Residential energy use: habitual behavior and possible interventions[1]

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Abstract

Altering energy related behavior in households using cognitive and financial measures is a laborious process. In the literature, the embedment of this behavior in larger activity patterns and habitual behavior are mentioned as important causes that need further scrutiny. Yet, it still seems to be an underexposed topic, which probably follows from the fact that theoretical models in this field are usually focused on planned behavior and that studying such behavior is difficult because of its less conscious and private nature. In addition, the results of research on habitual behavior in other areas are not easily translated to this domain, due to a variety of definitions and explanatory models, a rather vague distinction between habitual and planned behavior, and a certain disregard of habitually 'not-acting' (which is particularly relevant in the case of energy behavior in households, e.g. leaving the lights on) and of situational stimuli eliciting this behavior.

Based on a study of the literature, a theoretical model has been developed that partially solves a number of these problems. The model provides a conception of separate types of habitual behavior, a clarification of the differences between habitual and planned behavior in this field and suggestions for intervention and prevention. These suggestions are brought together in a method for typifying habitual activities and selecting appropriate strategies (HABIT: "Habit Assessment and Behavior Intervention Typology"). The theoretical and deductive nature of the research implies that the results still need empirical verification and possibly modification. Recommendations are made for a follow up.

Introduction

Despite governmental efforts to reduce the residential consumption of energy, it continues to rise. The bulk of this increase is due to electricity use associated with a growing number of (smaller) households, higher incomes and technological advancements. The rise seems to be difficult to stop because of the autonomous nature of these developments and the moderate results from current methods to modify purchasing practices and daily usage. Consumers, nevertheless, generally display a positive attitude towards energy conservation and a fair amount of environmental consciousness and knowledge of the issue. The major obstacle is the transformation into real action. This is primarily caused by: the general nature of policy

[1] Due to time constraints I was unable to write a new paper before the conference date. The following is the summary of the report on this research project and it provides a good overview of the results. It does not, however, contain any literature references because such information is not usually provided in a summary. The research has previously been published in a book chapter, with an emphasis on the use of technology in dealing with these matters: Heijs, W. (2006). Household energy consumption: habitual behavior and technology. In: P. Verbeek and A. Slob (Eds.). User Behavior and Technology Development: Shaping Sustainable Relations Between Consumers and Technologies. Dordrecht: Springer. pp. 149-157.

measures in contrast to a lack of specific knowledge of energy consumption and appliances in private situations; incompatibilities between substitute behavior and existing goals and values such as comfort; insufficient personal salience because of a low estimate of personal efficacy and responsibility; and the fact that energy-related household behavior is difficult to change because it is part of more comprehensive behavioral patterns and habitual actions. Especially the latter aspect is often mentioned in the literature as an important factor that merits further research. Altering household behavior still offers a considerable potential for saving energy, and the tackling of habits constitutes an opportunity that is used too little to tap this source.

Probable reasons for the relatively small role of habitual energy-related household behavior in research are that the prevailing theoretical models take planned behavior as a starting point and that empirical investigation is difficult to carry out in a private domain. This study uses a review of the literature concerning applied social scientific research on energy consumption and more fundamentally oriented social scientific research on habits to develop a theoretical framework. This framework is used to derive recommendations for the intervention in and the prevention of undesirable energy-related habitual behavior and to prompt new research.

Current research

Results from applied social scientific research on energy-related behavior show that habits are often better predictors of buying actions and energy consumption than variables used in the predominant social psychological models on attitude-behavior relationships. The literature, however, does not present an unambiguous definition of habit and theoretical models are scarce. This causes varying operationalizations of habit to be used (e.g. 'repeated behavior in the past' or 'lifestyle'), and a large range of activities to be possibly relevant (more or less specific, frequent, conscious or automatic). Furthermore, there is not enough insight in the origin, the development, and the function of habits within the social context of a household. In more fundamentally oriented social psychological studies on habits theoretical frameworks are used. Two groups may be identified. The first group tries to enhance the predictive power of traditional models on attitude-behavior relationships for repeated behavior by adding the variable 'past behavior/experience'. This variable, often termed 'habit', seems to have both direct and indirect effects on subsequent behavior (through attitude and intention). Relevant predictors include more and less frequent or conscious types of past behavior. The second group limits the scope of habitual behavior to frequent, situation-specific, goal-oriented and automatic acts that, once started, do not require conscious monitoring. Repetition causes formerly reasoned activities along with the associated situations and goals to be stored into mental structures. When triggered by particular environmental cues, these structures guide future behavior. 'Habit' is operationalized variously as 'the frequency of past behavior', 'the unconscious recurrence of these acts in the past', or 'the frequency of association' of certain situations with behavioral choices.

From the current research, it can be concluded that the descriptions of 'habit(ual behavior)' as well as the theoretical perspectives are, on some points, inconsistent, which raises a number of questions that have to be addressed in view of a fruitful application in the field of energy-related household behavior. The main issues are as follows. Firstly, in the second of the fundamentally oriented groups, 'habit(ual behavior)' is restricted to frequent, unconscious and automatic actions, whereas applied research shows that relevant habitual behavior has a larger range. This is substantiated by results in the first fundamentally oriented group and it is also more in line with common parlance. Secondly, provided that such criteria are suitable, it is unclear what limits should be used (e.g. what frequency would be necessary to indicate

habitual behavior). Thirdly, the features 'automatic' and '(un)conscious' are being treated as dichotomous although a gradual scale might be more appropriate (in which case the question regarding limits is relevant again). In fourth place, it remains vague whether the concept of 'habit' denotes a behavioral disposition, the behavior in itself, or both. Fifth, repeated non-behavior as a habitual pattern is not scrutinized in present research, although this seems to play a major role in energy-related household activities. In sixth place, situation and cue are not included in most theoretical models, despite their probably crucial role in the explanation of the formation and occurrence of habitual action. And finally, the intertwining of habitual and other behavior in broader behavioral patterns (scripts) is mentioned but not elaborated, so no conclusions can be drawn concerning the measures to be taken.

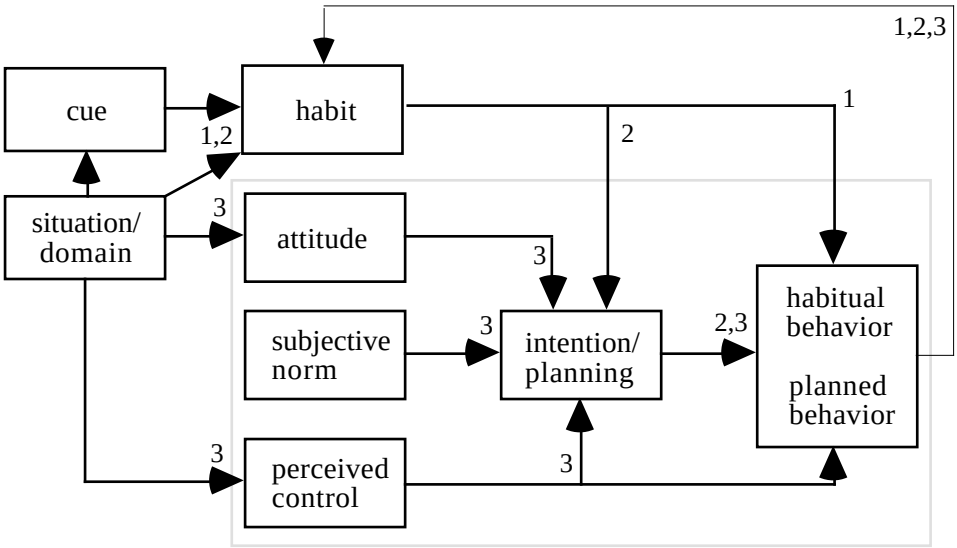
Theoretical framework

An analysis of the elements inherent to the meaning of 'habit(ual behavior)' in the history of social science, current research and common parlance, and of the variables and their relations in existing theoretical models leads to a new definition and model, eliminating several of the objections mentioned above while trying to preserve the explanatory inferences from previous studies. The latter is of importance in order to maintain the possibility of generalizing existing results to energy-related household behavior. The new descriptions separate 'habit' from 'habitual behavior'. 'Habit' (usually the independent variable) is defined as: *'A cognitive, mental structure, composed of a specific situation or life domain, a related goal, a behavioral disposition to reach this goal and a stimulus specific for that situation or domain (a cue that triggers the mental structure and the subsequent behavior), that is learned through reinforced repetition of the behavior in that particular situation and in response to that particular cue'.* 'Situation' refers to a rounded part of the physical or social environment (such as a 'buying' or 'using' situation); and 'domain' refers to a rounded part of daily life (such as personal hygiene). A 'cue' is generally to be taken as a distinct environmental stimulus triggering the structure, but it can also coincide with the situation or domain as a whole (especially in the case of repeated non-behavior). The definition of 'habitual behavior' (usually the dependent variable) is: *'The manifestation of a habit in repeated, overt behavior or non-behavior'.* This behavior can be more or less goal-oriented, can be preceded by unconscious as well as conscious behavioral choices (as a starting point), can occur with higher or lower frequencies and may progress in a more or a less automatic manner.

The theoretical model in Figure 1 is based on the model that is used in the first fundamentally oriented group (the Theory of Planned Behavior in the dotted frame with the addition of 'past behavior'). In the current diagram 'past behavior' is replaced by 'habit', the habitual mental structure, which may influence behavior like attitudinal structures. The situation and the cue are added as variables that are conditional for activating this structure (and for the activation of attitudes and subjective control in case suitable habits are lacking). The cue may exist of external (physical, social or symbolic) stimuli or internal (physiological or psychological) stimuli. The dependent variable is composed of habitual behavior (including non-behavior), planned behavior or a combination of both, and is recursively connected to "habit', thereby representing the development and strengthening of habits through repetition.

The model allows the differentiation among three main kinds of behavior. Starting from the principle that activities are initiated by heuristic mechanisms that require less cognitive effort (such as habits) in preference to more demanding mechanisms such as attitudes or intentions, the first main kind is habitual behavior with an unconscious start and an automatic progress (route 1 in the diagram). A habit is triggered by a situation and an associated cue, and leads to

action without the intervention of a conscious choice or intention (e.g. brushing teeth before going to bed). The second kind consists of habitual behavior with a conscious start and a more or less automatic development (route 2): activation of a habit by a situation and cue leads to an intentional choice and the planning of behavior because, for example, the habit is less strong (less well practiced) or because it has decision rules built into it (e.g. when sorting the laundry on Mondays). The degree to which this behavior is automatic depends among other things on the presence of further situational barriers. In both kinds, attitude is not an active component, even though this might be ostensible in the latter case. The third kind is planned behavior following the conventional models (route 3): unfamiliar situations, the absence of cues and/or the absence of appropriate habitual structures will successively cause an attitude to be built or activated, an intention and planning to be created and planned behavior to be performed (e.g. replacing old bulbs by energy efficient ones). A repetition of this behavior in similar situations and in response to similar cues may lead to the development of a new habit. Between these main kinds, various hybrid forms are possible, such as habitual actions with an unconscious start and a non-automatic progress as a result of, for example, situational interruptions.



1: habitual action: unconscious start, automatic progress
2: habitual action: conscious start, more or less automatic progress
3: planned behavior

Figure 1. A model of energy related habitual household behavior

Habitual activities do not only differ by their form but also by their genesis. Three processes are distinguished: operant conditioning (external -material or social- or intrinsic rewards or sanctions have a creating, strengthening or weakening influence), classical conditioning (by the joint occurrence of a cue and another stimulus, the latter can adopt the effect of the cue), and modeling (imitation of a comparable model, whose actions are positively or negatively reinforced, creates a habit). In addition, each of these processes may involve unconscious learning (i.e. unawareness of the actions, the goals and the behavioral choices at the time of development, such as leaving the tap open while brushing teeth) or, more or less, conscious learning (the transformation into a habit of planned behavior or explicit goals, or a post-hoc rationalization of behavior, such as leaving neon lights on because it is believed to save energy). Sometimes a habit is formed because the related behavior is the only available option (always lighting a hallway without windows); the formation of such a habit may preclude the consideration of future behavioral alternatives. Unconsciously starting habitual behavior can

be generalized unconsciously to a new situation if this involves a cue that bares resemblance to the one in the former situation (in contrast to classical conditioning, when the situation remains the same whereas the cue changes). Larger situational deviations will probably be tolerated if a habit is stronger (well rehearsed). Conscious generalization of a habit is also possible, for example if a certain subjective value is attached to the activity or the goal. In both cases, generalization may involve dysfunctional behavior (old habits that are not productive such as ventilating too often after moving to a new house with an automated ventilation system). Habitual activities can be incorporated into broader behavioral patterns such as scripts of which planned behaviors can also be a part (e.g. a routine of going to bed).

Several propositions have been made regarding the operationalization of the variables. The existence of a habitual mental structure and the strength of a habit can be deduced from the presence of its components (situation, cue, goal and disposition; for example by means of interviews) and the intensity of the respective bonds between them (through an empirically established function of response frequencies or times of association between components with the aid of a computer; the degree of specificity of associations on rating-scales; and possibly using 'past behavior' as a substitute or validating measure). The criterion for the habitual nature of a certain activity is the likely existence of a corresponding habitual mental structure. Once such a structure has been corroborated, the related habitual behavior (the dependent variable) can be described in more detail by the frequency of its occurrence, its kind and genesis (using rating-scales, methods based on learning theories, observation or objective, physical measurements).

The theoretical framework leads to the conclusion that the new definition and model match the diversity of habitual activities in the existing research and that they represent, at first sight, a useful integration of the various conceptual models. The two definitions (habit and habitual behavior) preclude the confounding of dependent and independent variables; and the use of these descriptions allows meaningful discriminations between habit(ual behavior) on the one side and related concepts, including planned behavior, reflexes, skills, mindless behavior, scripts, schemata and lifestyles on the other. Repeated non-behavior is compatible with the new conception. The situation and cue occupy a position in the model that conforms to their part in the development and onset of habitual behavior. Problematic criteria for the differentiation between habitual and planned behavior, such as the frequency of occurrence or degree of consciousness, have been replaced by the presence of a habitual mental structure. Less frequent, more conscious and less automatic behavior can also be habitual in nature, provided that the existence of such a structure is substantiated and related to the onset of the activities. Existence of habitual mental structures also supplies a means to discern habitual actions within more complex behavioral patterns (e.g. scripts or an admixture of habitual and planned behavior).

Intervention and prevention

The theoretical framework and the literature are roughly offering four general possibilities for intervention. Firstly, strategies can address the habitual mental structure itself. This structure may be changed or weakened through de-conditioning techniques (using rewards, sanctions, modification of the cue or the modeling situation, dependent on the genesis and the present type of reinforcement) and through the alteration of components (using cognitive means like, preferably specific, information or education). Feedback combines de-conditioning and the supply of information. Secondly, the activation of the mental structure can be blocked by transforming the situation or the cue. This may be accomplished through technological as

well as cognitive means (for example modifications of the dwelling, the equipment or the user-interface, or using prompts or implementation-intentions). Thirdly, when activation has already taken place, habitual activities can be hindered by situational, psychological or social blockades forcing a transition to planned behavior (e.g. by introducing necessary additional steps to be taken, importunate messages or social control). Fourth, negative consequences of habitual behavior can be limited or mitigated, which seems to be a preferred course of action because behavioral modification might then be superfluous (by making appliances automatic or 'fool-proof', or evoking the proper conduct through the design or the interface by using affordances or existing habitual patterns to realize a natural way of operating). New habits may be formed likewise.

The success of intervention measures dependents on the correspondence with existing cognition, the possibilities for alternative behavior (physically, instrumentally or financially), the constraints of broader behavioral patterns, goals and values, an analysis of costs and benefits (in terms of behavior, comfort, time and money) and, if situational changes are at hand, the possibility of an undesirable generalization of the activity. Therefore, a thorough behavioral analysis needs to be performed prior to any attempt at intervention. This might also prevent antagonistic reactions (rebound effects, adaptation, avoidance or reactance). In view of these possible impediments it is advisable to offer residents a sound explanation beforehand about the necessity of the intervention, to maintain sufficient user-control in the new situation and to give additional rewards to balance subjective costs and benefits (preferably with immediate effects, such as an increase of comfort).

After these general conditions are fulfilled, the further selection of aspects to be changed and methods used should be based on the kind of the habitual activity and its genesis. It is likely, for instance, that changing the situation might have an adverse effect (reactance) in the case of consciously learned habitual behavior with a conscious start, because such a measure can be perceived as a violation of personal control. In view of the complexity of the subject matter a systematic approach is needed to enable the proper selection of strategies (i.e. combinations of methods and their order of application). A first attempt at this is the introduction of a typology for a differential approach of habitual behavior ("HABIT": Habit Assessment and Behavior Intervention Typology). The typology consists of the fusion of the two main kinds of habitual behavior (unconscious start/automatic progression and conscious start/more or less automatic progress) with four classes of origin (conscious versus unconscious learning combined with the presence or absence of a later generalization), resulting in a matrix with eight cells representing the 'types' of habitual behavior. The cells contain the recommended strategies, based on a number of assumptions derived from the model and the literature. Within the classes of origin an additional distinction can be made regarding the learning processes, influencing the specific form of the techniques rather than their selection or their order of application. The practical use of the typology might proceed as follows. First, the behavior is determined to be, in fact, habitual and to have a potential for saving energy. If the outcome justifies an intervention, the existing 'type(s)' are established (because apparently similar activities may have different origins and kinds). After choosing the most frequently occurring types, the typology can suggest efficient and effective strategies.

The prevention of undesirable habitual behavior may involve avoiding the generalization of existing habits to new situations (for example to another dwelling or new appliances) and preventing the formation of new habits in relation to products that have yet to be introduced. In this case, the technological or situational modification is an established fact rather than an

option (as with intervention). Efficient strategies for prevention should make a use of this fact. A thorough behavioral analysis is needed here too, but now the focus is on habits that are likely to be generalized or on habitual behavior that is associated with applications similar to the new product. Attention has to be paid, among other things, to the mental structure of the habit involved, the type and the genesis of the behavior, the affordances of the present applications or the new situation or product, the behavior that may be considered 'natural' and that is regarded 'desirable' in the new situation or regarding the new product, and the general conditions to enhance the rate of success and prevent antagonistic behavior that have already been mentioned in the paragraphs on intervention. If the analysis results in a certain chance that an undesirable generalisation or formation of habits might occur, preventive measures are advisable. The preferred method is to obstruct the activation of the habit (e.g. by adjusting the situation or the cue, or by avoiding unsuitable affordances). As a result the habit will 'extinguish'. Alternatively, the habit(ual behavior) might be left intact while the consequences are corrected. In both cases, measures should be attuned to what is considered 'natural' conduct in these circumstances. If this is not feasible, technically or financially, the introduction of the situational change or of the new product will have to be accompanied by behavioral modification (using information, de-conditioning or hybrid forms such as feedback through a user-interface).

The general conclusion is that the intervention in, and the prevention of, habitual behavior are conceivable options. The model and the literature provide concrete aspects that allow control or modification and workable methods can be deduced from existing research. The subject matter, however, is very complex involving many variables and containing various pitfalls. In view of this complexity, a systematic approach is needed to enable a selection of strategies in which these matters are taken into account. The proposed typology (HABIT) represents a first attempt at such an approach. Additional research is needed to evaluate its applicability and to determine the necessary improvements.

Additional and future research

Although the new definitions and model provide solutions for several problems identified in the literature review, the theoretical and deductive nature of this study implies that the results need empirical verification and correction. Likewise, the proposed methods for intervention and prevention generate questions that can only be answered by additional research in the laboratory as well as in real settings.

From a *theoretical* point of view, it is of interest to validate the definitions and the model in real life circumstances, specifically by registering the main and hybrid kinds of habitual behavior, their distinctive features and the conditions that accompany their presence. Field research is also proposed to study the nature of situations and cues in relation to particular kinds of habitual behavior and the interaction process between the environment and habitual actions. This is required for a correct and systematic experimental variation of the situation and the cue. A third topic for field research is to supply the information that is lacking about scripts and about the interaction and decision-making aspects of buying behavior and energy use within the social context of a household. Laboratory research is recommended for the circumstances in which habitual mental structures are formed (scrutinizing the role of the frequency of behavior and of implementation-intentions, the determinants of the strength of relations between components, the meaning of specificity in relation to strength, the nature of the initial goals, and the completeness of the classification of relevant learning processes). A laboratory setting is also advisable to study the extent of divergence in situations that is

'tolerated' by habits of various kinds and strength, and to investigate the conditions that cause either generalization or the onset of planned behavior. This may improve the strategies of situational intervention by reducing the risk of dysfunctional behavior. Two issues require both laboratory and field research: the theoretical and empirical examination of repeated non-behavior (being an important aspect of energy-related habits that seems to be in accord with the model but nevertheless shows some distinct features); and, after the necessary corrections are made, the possible generalization of the theoretical framework to habit(ual behavior) in other domains.

From a *methodological* point of view, the propositions for operationalization of the variables and the registration of actual behavior have to be judged in view of their correspondence with the theory, their applicability and the need for elaboration. It is required, for example, that reliable and valid measures are created to describe the relevant characteristics of the situations and cues, determine the components of the habitual mental structure, establish the strength of a habit, and construct comprehensive profiles of the variables involved. In addition, methods have to be devised to characterize habitual behavior in buying and energy use (indications of the kind, the genesis and the type; classifications of the role and the place in the social context of the household and within broader behavioral patterns such as scripts; and an unobtrusive registration of the frequency of behavior). Especially the latter poses a problem. A part of the solution might be distant measuring using the Internet. New methods should preferably be suitable for use in field research (e.g. on laptops).

Finally, from an *application* point of view, preliminary laboratory and field research is necessary to examine suitable aspects for intervention and prevention, the aptness of the methods mentioned before (considering, among other things, completeness, suitability and possibilities for refinement) and the nature of antagonistic behavior together with conditions of its occurrence. Exploratory research should provide further insight into habitual actions (in buying and use) that are eligible for intervention, based on frequency and potential savings. Identification of focal groups might improve the efficiency of intervention. The differential typology (HABIT) can be a point of departure for developing strategies, after the integration of the results of the other studies and its verification for buying as well as the use of energy. The following step consists of a try-out of the strategies on habit(ual behavior) with a large energy-saving potential, and the implementation of the necessary changes. A comprehensive study, involving various kinds of habitual behavior and focal groups, may then be initiated to draw conclusions regarding the actual need for a differential approach. With a view to the prevention of undesirable habitual behavior, an extrapolation from the results of intervention studies can provide insight into the possibilities for precluding the generalization of unwanted activities. It is advisable to investigate the options for the formulation of explicit conditions regarding the design of new products to prevent unwanted habits and to enhance the coherence with 'natural' behavior, analogous to existing ergonomic and safety regulations.