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Eating in the dark: A dissociation between perceived and actual food consumption

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ABSTRACT

Objective: According to folk intuition "Eye appeal is half the meal," raising the question how the absence of vision or 'visual flavor' affects food perception, willingness to buy, and food intake. *Method:* In the present experiment, ninety students were assigned to either a blindfolded or a non-blindfolded condition and completed a bogus ice cream taste test. Taste perceptions and purchase willingness were assessed during tasting, and actual and perceived intake, afterward. *Results:* Blindfolded participants rated the ice cream lower on hedonic but higher on ambiguity taste attributes. Although eating without vision led to a lower purchase willingness and a 9% decrease in the actual intake, blindfolded participants overestimated their intake by 88% while non-blindfolded overestimated their intake only by 35%. *Conclusions:* Thus, depriving participants of visual input dissociated perceived intake from actual intake. Shifting attention toward interoceptive cues of eating may provide unobtrusive and naturalistic means to change eating experiences.

1. Introduction

Human eating behavior is a fascinating and complex system. Most of the behavioral eating repertoire is not innate, and the system is highly adaptive to the environment. This becomes obvious when we consider that human beings can adapt to eat virtually anything. For example, mud or soil, which most human beings would not consider as eatable, has recently become a special ingredient at some of Japan's high-end restaurants. News outlets such as CNN and The Japan Times featured chef Toshio Tanabe, the inventor of the new *tsuchi ryōri* ("earth cuisine") which includes courses from appetizers to desserts that are based on real earth from the ground (Swinnerton, 2013; Zolbert, 2013).

From this point of view, eating behavior can be conceptualized as an embodied behavior system (Ghane & Sweeny, 2013). This means that our behavioral eating responses, our thoughts, feelings, and observable behavior related to food intake, are the result of bodily interactions with the food environment. We react to food based on our five senses, and vision is particularly important for food choice and eating (see also Wadhera & Capaldi-Phillips, 2014). Folk wisdom tells us that "eye appeal is half the meal", and scientific evidence confirms this idea. Visual cues determine the hedonic appeal of food by triggering hedonic anticipations or, as Spence and Piqueras-Fiszman (2012) have phrased it, they trigger the 'visual flavor'. Thus, the visual system is key for physiological, emotional, and cognitive responses toward food (Schupp & Renner, 2011; van der Laan, de Ridder, Viergever, & Smeets, 2011). In contrast, public health interventions often recommend eating regulation strategies that rely on the cognitive system in order to navigate the complex food environment. For example, dietary guidelines or nutrition facts are rather abstract and cognitive; most people probably cannot see, smell, or taste a food when presented with nutrition facts. Thus, knowing the nutrition facts does not tell us which food it is and what it looks like, and whether it is green or red, fluffy or mushy, aromatic or bland. Considering this, the question arises whether food perception and eating behavior change when consumers are sensorily deprived; that is, what happens to our behavioral eating responses when we cannot see the food we are eating?

Only a few studies have examined the impact of vision on eating behavior so far (see for an overview Spence & Piqueras-Fiszman, 2012; Wadhera & Capaldi-Phillips, 2014). In a first, pioneering experimental study, Linné, Barkeling, Rössner, and Rooth (2002) asked normal-weight participants to eat a set test-meal lunch once with and once without a blindfold. When blindfolded, participants ate 22% less food but felt just as satiated as

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when eating without a blindfold. A similar pattern was observed within obese subjects eating a set lunch (Barkeling, Linné, Melin, & Rooth, 2003) or breakfast (Burger, Fisher, & Johnson, 2011) with an observed decrease in intake between 12% and 24% in the blindfolded compared to the non-blindfolded condition. Conversely, Scheibehenne, Todd, and Wansink (2010) studied food intake during a set lunch in a "dark" restaurant and found that (in the so-called "regular portion size" condition) food intake was 6% higher than when the restaurant was normally lit. However, people tended to empty their plate: in the dark, participants ate 96% of the amount served. This suggests that portion size was the leading cue for consumption in the dark condition, resulting in a higher consumption overall compared to the normally lit condition (see also Wansink, Shimizu, Cardello, & Wright, 2012).

In all previous studies, people received a complete meal. Since people have a tendency to view the portion they are being served as appropriate and normal, portion size norms (Burger et al., 2011; Herman & Polivy, 2008; Scheibehenne et al., 2010) may have affected the observed results. Likewise, the served complete meals were intended as a free substitute for a regular meal; thus, financial concerns may have influenced the results. In order to decrease the potential influence of portion size norms and financial concerns inherent in serving a complete substitute meal, the present study used a taste test paradigm with several portions of one food item (ice cream). Furthermore, Wansink and colleagues (2012) suggested that vision deprivation might increase the perceived ambiguity of the food, leading to a decrease in willingness to consume the food in the future. However, this contention has not explicitly been investigated, yet.

Extending these meal-based studies examining the impact of visual deprivation, the present study assessed, in addition to actual food intake, also other outcome variables in order to shed more light on the mechanisms. During the food intake session, taste and texture perception as well as approach behavior such as willingness to buy the product indicating acceptance of the food sample were measured. We assessed taste perception 'online' – that is, in real time during the food intake process – and not post-meal (see for example Burger et al., 2011; Scheibehenne et al., 2010), in order to reduce potential memory effects due to retrieving prior experiences (see Robinson, 2014). Moreover, perceived food intake was assessed indicating the ability to monitor food intake. Taken together, we examined the effect of visual deprivation on four different response modes: (1) taste perceptions, for example, how much participants like what they eat and whether they perceive the food as ambiguous; (2) willingness to buy the product; (3) intake behavior, i.e. how much participants actually eat; and (4) the ability to monitor food intake, i.e. how much participants think they eat.

2. Material and methods

2.1. Sample

Ninety participants from the University of Konstanz took part in the experiment. No participant was excluded; however, the numbers of observations vary slightly due to missing values. List-wise deletion per analysis was applied to handle missing data. Thus, if any single value was missing, the case was excluded from analysis. However, rate of missing data was low with a maximum of two missing per variable. Participants were assigned to one of two experimental conditions: blindfolded ($n = 50$) and non-blindfolded ($n = 40$). For practical reasons, the conditions were not run simultaneously but one after the other on a rolling basis. The non-blindfolded condition was run first. Participants had a mean age of 22.5 years ($SD = 4.1$) and a mean body mass index (BMI) of 21.8 kg/m^2 ($SD = 3.0$). Sixty-two of the participants were female (69%) and 28 were male (31%). For more details on participant characteristics see also Table S1 in the Supplementary Material available online. Participants received €8 for participation or course credit.

2.2. Procedure and materials

Participants arrived at the laboratory with the understanding that they would be taking part in a study about tasting. To decrease possible differences in initial hunger level, we informed participants when they scheduled an appointment that they should refrain from eating for two hours before participation.

The outside temperature was recorded as a control variable. After giving informed consent, participants filled in a brief questionnaire assessing their demographics, baseline hunger (rated on a 6-point scale ranging from 1 = very hungry to 6 = very satiated), and general liking of the ice cream ("I like ice cream" rated on a 4-point scale ranging from 1 = completely disagree to 4 = completely agree). Several additional variables were assessed at baseline.[1] These variables are not the focus of the current paper and are reported only in the interest of full disclosure. Afterward, actual food intake was assessed by a bogus taste test (e.g., Sproesser, Schupp, & Renner, 2014). Bogus taste tests assess actual consumption of foods, thereby omitting the bias of self-reports or retrospective memories of eating behavior (e.g., Evers, de Ridder, & Adriaanse, 2009).

Participants were provided with three individual-sized cups of Grandessa® ice cream which is sold by retailers in Germany. Three different popular flavors were presented to the participants: Amarena Cherry, Caramel, and Spaghetti (a typically German type of ice cream which consists of vanilla ice cream pressed through a shape to resemble the shape of cooked spaghetti and strawberry sauce to simulate tomato sauce). Each cup weighed approximately 95 g, equivalent to 188 kcal. A standard tea spoon accompanied each of the three cups. Participants were asked to evaluate the taste and texture of the ice cream as well as how much they liked it by rating basic taste aspects including hedonic appeal, ambiguity, naturalness, freshness, as well as texture and mouth feeling. Specifically, the taste test included 17 questions per ice cream flavor aiming at a comprehensive evaluation of the ice creams (e.g., "How much do you like this ice cream?" or "How surprising is the taste of this ice cream?") with a 4-point response scale ranging from 1 (not at all) to 4 (very much; cf. Sproesser et al., 2014, see also Evers et al., 2009 and Table S2 in the Supplementary Material available online). As there were no a priori reasons to assume differences in taste ratings between the three ice creams, and as the impact of the condition did not differ across the three flavors, taste ratings were summarized across the three flavors for analyses. In addition, willingness to purchase was measured separately for each presented ice cream on a 4-point scale from 1 (very unlikely) to 4 (very likely) and summarized across the three flavors for analyses.

The three ice cream bowls were placed in a handcrafted wooden mount. Participants were told to taste and eat as much as they liked. For effective blindfolding, participants wore modified ski goggles and a plastic cape to protect their clothing in case of spillage. Since blind-folded participants could not fill in the taste rating questionnaire, an audio questionnaire, programmed in Presentation®, was implemented in this condition. Participants could navigate the questions using foot pedals (start question, stop) and answered the questions aloud. A microphone in the room

[1] The other variables that were assessed at baseline were positive and negative affect, trait motives for eating, external and internal influences on eating, and tendency to eat when stressed.