Dining in the dark: How uncertainty influences food acceptance in the absence of light

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Abstract
Sensory cues such as the visual appearance of foods can have a significant effect on food acceptance and food intake. Yet there are many situations – such as those involving deployed soldiers, night workers, and nighttime snackers – where such cues are masked by darkness. This study examines how and why darkness negatively influences food acceptance and future intake and what can be done to mitigate any potential problem. The results show that ambiguous foods eaten in the dark conditions have a low level of acceptance, which may be mediated by one’s uncertainty about the food. Using clear product information (through packaging and labeling, for instance) can reduce this uncertainty and increase acceptance as well as future intake. Interpretations of these findings are discussed and their implications are underscored for those situations where individuals often eat in darkness.

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1. Introduction

Environmental cues such as sounds, smell or temperature influence food acceptance and intake (e.g., Yeomans, 2006; for reviews Stroebele & De Castro, 2004; Wansink, 2004). In particular, it has been shown that visual information plays a crucial role in gathering product information (Schifferstein & Desmet, 2007). For example, several studies found that visual cues, such as illumination and color, influence the appearance of food (Barbut, 2001; Wada et al., 2010), food acceptance (Imram, 1999), and food choice (Clydesdale, 1993). Similarly, visual cues influence taste evaluations (Wilson & Gregson, 1967), and intake (Barkeling, Linne, Melin, & Rooth, 2003; Linne, Barkeling, Rossner, & Rooth, 2002). For instance, Linne et al. demonstrated that, while the eating behavior of blind subjects and control subjects (not blindfolded) was quite similar, the intake of food was significantly reduced when control subjects were blindfolded. In general, food served in high illumination conditions and food that has vivid color is more likely to be evaluated favorably and consumed more. Thus, it is not surprising that obese people are more likely to eat food that is presented on brightly-illuminated tables (Ross, 1974). This is also consistent with the idea that more perceptually accessible foods are more likely to be consumed (e.g., Wansink, Painter, & Lee, 2006; for a review Wansink, 2004).

These studies beg the question as to whether people are less likely to accept, evaluate favorably, and/or consume foods served in dark environments. In fact, several studies suggest otherwise. Scheibehenne, Todd, and Wansink (2010) demonstrated that eating familiar foods in the dark can lead a person to overeat. Kasof (2002) has also found that overeating among college undergraduate students was associated with dimmer light. However, from an evolutionary perspective, one may well reason that eating unfamiliar or ambiguous foods in the dark would lead to lower acceptance and lower intake because of the increased likelihood of inadvertently eating toxic foods.

Clearly, when the sense of sight is removed from product identification, the individual’s uncertainty about what they are eating increases. Thus, as far as eating familiar foods, people may eat more in the dark because of reduced ability to monitor how much they eat (Scheibehenne et al., 2010) or lower self-regulatory control (Kasof, 2002). However, when eating unfamiliar food, people may eat less because of increased uncertainty or anxiety about the food. In fact, previous work in the novel foods research area has shown that increases in product uncertainty can attenuate hedonic responses (Tuorila, Meiselman, Bell, Cardello, & Johnson, 1994) and that stresses associated with this uncertainty could compound the stress from the absence of light, further compromising food intake.

The present study examines whether the absence of light reduces food acceptance and the intentions to consume the food in...
the future. The study also examines whether this effect may be mediated by a reduction in product uncertainty. Most importantly, we examine if any such reduction can be mitigated by the use of clearly identified foods and the inclusion of product information. To explore this, we investigate how eating in darkness differentially influences the acceptance of ambiguous versus unambiguous foods, what causes this, and what can ameliorate this. Finally, implications are outlined to help improve research on cue compatibility, product innovation, and food intake among those who often eat under darkened conditions.

It is also important to note that, although food is normally consumed in well-lit surroundings, investigating the effect of the absence of light on food intake attains more practical interest in certain unique feeding environments. For example, during nighttime operations, military rations are consumed in near total darkness. Such nighttime work conditions are also common among emergency personnel, requiring them to consume food in lighting environments that are dark or less than ideal.

2. Methods

2.1. Design and hypotheses

We sought to test these differential effects by asking participants to rate liking and “likelihood to consume” two products – beef enchilada and crackers – in either well lit or darkened conditions. Both products were shelf-stable Meals Ready to Eat (MRE) items that were packaged in standard, military trilaminate flexible packages. Beef enchilada was selected to serve as a high ambiguity product because it contains multiple ingredients (e.g., beef, onions, and seasonings wrapped in a corn tortilla and topped with green chili peppers and tomatoes) and because when it is removed from its package, the physical integrity of the product is lost as a consequence of the tortilla absorbing moisture during storage. The resulting product, which is often dark and soupy, is difficult to identify, even in lighted conditions, without tasting it.

The MRE cracker was selected as a low ambiguity product since it is a traditional baked cracker made from flour. When removed from its package, the cracker maintains its physical integrity, original shape and texture, and is readily identifiable even in the dark. We also manipulated product information by labeling – or not labeling – the product in order to examine if reducing product uncertainty influences participants’ acceptance and/or future intention to consume these foods. Thus, we conducted a 2 x 2 x 2 mixed-subject design in which environmental lighting was manipulated as a within-subject factor, and product type and product information were manipulated as between-subject factors.

We hypothesized that participants would rate their acceptance and likelihood of future consumption of beef enchilada lower in the dark, but that providing information about what was being consumed would countermand this effect by reducing uncertainty. We also hypothesized that crackers, whether labeled or not, would be less affected by dim lighting conditions because participants would still be better able to discern what they were eating, even in the dark.

2.2. Participants and procedure

One hundred and sixty participants were randomly recruited from a panel of more than 300 volunteer consumer panelists at the US Army Natick Soldier Center. Those consumer panelists were male and female civilians, ranging in age from 19 to 63 years.

Foods consisted of a beef enchilada consumed with a spoon (less easily identifiable in darkness condition) and a cracker eaten by hand (easily identifiable in darkness condition). Two groups of 40 participants each evaluated foods without any information about the product they were about to eat (simply told they were to participate in a food acceptance study) or with information, which consisted of the correct/actual name of the product – beef enchilada or crackers – presented on an information board located at the entrance to the taste test area and on the computer screen that subjects used to make judgments after tasting the food.

Each group participated in two counterbalanced sessions. In one, participants sat in individual sensory testing cubicles separated by dividers, and with a doored passway for presentation of samples. Beef enchiladas were presented on a white dish in near total darkness (0.5 Lux ±10%), accomplished by closing the door to the cubicle room. No lights were illuminated and the food passway for samples was double-sided to prevent all but a minute amount of light to enter from the kitchen area, which also had its lights off. The only light present was that from the computer monitor (cathode ray tube), which was adjusted to the lowest possible level of brightness. In the other condition, participants sat in the same sensory testing cubicles, but samples were presented under normal indoor fluorescent lighting conditions. Between those two lighting conditions, participants were asked to wait while the light was put on or put off. It is important to note that participants in the no label condition were not told that they were eating an identical food sample in the second lighting condition.

Two other groups of 40 volunteers participated in the same two illumination conditions, but the food they tasted was a standard cracker presented on a white paper dish. In all conditions, after tasting/eating the test sample, participants were asked to rate their acceptance of the sample on a 9-point hedonic scale (Peryam & Pilgrim, 1957) and their likelihood of consuming the food in the future on a 9-point scale (1 = I will never eat this product again; 9 = I will definitely eat this product again).

3. Results

We first conducted a 2 (order of the environmental lighting: dark first or light first) x 2 (environmental lighting: dark or light) x 2 (food ambiguity: ambiguous – beef enchilada; unambiguous – cracker) x 2 (product information: labeled or unlabeled) mixed between/within ANOVA to examine if there was any main or interaction effect of the order for both dependent variables (i.e., acceptance and likelihood of consuming the food). Because there was no main or interaction effect of the order, we dropped the order from the following analyses. The subsequent 3-way ANOVA also indicated that there was no main effect or 2-way interaction effect among those variables. However, for both dependent variables, there were significant 3-way (environmental lighting x food ambiguity x product information) interactions, F(1,156) = 11.98, p < 0.001, F(1,156) = 9.62, p < 0.01, respectively. These results suggest that the effects of environmental lighting and product information were different depending upon the food product.

Specifically, for the crackers, there was no decline in acceptance when it was tasted/eaten in the dark condition regardless of information condition. However, for enchilada, participants reported less acceptance when tasted/eaten in the dark (M = 5.70) than when tasted/eaten in the light (M = 6.18) in the condition without product information. In contrast, in the condition with product information, there was no effect of light condition on acceptance.

The results for likelihood of consuming the food yielded similar effects. For the crackers, there was no decline in likelihood to consume the product when it was tasted/eaten in the dark condition regardless of information condition. However, for enchilada, participants reported less acceptance when tasted/eaten in the dark (M = 5.23) than when tasted/eaten in the light (M = 6.83) in the condition without product information. In contrast, in the
4. Discussion

Our results are consistent with the hypotheses set out at the start of the experiment and may be explained through differences in uncertainty about the product(s) to be consumed. Without information, the ambiguous product (enchilada) served in the dark was less acceptable and less likely to be consumed, a fact that is consistent with the notion that the absence of light increased uncertainty about the product, which lowered acceptance and motivation to consume. Given that there was no effect of the order of the lighting condition, the above effect occurred even when the same product was served in the dark after being served in the light. In this regard, momentary uncertainty about the product was sufficient to elicit the effect.

On the other hand, when information about the product (i.e., its name) was provided in the dark condition, no similar reduction in liking or intent to consume was observed. Again, this fact is consistent with a reduction in the uncertainty of the item by the information that was provided.

When a product that had low initial uncertainty (crackers) was presented in the dark, no similar reduction in acceptance or intent to consume was observed regardless of information condition. This fact is consistent with the notion that the uncertainty of a product that is easily identified in the dark through sensory cues, whether flavor, texture odor or tactile, is not elevated when served in the dark.

The combined results here suggest that ambiguous foods (from a sensory perspective) eaten in the dark will be less liked and readily consumed than the same food eaten in standard lighting situations. In addition, the results are interpretable within the theoretical framework of stimulus uncertainty, i.e., increases in the uncertainty of a product reduce liking and the likelihood of consumption, whereas reductions in uncertainty increase liking and the likelihood of future consumption.

The findings here also suggest that Kasof’s (2002) observation that college undergraduates were more likely to eat when they were in dimmer light should be true to the degree that they were eating unambiguous food. Even when they were less self-conscious, they would be more reluctant to eat ambiguous foods such as beef enchilada. This is consistent with the fact that college undergraduates normally consume easily identifiable food such as potato chips (e.g., Weingarten & Elston, 1991).

4.1. Limitations and future research

The present study was limited because it involved only two product types and one source of product information. Furthermore, the present study did not measure psychological process (i.e., uncertainty toward the target food) underlying the effect. In addition, although we did not observe any effect of the order, ideally the lighting condition should be manipulated as a between-subject factor, which is less prone to testing effects — e.g., individuals participating in the light condition first may be more likely to discern what they are eating in the subsequent dark condition.

This study suggests that future research could make a contribution to this area by examining a wider range of foods and by measuring more process variables. This would help better understand how reducing uncertainty influences liking, intent to consume, and overall food intake. In addition, it would be useful to examine whether additional sensory cues, such as the scent of the product, could reduce uncertainty about its nature and improve the behavioral response toward foods eaten in dim lighting conditions.

4.2. Implications

These results hold promise in helping resolve problems that have been consistently found with the under-consumption of food by military and emergency personnel who are deployed in the field. For instance, deployed soldiers are given MREs that are poorly labeled with small or low contrast package labels. One way to improve this may be improving the package labeling of food. This could be done with larger fonts, more contrast, or a tactile cue. The second alternative would be to do this by enhancing the congruency of an odor and the product. This could be done by infusing the product with more of an odor, infusing inert gas into the package, or embedding the odor in the packaging itself.

For the nighttime snacker, however, the issue is not eating too little, but eating too much. While the present study showed that the acceptance and likelihood of future consumption of unambiguous foods is unaffected by the light condition, it also appears that eating familiar foods in the dark can lead a person to overeat (Scheibeheen et al., 2010), very possibly because the darkness interferes with their ability to monitor how much they have eaten.
The present study suggests that this could be mitigated by making easily identifiable (i.e., unambiguous, low uncertainty) snacks less accessible.

References


