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The impact of multiple immersion levels on data quality and panelist engagement for the evaluation of cookies under a preparation-based scenario

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ABSTRACT

Prior research indicates using immersive technologies to restore relevant contextual cues during product acceptance testing leads to more discriminating and reliable data likely due to improved ecological validity and heightened panelist engagement. However, as the use of immersive technologies in food and consumer product testing is emerging, the opportunities and limitations associated with such paradigms remain largely unexplored. To gain further insight, panelists assessed cookie liking in a traditional testing environment devoid of contextual information and two immersive environments in which audiovisual and olfactory cues depicting the baking of cookies in a home kitchen were presented. In the mixed immersion condition contextual information was presented to panelists via computer screen, head phones and localized aroma dispersion while evaluating cookies in a sensory booth. In the full immersion condition, the same information was presented via video wall, surround sound ceiling speakers and hidden scent dispersal. Following a three-week hiatus, panelists re-assessed the same cookies in the same three conditions. Despite panelists indicating similar levels of engagement in the two immersive conditions, hedonic data proved to be more discriminating and reliable in the fully immersive environment. These data indicate that scenarios depicting food preparation provide relevant contextual information that can influence product liking. Moreover, as the level of immersion becomes more complete, the discriminability and reliability of consumer acceptance data improves. Whether similar findings are observed with other product-scenario combinations remains to be explored.

1. Introduction

New product development is critical to the success and growth of most companies manufacturing and selling consumer packaged goods. In the food and beverage industry, prior studies have indicated that 60–80% of new product launches fail (Costa & Jongen, 2006; Redmond, 1995), costing companies billions of dollars in lost resources and potential revenue. Although multiple factors may contribute to these failed product launches, we recently posited that the poor reliability of traditional consumer testing methodologies may bear some responsibility (Bangcuyo et al., 2015).

In traditional consumer testing scenarios, panelists are asked to evaluate products in isolated booths where relevant non-product contextual information is purposefully minimized. Whereas these environments enable strict control over product testing, they lack ecological validity and dismiss the role of context in shaping product perceptions and acceptance (Bell, Meiselman, Pierson, & Reeve, 1994; Delarue & Boutrolle, 2010; Ferber & Cabanac, 1987; Kasof, 2002; King, Weber, Meiselman, & Lv, 2004; Petit & Siefferman, 2007; Sommer & Steele, 1997; Stroebele & De Castro, 2004; Westerterp-Platenga, 1999). Recently, we utilized immersive technologies to depict a virtual coffeehouse in which important visual, audio and olfactory information was restored during consumer testing (Bangcuyo et al., 2015). We found significant differences in preference order and liking for coffees evaluated by the same people when evaluations occurred in the virtual coffeehouse compared to traditional testing booths. The hedonic data collected in the virtual coffeehouse was also more discriminating and a more reliable predictor of future coffee liking unlike data collected in traditional sensory booths. Furthermore, we found consumers to be more engaged in the testing when evaluating coffees in the virtual coffeehouse, an outcome that likely also contributed to improved data quality.

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These results suggest that methodological changes to current testing strategies have the potential to improve the power and reliability of consumer data, providing food and consumer product companies significant savings on product development costs and failed launches. However, as the use of immersive technologies in consumer testing paradigms is new, questions still remain regarding the utility and best practices incorporating these techniques. In particular, it is unclear whether limitations exist as to the product types or scenarios where immersive technologies prove useful. In our prior study, we depicted a virtual coffeehouse—a scenario that represents a generally positive consumption occasion. However, food liking can also be influenced by contextual information unrelated to consumption, for instance preparation scenarios (Dohle, Rall, & Siegrist, 2016). The sights, sounds and smells associated with the preparation of foods have been previously shown to influence food wanting and liking (Kantono et al., 2016; Spence, 2012; Yeomans, 2006). In addition, it is presently unclear how immersive an environment must be to realize the heightened test power and reliability. It is possible that data quality can be substantially improved simply by providing relevant contextual information in a traditional sensory environment. Indeed, some studies have indicated that simply providing verbal context in the form of a story can have an impact on liking results (Hein, Hamid, Jaeger, & Delahunty, 2010, 2012; Jaeger & Meiselman, 2004; Kim, Lee, & Kim, 2016) although the effect is inconsistent (Jaeger et al., 2017; Lusk, Hamid, Delahunty, & Jaeger, 2015).

To address these questions, we asked consumer panelists to evaluate cookie liking in a traditional testing booth devoid of environmental contextual cues and compared results from those same panelists when evaluating the cookies in an immersive environment depicting a domestic kitchen scenario in which homemade cookies are being prepared by the homeowner. Two levels of immersion were assessed—a fully immersive environment as used previously (Bangcuyo et al., 2015) and a mixed immersion environment in which relevant contextual information was conveyed to panelists via computer screen, headphones, and localized scent dispersion while sitting in a sensory booth. Cookies were evaluated in all three environments during a single session. The ability of consumer data to reliably predict future cookie liking was also measured by having panelists evaluate the same cookies in the same three conditions during a second session of testing that occurred following a three week hiatus. Moreover, in both testing sessions, we assessed the level of panelist engagement in each environment. We hypothesized that improving the ecological validity of consumer hedonic testing by incorporating relevant visual, audio and olfactory cues through the use of immersive technologies would result in a more engaging testing experience and hedonic assessments that are more discriminating and reliable compared to those derived from traditional testing paradigms. We further hypothesized that the different levels of immersion utilized in the full immersion and mixed immersion environments during testing would differentially impact how much improvement was observed in the sensitivity, power and reliability of hedonic data and the subjective assessment of engagement when compared to results from the traditional sensory testing environment.

2. Materials & methods

2.1. Subjects

Fifty-nine subjects (21 male and 38 female) ranging in age from 18 to 69 years old were recruited for this study using The Ohio State University Sensory Evaluation Center's recruitment database. All 59 subjects reported consuming cookies (of any type) at least once a month and approximately half of them baked cookies (of any type) at least once a month. All participants were enrolled under IRB-approved informed consent (2013B0585). Subjects were asked to refrain from eating, drinking or smoking for at least 2 h prior to the start of the experiment. Each subject participated in two experimental sessions (referred to as replication 1 and replication 2) approximately 3-weeks apart. For each panelist, the start time of both experimental sessions was consistent and each session lasted approximately 30-min. At the conclusion of their second session, participants received a $20 cash incentive for their participation.

2.2. Stimuli

Four brands of store bought soft chocolate chip cookies were used in this study: Chips Ahoy Chewy Chocolate Chip Cookies (Mondelēz International Group, East Hanover, NJ), Kroger Bakery Chocolate Chip Cookies (Cincinnati, OH), Pepperidge Farm Soft Baked Montauk Chocolate Chip Cookies (Norwalk, CT) and Keebler Soft Batch Chocolate Chip Cookies (Kellogg's, Battle Creek, MI). Cookie samples were purchased regularly at a local grocery store throughout the experiment and were stored in sealed containers at room temperature when not in use. These four stimuli were selected based on the preliminary assessment that they differed enough in quality to obtain discriminating hedonic responses, were similar enough in appearance to prevent panelists from being able to memorize samples, and were all store bought, chocolate chip, soft-style cookies. To further standardize their appearances, a circular cookie cutter with a 1.5 in. diameter was used on all of the samples prior to their evaluation to give them a uniform size and shape. All sample preparation took place within one day of the testing sessions to prevent samples from becoming stale. Each sample was packaged in a translucent plastic 2 oz. soufflé cup (Georgia-Pacific, Atlanta, GA) and covered with a translucent 2 oz. portion cup lid (Georgia-Pacific, Atlanta, GA) to prevent panelists from being able to see the appearance of the cookie until it was time for them to evaluate it. Each stimulus was assigned a 3-digit blinding code displayed by a sticker on the sample cup's lid and new blinding codes were reassigned to each cookie for each environment in each session. All four cookie samples were presented simultaneously at room temperature. The order the samples were presented in was randomized among the panelists but remained the same for each individual across all three testing environments for both sessions to avoid changes in hedonic scores due to order effects (Mead & Gay, 1995) and to help ensure that the main variable influencing the data were the environmental differences.

2.3. Procedure

At the beginning of each testing session an instructions sheet was read to the panelists that contained general information regarding proper sample evaluation methods and how to input answers using the tablet device provided. This general instructions sheet was made available in all three of the testing environments so that participants could refer back to it at any point of the testing session. After the general instructions sheet was read, panelists confirmed their understanding of the testing procedures and were directed to their first testing environment. Once each panelist arrived in their first testing environment for their first testing session they began by signing the informed consent form and filling out a brief demographic questionnaire. This was the only time this information was gathered so upon entrance to any subsequent testing environment panelists immediately began product evaluation. Panelists were then instructed to rate the acceptability of