Revealing mental models of a cooking process through use of a hidden moderator: a case study

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This case study applies a method historically used in social psychology, namely the use of a confederate (more precisely a "hidden moderator" in our case), to the process of user-centered product design. Whirlpool Corporation's User Experience Group desired to learn more about user processes and mental models associated with broiling food inside an oven. To this end we needed to elicit users' mental models, thoughts and descriptions as they carried out broiling tasks, but also needed to avoid influencing either the formation of, or the revealing of, mental models by overtly probing with scripted questions and prompts. We were able to accomplish this by planting a hidden moderator (whose role was to co-moderate) within small groups of test participants. We found that the focus of the test participants shifted away from the primary moderator and towards the hidden moderator. By having the hidden moderator play the role of a novice that wished to learn from the expertise of the test participants, participants were more motivated to engage in detailed, natural dialogue, thus leveraging a familiar and valuable teacher-student social dynamic. Initial data suggest that the use of a hidden moderator in user testing can help reveal users' mental models of complex procedures, critical user needs, and usage context – information that is difficult to access using traditional user research or usability methods.

Whirlpool Corporation desired to learn about users' task processes and mental models associated with broiling food. Although the concept of broiling is not new, specific and better data about the nature of peoples' mental models when broiling, how they understand and construct processes, meanings and schemas around broiling, is needed in order to inform the user-centered design of broiling products. Note: "broiling" is a term widely used in the US to refer to what in some countries is known as grilling; in US parlance "grilling" refers to the specific cooking of food outdoors using (usually) a charcoal-fueled barbeque grill. A characteristic difference is that in broiling the heat source is above the food, whereas in grilling the heat source is below the food.

We sought to obtain that information in the context of four different broiler designs inside four different types of oven. In order to engender rich dialogue we decided to recreate the kind of small group social situation in which broiling often takes place. However, being mindful of the difficulty of tapping in to users' mental models in a highly interactive, task driven setting, we sought to exploit the natural social phenomena to which these small group situations may give rise. We essentially designed our study to allow the primary Test Moderator to step back from the dialogue, while at the same time increasing the likelihood that test participants would freely share their thoughts, desires, experiences, anecdotes and concerns about broiling. In order to facilitate this through a free-flowing dialogue we introduced a confederate, or "Hidden Moderator", to help co-moderate the study (see also, Galletta, et al., 1995).

The use of confederates in behavioral experiments has been well documented and is a widely known technique. In such studies a member of an experimental team is planted into the experiment in order to enable the unobtrusive manipulation of variables, or to challenge participants' opinions and judgements. These methods have been pioneered in classic studies of social psychology (Asch, 1951, 1952; Schachter and Singer, 1962; Milgram, 1974). In recent years the ethics of using confederates has come under question. In the current study, although the test participants were unaware of the true identity of the Hidden Moderator - assuming that he or she was a bona fide test participant like

themselves - the role of the accomplice was innocuous and served only to facilitate dialogue.

USING HIDDEN MODERATORS

Because our experimental need was to promote unconstrained dialogue between test participants, traditional user research techniques that depend heavily on a moderated interview script, were deemed inappropriate. Under heavily moderated or constrained conditions, test participants frequently have difficulty articulating their thoughts, and often defer to the moderator. Under these circumstances inadvertent experimenter/moderator effects can be considerable and the ensuing data only minimally useful.

An "experimenter-subject" relationship is not conducive to free-flowing, unconstrained discourse. However, by inserting a Hidden Moderator into the study, we were able to leverage the natural tendency for people to want to demonstrate to others how skilled they are at a given task, and thus set up a "teacher-student" or "master-apprentice" relationship. This design shifted the focus of the participant away from the test moderator, and eliminated dependency on any other player. The test moderator now assumed only a supporting role, and the Hidden Moderator's role, though now primary, was not obvious to the test participant.

In order to ascertain an individual's mental model of an operational concept, it is necessary to give him or her freedom to introduce and explore trains of thought that are undirected by experimental limitations. To this end, all user tasks in the current study were open-ended around a core goal of broiling steak, with no right or wrong methods or answers. Thus the test participants were free to drive the discussions in the direction that they chose. We felt that the participants would be motivated to "teach" the confederate how to broil, and that this would allow the participant to play the role of an expert. The Hidden Moderators (one male and one female) were required to meet the following conditions. He or she:

- must not be known to any of the test participants
- must have an ability to play the role of a naïve, inexperienced, beginning "broiler", and must have an aptitude for eliciting information from the test participants
- must have the ability to effectively "co-moderate" the study without betraying his or her identity as a Hidden Moderator; and must also have the ability to interact naturally and "in character" with the main test moderator

Each Hidden Moderator was required to have considerable experience and a high degree of comfort in role-playing. Hidden Moderators were also required to have had training and/or key experience in various techniques of user research (such as controlled conversations and test moderation). However, the Hidden Moderators were not required to be experts at broiling. Finally, prior to the study, both Hidden Moderators were trained to ensure a consistent use of prompting techniques, identification of likely issues, and topics to probe with participants, as well as how to manage the logistics of arriving at the facility in the guise of a test participant.

Training materials for the Hidden Moderators consisted of documented guidelines, constructed so that each Hidden Moderator was able to assume a "specific identity" so that answers to basic "personal" questions, asked either by the other participants or by the test moderator, could be easily given. This allowed for the Hidden Moderator to focus on playing the role of the novice, and on eliciting feedback from the test participant whose role became that of a Subject Matter Expert.

By playing the role of a novice user well, the Hidden Moderators expected to help facilitate a detailed and naturalistic dialogue to reveal the participants' thinking and decision-making. By deferring to the test participant as the expert, the Hidden Moderator was able to better motivate the participant to discuss their experiences, processes and thoughts in greater detail.

Given this test design, and the highly skilled Hidden Moderators employed, we expected to be able to reveal important consumer insights on the processes

and mental models of broiling. Specifically, we hoped to find answers to at least the following:

- how do users establish meaning and structure around the activity of broiling food?
- what is the precise nature of the consumers' mental models?
- to what degree do consumers' mental models concur; and are there commonalities across users that may comprise a prototypical mental model of broiling?
- to what extent do users' mental models vary or conflict with each other?
- why, how and when do users deviate from the usual processes?
- under what conditions might the mental model fail the user?
- what are the social relationships that may be intertwined with a cooking event taking place in a kitchen?

TEST METHOD

In our broiling tests four different designs of broiling ovens were used. Specifically, three of the ovens were free-standing ovens powered by either gas, electricity or by a combination of both fuel types. The fourth oven was a built-in electric oven. Twenty test participants (17 female and 3 male, and all native speakers of English) were recruited from the local St. Joseph, Michigan community. Each participant was a user or owner of the specific type of appliance being testing for a particular session; and during the sessions each test participant experienced only one of the broiling oven types. Thus each broil oven was used by (on average) five test participants. Two participants were assigned to each session and each participant duo was joined by a third "participant", the Hidden Moderator. (Note that in two sessions we had only one test participant, and one session was dropped due to no-shows. Because our primary focus was on individuals' mental models, and not on their performance vis-à-vis any specific oven model, the test was not considered to have lost any inherent balance).

Each session consisted of two parts:

1) small group interviews
2) broiling and sampling pieces of steak

The small group interviews probed the participants' backgrounds, current broiling processes, experiences, attitudes and beliefs about broiling, and lasted about 30-45 minutes. The interviews were conducted by the Test Moderator and included questioning of the Hidden Moderator. During this phase the Hidden Moderator also asked questions of, or prompted for additional clarification by, the other test participants. The steak broiling lasted about 45 minutes, and each participant and the Hidden Moderator broiled one steak. Because the test participant(s) and the Hidden Moderator each broiled a steak, the test participants found themselves in two key roles: First they performed as demonstrators (when they were doing the broiling); and Second they performed as advisors or instructors (when the Hidden Moderator was broiling). Thus we were able to elicit information about the users' mental models in more than one form.

OUR FINDINGS

Our findings confirmed the benefit of using a Hidden Moderator. Having a Hidden Moderator play the role of a novice produced the following results:

- it successfully drew the focus of the test participants away from the Test Moderator, and refocused it onto the Hidden Moderator
- it created a known and familiar context (teacher-student) for the session dialogue
- participants articulated their expert viewpoint in great detail as well as in a naturalistic, and conversational manner
- the verbal data were more detailed
- the data provided more anecdotal stories
- the data provided more reasoning on why the participant was doing things a certain way
- the natural flow of discussion lead to findings that we could not have anticipated and so could not have elicited through conventional questioning methods

One example serves to show the richness of the data that was elicited using this method. We were able to

determine that even though broiling and grilling food can give similar results, broiling has an entirely different meaning and context for use, and thus supports a very different mental model. Broiling (cooking food indoors in an oven broiler) is a solitary activity, the main purpose of which is to prepare a meal as quickly as possible. Participants felt they had less control over cooking their food when broiling, and expressed more concern about the food, as well as concern about how messy the oven and broil pan became and how difficult they were to clean. On the other hand grilling (cooking food outdoors on a gas or charcoal grill) was seen primarily as a social activity with the food being secondary in importance. Grilled food, by the way, was also perceived to be much better tasting. Users felt that when grilling they had a higher degree of control, and they did not feel anxious about cooking the food or about cleaning up after grilling. Indeed, cleaning after grilling was considered to be an optional step.

An additional example shows how a user's mental model of broiling may fail him or her, when it does not adequately accommodate changes to the process. Typically the user's default mental model of broiling begins with preparation of the food and equipment (oven, pans etc.). Food (usually, but not always, meat) is then prepared, pans readied, and ovens (sometimes) preheated. After any adjustments to the oven have been made (rack position, food position on the rack, temperature, timer etc.) users broil the food. Next, users will check the food (after varying degrees of time) by invariably opening the oven door to peer in and visually inspect the progress of how well the food is cooking. Visual signs which confirm that the meat is cooking well are crispy edges, caramelized color, and being able to hear and see the "sizzle and pop" of meat juices in the oven cavity. If the food looks like it is cooking well and evenly, users will wait the duration of time they believe it takes for a given piece of meat to finish broiling. Some may check whether or not the meat is done by pinching, squeezing, and sometimes by cutting into the meat. When the meat appears to be done users will remove the food, then go about serving and eating the food. Finally, clean-up is seen as a necessary step because broiling is considered to be a very messy process. Cleaning (of the oven and the pans) is judged to require considerable effort following each use of the oven for broiling. Figure 1 illustrates this basic and typical mental model of broiling.

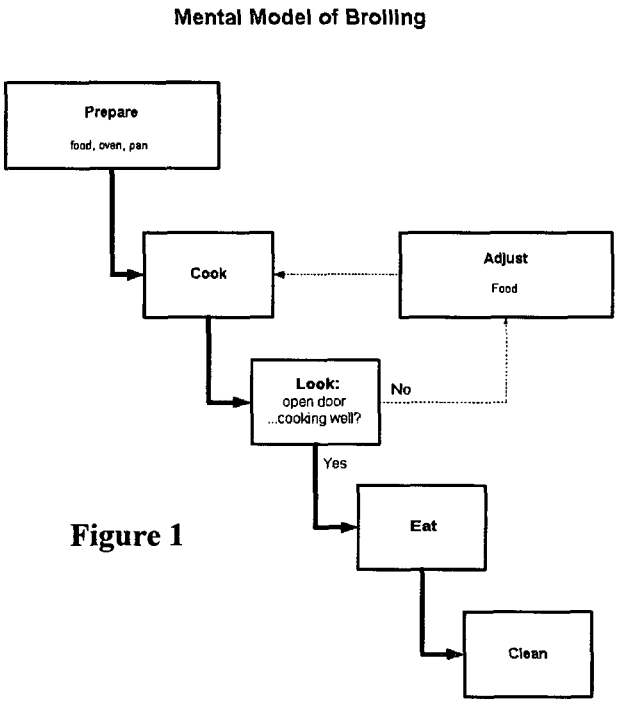

Figure 1

The mental model shown in Figure 2, on the other hand, shows how users continue to rely on well proven mental models even when using new and

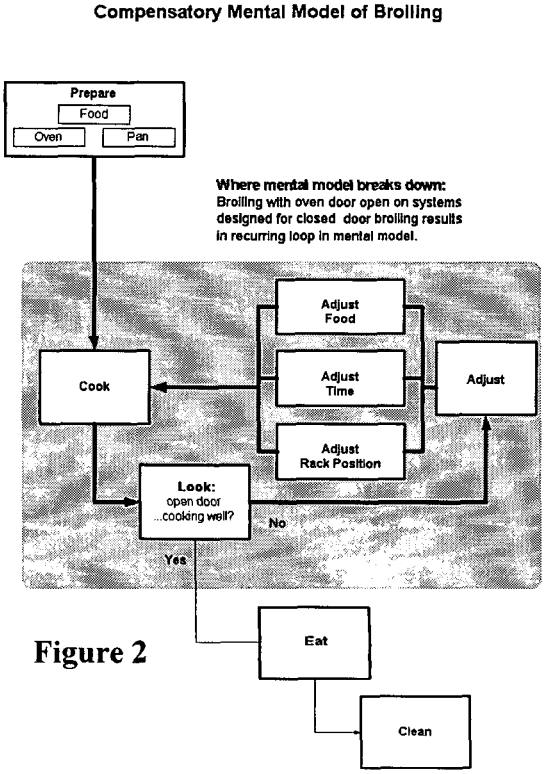

Figure 2

unfamiliar products.

In this mental model users who learn how to broil by keeping the oven door open tend to want to broil with the oven door open irrespective of the oven used. In this model checking and adjusting play a disproportionately significant, and often unnecessary, role. The user's previous mental model blocks realization of the differences between ovens that broil with the door open versus ovens that broil with the door shut. Such a discovery can have implications for the design of broiler ovens.

DISCUSSION

We believe that the results of our Hidden Moderator study suggest that when learning takes place in a social situation, the use of a properly trained Hidden Moderator, or confederate, can be a very effective way of learning about users' experiences, needs, concerns, and perceptions. Naturalistic social relationships can be leveraged, where appropriate, to facilitate ease of conversation, allowing participants to more easily express and articulate their thoughts and beliefs.

Consumer-focused applications combining social interactions with product interactions are potentially good candidates for consideration of a Hidden Moderator-facilitated study. We believe that this may be particularly useful for the domestic appliance industry, and possibly for the telecommunications industry, where product familiarity and task learning frequently take place through social relationships.

When a participant is allowed and encouraged to take on the role of an expert in order to impart knowledge and experience to a novice, a dynamic is created that cannot exist when a moderator probes for the same information. Simply put, there is an artificial relationship between a moderator and a participant which interferes with the ability of the participant to articulate a detailed and reliable verbal commentary. Similarly, when interrogated, the tendency under pressure is for test participants to provide some answer to every question, even though it may not be an accurate portrayal of fact (see Nisbett and Wilson, 1977). In contrast, during this broiling case study, we witnessed participants taking precise care to make sure that their responses and instructions were as accurate as possible, and that the Hidden Moderator ("novice") understood the fine details and were helped to perform their own task successfully. In short, the "demonstrator" model combined with the "teacher-student" model afforded a natural dialogue and a structure that closely mimics the very familiar social dynamics of learning experienced between, for example, a master and an apprentice, or a parent and a child.

Our initial foray into a methodology employing a Hidden Moderator has produced rich and detailed data to help us establish a baseline for understanding users' mental models for broiling. Our future investigations will refine this method and will apply it to the understanding of the operations of other products that are primarily used in a social context.

ACKNOWLEDGEMENTS

We would like thank Angela von Dorpowski, Tina Shearer and Ali Vassigh for their help during this study, and for their comments on an earlier draft of this paper.

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