An overture to overeating: The cross-modal effects of acoustic pitch on food preferences and serving behavior

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A B S T R A C T
Billions of dollars are spent annually with the aim of enticing consumers to purchase food. Yet despite the prevalence of such advertising, little is known about how the actual sensation of this advertising media affects consumer behavior, including consequential choices regarding food. This paper explores the effect of acoustic pitch in food advertising, demonstrating in two studies, including a field study in a live retail environment, how the perception of pitch in advertising can impact food desirability and decisions regarding serving size. In study 1, a field study, pitch affects actual serving sizes and purchase behavior in a live, self-serve retail setting, with low pitch leading to larger serving sizes. Study 2 demonstrates how low pitch increases desire for a food product among hungry consumers, and that this effect is mediated by perceptions of size and how filling consumers believe the product will be. We discuss these results in the context of cross-modal correspondence and mental imagery.

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Each year staggering amounts of money are spent on media intended to sell food to consumers; marketers spend in excess of 8 billion dollars annually persuading consumers to buy their food (Statista, 2016). With hundreds to thousands of media touch-points weekly, consumer’s appetites (and wallets) are significantly influenced by food-related advertising messages.

For example, food advertisements can prime television viewers to eat more of their own available snacks (Harris, Bargh, & Brownell, 2009) and may influence food choices toward higher-fat or higher-energy foods (Hill & Peters, 1998; Jeffery & French, 1998). Increased exposure to food advertisements also results in increased subsequent consumption of the advertised food categories (Andreyeva, Kelly, & Harris, 2011). Certainly these effects are at least partially attributable to the heightened awareness, saliency, and accessibility that accompany exposure to an advertised food or restaurant (French, Story, & Jeffery, 2001). However, much of what is known appertains primarily to the effects of exposure to food advertisements rather than the role of underlying sensory features utilized in those advertisements.

Prior research on sensory issues in advertising has examined the impact of the message itself (i.e., the language used; Bruthiaux, 2005; Noriega & Blair, 2008), mental visual imagery (Kemps, Tiggemann, & Hollitt, 2014), and the visual components of the ad (Cutler & Javalgi, 1992; Mitchell, 1988). As the vast majority of food advertising budgets are spent on television advertising (Harris, Sarda, Schwartz, & Brownell, 2013) where sound plays a prominent role, there is merit in understanding how sonic elements in advertising impact consumer behavior. Herein we focus on the role of acoustic pitch on a food product’s desirability and on serving sizes, emphasizing the importance of these outcomes in this domain due to the impact that portion size can have on consumption (Edelman, Engell, Bronstein, & Hirsch, 1986; Rolls, Morris, & Roe, 2002) and the ongoing concern for public health issues such as obesity and diabetes (CDC, 2016). The purpose of this work is to better understand how serving size preferences might be shaped by “sensory marketing” (Krishna, 2012). Specifically, this work explores how the acoustic pitch of sound in advertising can influence food desirability, serving size, and purchase behavior in a live retail environment.

1. Sound and cross-modal correspondences

Virtually anytime food is advertised on television, radio, internet video, or even directly from a store employee, sound is involved in
the form of spoken words or music and can influence food consumption in various ways (Reinoso Carvalho, Wang, Van Ee & Spence, 2016). Most relevant to our purposes are the features or characteristics of sound in advertising, beyond language, that may communicate information about the associated product. Sound in advertising can influence consumer perceptions through “cross-modal correspondences”, that is, the perceptual compatibility of a sensory experience in one modality with that of another sensory modality (Lowe & Haws, 2017; Spence, 2011, 2012). With respect to food, taste is influenced by cross-modal correspondences in the multi-sensory experience of eating (Simmer, Cuskley, & Kirby, 2010; Wang, Keller, & Spence, 2017). For example, certain shapes correspond with perceptions of the basic dimensions of taste, such as sweetness and roundness (Velasco, Woods, Deroy, & Spence, 2015), and some soundscapes can “match” or evoke particular tastes (Wang, Woods, & Spence, 2015).

When considering sound, certain cross-modal correspondences may also be particularly relevant as they pertain to food. Sound varies along three dimensions including amplitude, which is perceived as volume; harmonics, which we know as timbre; and frequency, which we associate with pitch (Fletcher, 1934; Stevens, Volkmann, & Newman, 1937). Prior research in which participants matched various tastes (sweet, sour, bitter, salty) with sounds heard on a computer showed that greater spectral balance (which reflects an evenness in the volumes of different frequencies) and higher frequencies have been reliably associated with sweet and sour tastes (Crisinel & Spence, 2010; Simmer et al., 2010) while the opposite is true for bitter and umami. Beyond mere cross-modal mapping, background soundtracks can affect actual taste perceptions, with lower- (higher-) pitched sound leading to more bitter (sweeter) taste perceptions (Crisinel et al., 2012). Thus, a change in the sound of advertising media may affect sensory-related perceptions or cognitions involving non-acoustic information.

Further exploring the potential effects of cross-modal correspondences on actual perceptions and behaviors, we propose that acoustic pitch in food advertising will have a significant impact on food-related decisions due to cross-modal correspondences between pitch and size. As larger objects are more likely to produce the slower vibrations that would create lower-pitched sounds (Plack & Oxenham, 2005), lower pitch is frequently associated with larger size. For instance, participants in studies in which auditory and visual cues are presented simultaneously are more likely to automatically associate lower-pitched sounds with larger visible objects (Spence, 2011). Expounding on this idea, Lowe and Haws (2017) demonstrate that pitch in advertising can affect actual perceptions of size in products associated with the sound, even when it could be reasonably inferred that the sound did not emanate from the product itself. For example, music used to promote a new camera led participants to believe that the camera was physically larger when the pitch of the music was relatively lower (Lowe & Haws, 2017). If pitch affects a consumer’s perceptions of a food’s size, it could readily affect subsequent serving behavior, with lower relative pitch cueing larger servings, as well as preference for certain food products based on one’s current goal state. The relative nature of these cross-modal effects is key as any degree of linearity in the pitch/size relationship is yet unclear (Knöferle & Spence, 2012).

2. Influences on desirability and serving sizes

We now draw upon literature about serving size and serving size perceptions to propose important outcomes that may be impacted by differences in acoustic pitch in advertising. First, we focus on how pitch-size associations may impact consumer-controlled serving sizes and consumption when consumers are in a restaurant environment for the purpose of consumption (as tested in Study 1). We then explore how pitch-size associations impact the desirability of an advertised food product when serving size is not controlled by the consumer and consumer goal states (i.e. hunger) may differ (as tested in Study 2).

At a fundamental level, characteristics such as good taste (Sorensen, Moller, Flint, Martens, & Raben, 2003) and desire (Kemps et al., 2014) lead people to consume more. In addition, even subtle cues have been shown to influence serving size. For instance, studies repeatedly show that larger package sizes or larger portions served at a restaurant lead to greater consumption (Rolls et al., 2002). Further, perceptions of serving sizes and their appropriateness are influenced by many environmental factors. For instance, the size and shape of dishes (Attwood, Scott-Samuel, Stothart, & Munafò, 2012; Raghurub & Krishna, 1999) influence serving size and consumption such that larger plates are filled with more food, larger serving dishes lead to larger servings, and shorter, wider glasses lead to greater consumption, although a meta-analysis of such dish studies has raised questions regarding this effect (Robinson et al., 2014). In addition, other’s serving sizes and even the body type of servers or other consumers can act as a subtle signal of serving size appropriateness (McFerran, Dahl, Fitzsimons, & Morales, 2009). Therefore, consistent with consumers adjusting serving sizes according to such suggestions of appropriateness, we propose that pitch will affect serving behavior by similarly cueing differences in visualized serving sizes. As the evoking of an image can prime consumers to behave in ways consistent with that image (Fitzsimons, Chartard, & Fitzsimons, 2008), we expect that low pitch primes a mental image of a larger product (Lowe & Haws, 2017), and that this mental image will affect actual serving size in a consistent direction.

We test these predictions in a set of exploratory studies. We begin by examining the effect of pitch via an in-store advertisement on serving size in a live retail environment in which consumers served themselves and paid for their food based on serving size. As such, Study 1 tests whether or not the effects of pitch impact actual serving sizes in a restaurant environment, focusing explicitly on the pitch→serving size relationship. In study 2 we explore the proposed interaction between pitch associated with an advertising stimulus and hunger (an active goal state affecting desired serving size) on the desirability of a food product. Specifically, we expect that the same food associated with a lower pitch will be more desirable to a hungrier participant, while a less hungry participant may not experience any such effect of pitch. Further, these effects will likely be driven by size perceptions, such that those hearing the lower pitch imagine a larger size than those hearing the higher pitch. This larger product size will subsequently be seen as being more filling, and ultimately more desirable for hungry (versus less hungry) consumers. As such, study 2 examines the boundary conditions and process for how pitch influences perceptions of food offerings (see Fig. 2 for a graphical depiction). In both studies, the research was conducted with the approval of the university’s ethics committee (Study 1:2014–0199D, Study 2: Protocol H15371Proto-col). Sample size was a function of the number of customers visiting the retail location during the specified period in Study 1 and a function of the availability of students enrolled in the course in Study 2.

3. Study 1

In study 1 we explore whether cross-modal correspondence effects can lead consumers to alter their actual serving size of a product purchased. Specifically, we examine the effects of pitch on purchase behavior in a restaurant setting in which customers have control over serving size and in which the price of the product is directly proportional to the self-served quantity. Accordingly, serving size is a reliable proxy for planned consumption quantity.
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