood (content), it is particularly the ease or automaticity with which such thinking reoccurs (process), which is the crucial marker of vulnerability to depression (e.g., Segal & Ingram, 1994). Corroborating the assumption that the HINT taps a process aspect, this measure appeared significantly correlated with an Implicit Association Test measuring implicit self-esteem, whereas the (frequency-based) ATQ did not (Verplanken, Friborg et al., 2005, Study 3).

The results of Study 3 point to another achievement, as it demonstrated that it is possible to manipulate habit strength independently of frequency of behaviour. The availability of a habit measure such as the SRHI thus provides opportunities for investigating and testing conditions that lead to stronger or weaker habits. This opens up new roads to advance habit theory as well as including habit as a mediating construct in other domains, such as effects of learning and experience.

Separating habit from past frequency is not only important from a theoretical perspective, but is also important for interventions aimed at behaviour change (e.g., Dahlstrand & Biel, 1997; Trafimow, 2000). Old habits may form obstacles to change. However, the very features that make old habits obstacles to change, are desirable when it comes to the new behaviour which an intervention aims to promote. The development of new habits may therefore be explicitly adopted as an intervention goal. Thus, new behaviour

should not only occur frequently, it should preferably become habitual. This outcome can only be evaluated or monitored over time with an independent habit measure, such as the SRHI.

Conclusion

Habit is often considered as an 'empty construct', i.e., a construct that has no explanatory value. The main reason for this seems to me the fact that habit has been equated with behavioural frequency, which indeed *is* an empty construct. Very much related to this is the lack of appropriate measures (Eagly & Chaiken, 1993). This is the more unfortunate because most of the behaviours social psychologists are interested in are repetitive and habitual. Considering habit as a mental construct and distinguishing habit from frequency of occurrence may give the habit construct new meaning. Habit may thus begin a career as an interesting psychological construct.

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Footnotes

1. It should be noted that by defining habit as a form of automaticity, I do not mean to say that habits do not take up any mental resources. However, habit formation does imply freeing up mental resources, which makes that habits may be executed in parallel with other activities (cf., Wood et al., 2002). In discussions on this issue it is also important to define exactly the habit proper. Habits may be part of larger behavioural structures, parts of which may vary in degree and type of automaticity. For example, the very decision to take the car to go to work (instead of alternative transportation modes) may be habitual and thus automated to a high degree, whereas a person may have conscious thoughts about the behaviour that follows (e.g., thoughts on road conditions or congestion problems).

2. The general nature of the habit measure leaves it uncertain whether the negative thoughts to which the measure refers match the thoughts specified in the ATQ. However, in one of the studies validating the HINT, we found that the HINT correlated significantly particularly with spontaneously generated negative self-attributions (Verplanken, Friborg et al., 2005). These type of thoughts do occur in the ATQ as well (e.g., “I’ve let people down”, ”I can’t get things together”, “Why can’t I ever succeed”).

Table 1. Means, standard deviations, and correlations of the variables included in Study 1.

Variable and range		*M*	*SD*	2	3	4	5	6	7
1.	Mean *N* of unhealthy snacks[1] (0-20)	7.37	4.62	0.513***	0.384***	0.230*	0.103	0.231*	0.429**
2.	Habit (1-7)	3.56	1.21		0.609***	0.272**	0.090	0.276**	0.519***
3.	Past behavioural frequency (0-15)	7.84	4.13			0.301***	0.168	0.167	0.499***
4.	Attitude (1-7)	5.38	1.88				0.268**	-0.213*	0.458***
5.	Subjective norm (1-7)	5.59	1.70					-0.049	0.296***
6.	Perceived behavioural control (1-7)	2.60	1.23						0.096
7.	Intention (1-7)	4.72	1.37						

Note: * = $p < .05$; ** = $p < .01$; *** = $p < .001$. [1] Recorded during the week after the other measures were taken.

Table 2: Hierarchical multiple regression analysis predicting the mean number of unhealthy snacks consumed during a week (Study 1).

Predictor	B	*SE* B	β	ΔR^2	Final β
Step 1:					
Attitude	0.345	0.253	0.137	0.230***	0.097
Subjective norm	-0.030	0.238	-0.011		0.026
Perceived behavioural control	0.811	0.345	0.210*		0.100
Intention	1.180	0.341	0.351***		0.129
Step 2:					
Past behavioural frequency	0.245	0.114	0.219*	0.033*	0.096
Step 3:					
Habit	1.232	0.428	0.333**	0.055**	0.333**

Note: * = $p < .05$; ** = $p < .01$; *** = $p < .001$. The dependent measure is the mean number of unhealthy snacks consumed during the week after the other measures were taken. $R^2 = 0.318$.

Table 3: Means, standard deviations, and correlations of the variables included in Study 2.

Variable and range	*M*	*SD*	2	3	4
1. Habit (1-5)	2.32	1.00	0.648***	-0.737***	0.571***
2. Past frequency (1-5)	1.67	0.51		-0.738***	0.675***
3. Self-esteem (1-5)	3.71	0.85			-0.698***
4. Depressive/anxiety symptoms (1-4)	1.88	4.08			

Note: *** = $p < .001$.

Table 4: Hierarchical multiple regression analyses predicting self-esteem and depressive/anxiety symptoms (Study 2).

	Self-esteem					*Depressive/anxiety symptoms*				
Predictor	B	*SE* B	β	ΔR^2	Final β	B	*SE* B	β	ΔR^2	Final β
Step 1:										
Past frequency	-1.181	0.080	-0.732 ***	0.536***	-0.435***	0.571	0.042	0.707***	0.500***	0.530***
Step 2:										
Habit	-0.378	0.045	-0.464***	0.127***	-0.464***	0.113	0.027	0.274***	0.044***	0.274***

Note: *** = $p < .001$. The dependent variables are self-esteem (left-hand panel), $R^2 = 0.663$, and the presence of depressive/anxiety symptoms (right-hand panel), $R^2 = 0.544$.