Touching tastes: The haptic perception transfer of liquid food packaging materials

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A B S T R A C T

Based on the theory of crossmodal correspondence, which addresses transfer effects from one sense to another, and research that has explored the impact of touch on taste, the present study examined how the packaging materials of traditional Chinese cold tea drinks generated touch–taste associations. Blindfolded participants used a set of tasting attribute items to evaluate the taste of a liquid food product that differed only by the materials used to contain it, although they were led to believe that the products could differ. The results of Experiment 1 suggest that consumers’ haptic perception of packing materials significantly impacted their sense of the product’s SWEET dimension, but not the product’s SOUR or BITTER dimensions. Consumers rated a liquid food product’s sense of cold and ice (sub-dimensions of SWEET) higher when it was presented in a glass container rather than in paper or organic plastic containers. However, with the cups’ weight controlled, the results of Experiment 2 revealed that consumers’ haptic perception of packing materials only significantly impacted their sense of ice, but not their sense of cold. Consumers rated a liquid food product’s sense of ice higher when it was presented in a glass container rather than in an organic plastic container. The preliminary findings of both experiments indicate a crossmodal correspondence between the touch of food packaging materials and the taste of the food contained within them. Sensation transference provides the most likely explanation for the results. Affective ventriloquism effects provide another, but less likely, explanation. The study’s implications for choosing between packaging materials for liquid food products are discussed.

Introduction

When wandering in the supermarket to shop for everyday food and beverages, consumers will find that liquid food packaging material is diverse. This diversity makes liquid food packaging an ideal medium for testing the haptic effects of food packaging, providing us with a convenient site for conducting multi-comparisons and controlling independent variables (i.e., packaging materials). However, among all liquid food products, tea most clearly manifests Eastern cultural traditions and characteristics. Specifically, in China, the history of using herbal tea may as long as the history of using traditional Chinese medicines (TCMs), many of which are consumed in the form of tea (Zhao, Deng, Chen, & Li, 2013). According to the statistical report of the China National Food Industry Association, herbal tea has a 20% share of the Chinese beverage consumption market, and its market share is increasing at the surprising rate of 30% per year (cited by Zhong & Wu, 2013). Due to its cultural significance and popularity, we selected Chinese cold tea to represent the liquid food stimulus for the present study.

At its most fundamental, packaging contains, protects, and preserves products; however, at its most sophisticated, it influences selling operations (Paine & Paine, 1992). In the highly competitive environment of retail stores, where the typical shopper passes by some 300 items per minute and makes 40–70% of all purchase decisions, packaging performs many sales functions and acts as an important promotional medium (Armstrong & Kotler, 2013). Food packaging, which is often intertwined with food, is a broad term, including form, structure, materials, color, imagery, typography, and regulatory information with a few ancillary elements (Xu, Li, & Wei, 2009). Successful food packaging not only creates desire and establishes brand loyalty, but it also often provides the sole reason for buying a product (Klimchuk & Krasovec, 2013, pp. 39–40). A substantial amount of research has exclusively examined how the shape and color of packaging affect
taste experiences. In studying the impact of shape, Spence and Gallace (2011a), for example, found an association between presenting sparkling water, cranberry juice, and Maltesers chocolate with angular shapes. In studying packaging color, Piqueras-Fiszman, Alcaide, Rouara, & Spence (2012) found consumers rated the flavor intensity and sweetness of strawberry mousse higher when it was presented on a white plate rather than on a black one. Further, to a great extent, the physical features of food packaging have been shown to affect consumers' product attitude and price expectations (Becker, Van Rompay, Schifferstein, & Galetzka, 2011), perceived quality of a product (Borland, Savvas, Sharkie, & Moore, 2013), and perceived brand attributes (Parise & Spence, 2012). Even the cutlery with which a food sample is served has been shown to affect the response of consumers. Harrar and Spence (2013) found, for instance, that consumers perceived yoghurt as denser and more expensive when tasted from a lighter plastic spoon as compared to an artificially weighted spoon. Studies focusing on the color and shape of food packaging have contributed to a better understanding of how packaging can impact consumers' food taste and brand perception, yet the majority of the published research on food texture, or touch, has focused primarily on what occurs inside the mouth during consumption (Piqueras-Fiszman & Spence, 2012b). Less attention has typically been given to the possible influence of food packaging materials on consumers' taste experiences (Krisha & Morrin, 2008; Piqueras-Fiszman et al., 2012; Piqueras-Fiszman & Spence, 2012a, 2012b; Schifferstein, 2009).

The importance of consumers' ability to touch products that they are considering for purchase cannot be overstated. Whether in store- or internet-based selling, products with primarily material properties are more likely to be preferred (Citrin, Stem, Spangenberg, & Clark, 2003; McCabe & Nowlis, 2003) and to be rated more highly in shopping environments that allow physical inspection rather than in those environments that do not (Peck & Childers, 2003b). Those pre-selected high-quality products for which tactile input is diagnostic obtain more positive and favorable product evaluations (Grohmann, Spangenberg, & Sprott, 2007). Physical touch, sensorial judgment, and affective response are often related to one another in a specific hierarchy; for example, “relaxing” is a combination of indulgent/sensual and warm, while “precious” is a combination of indulgent/sensual and not warm (Chen, Barnes, Childs, Henson, & Shao, 2009). Researchers have examined how expectancy-based effects impact crossmodal correspondence, and have found that people generate expectations about the taste of a food from contextual cues, such as the features of hot and cold (Spence, Levitan, Shankar, & Zampini, 2010). A consumer’s sense of touch has been shown to play a very important role, especially in the first stage of buying, during which the consumer develops a “feel” for the package and the ingredients inside (Schifferstein, Fenko, Desmet, Labbe, & Martin, 2013). Accordingly, we may reasonably speculate that when consumers purchase food they come to expect the actual taste of that food by habitually or subconsciously touching the packaging, indirectly evoking memories of the purchased food’s taste. At the same time, touch may arouse affective responses, independently moderating the effect of food tactility on consumers' buying decision-making process. The present study contributes to this field of research, which is now gradually receiving increased attention. Specifically, the field focuses on how haptic, or touch-related, properties of food packaging materials affect consumer food-taste experiences. Since haptic perception is complicated by the number of perceptual processing inputs that are generated from multiple subsystems—including those in skin, muscles, tendons, and joints (Goldstein, 2013)—we address key issues in studying haptic perception before presenting the formal study.

Consumers experience a wide range of haptic sensations from the many different kinds of liquid food packaging materials to which they are exposed in the market, and they may associate these materials and sensations with qualities derived from cultural semantics. For example, Tu, Yang, and Ma (2013) noted that consumers perceived organic glass as bright; wood packaging material as natural and comfortable, signifying something pure and sweet; and plastic as compact and smooth, suggesting something exquisite and elegant. Haptic perception may be divided into at least two systems of haptic classification. Lederman and Klatzky's (1990) initial classification of haptic sensation distinguished between eight diagnostic attributes: shape and size; texture and hardness; weight; temperature; part; and motion of a part. Littel and Orth (2013) narrowed haptic perception to four factors: size, hardness, contour, and texture. Researchers have observed that certain stereotypical hand-movement patterns were directed at extracting particular object properties; for example, static contact with temperature and unsupported holding with weight (Klatzky & Lederman, 1992; Lederman & Klatzky, 1987). Furthermore, Klatzky, Lederman, and Reed (1989) found that redundancy gains (shortened response time) were observed only for two substance factors at any given time (in their case, texture and hardness with planar contour). Lederman and Klatzky's (1996) also observed that when neither hand was favored by the initial mode of contact, the subject tended to use both hands throughout, which implies that holding a drink container in both hands may be a habit in everyday life. They also found that participants came to associate the most diagnostic (haptic) attributes (MDA) with specific exploratory procedures (EPs); for example, Texture MDA with Lateral Motion EP, Hardness MDA with Pressure EP, Temperature MDA with Static Contact EP, and Weight MDA with Unsupported Holding EP.

The present study is especially concerned with the crossmodal correspondence of haptic temperature, weight, and texture perceptions with taste. Crossmodal correspondence occurs when polarized stimulus dimensions between different, basic physical stimulus attributes—or features in different sensory modalities—seem to be associated, such as when a more-or-less extreme stimulus value on a given dimension is found to be compatible with a more-or-less extreme sensory value on a corresponding dimension (Spence, 2011). Crossmodality may occur at any level, depending on the stimulus meaning/valence, which could just as effectively associate low-level modal stimulus properties as high-level cognitive correspondence (Spence, 2011). Researchers have discussed crossmodal correspondence between many different pairs of stimuli (pitch and elevation, brightness and lightness, size and angularity of shape), but the majority of studies have matched auditory and visual stimuli (Spence & Deroy, 2013). Based on crossmodal correspondence theory, we have reason to believe that the haptic temperature, weight, and texture of food packaging materials may map onto food taste experiences. Krishna, Elder, and Caldara (2010) have shown that both smell and touch have semantic associations that can enhance haptic perception and product evaluation. Research has also established that the physical properties (e.g., weight) of food packaging containers can exert significant influence on consumers' expected satiety and perception of density (Piqueras-Fiszman & Spence, 2012a), sensory and hedonic responses (Piqueras-Fiszman, Harrar, Alcaide, & Spence, 2011), and even impressions and decisions (Ackerman, Nocera, & Bargh, 2010). Piqueras-Fiszman and Spence (2012b) found, for example, that a biscuit (i.e., cookie) contained in a rougher, yoghurt-like pot (i.e., cup) was perceived as being significantly crunchier and harder than those contained in a smoother, yoghurt-like pot.

Schifferstein (2009) has explored in particular how the experience of cups made of different materials affects the experience of drinking a liquid food product. That study revealed that different cup materials evoked different experiences. Schifferstein suggested that if the meaning of the test items could be derived directly from the perceived sensory characteristics of the liquid food product,
participants’ responses would be likely to follow the shifts in the corresponding physical characteristics and the results could be interpreted in a straightforward manner. Schifferstein also pointed out that although the cups used in the study were similar in size and shape, they differed in several respects, such as in appearance. This suggested that, in future studies, it would be advisable for subjects to be blindfolded, in order to control for the visual appearance of the product characteristics and focus attention on the effect of touch alone (Krishna & Morrin, 2008). Following Schifferstein (2009) study, the present study was designed to explore the phenomenon of crossmodal correspondence to ascertain whether subjects reliably associated certain attributes of packaging material with their experience of its liquid food content’s taste. We asked blindfolded participants to rate the taste of cold tea, to ensure that taste would be their main sensory perception, and required that participants take a sip with an approximate volume of 15 ml. Furthermore, we paid special attention to participants’ hand-movement patterns in order to strictly control the sense of touch produced by touching different materials.

Pretest

A pretest was conducted in order to form a baseline measure for the taste of the cold tea that would be used in the formal experiment. Eighteen participants (6 male, 12 female; mean age 24.18 years) tasted the cold tea according to the following procedure. First, the participant was presented with the instruction, “Please taste a new type of drink. During tasting, we will cover your eyes with a blindfold, and then guide you to pinch your nose with one hand, and with another hand lift the cup to drink (do not swallow).” After putting the drink into your mouth, release the hand pinching your nose, carefully taste the drink in your mouth for about 10 s, and then spit into the original cup”. Second, after participants covered their eyes, two experimental assistants (one male, one female) used a cup with scales to pour the prepared 15 ml of cold tea into disposable cups. Third, participants tasted the cold tea in accordance with the experimental instruction, immediately writing down the taste experience on a blank A4 paper. Finally, participants were thanked for their cooperation and dismissed. The experimenter and two assistants checked the above responsive taste experiences using a content analysis method. We firstly quickly browsed through all of the answers to select the approximate taste category. Answers that could not be classified were treated as a new subcategory. If subcategories could not be merged, they were treated as new, separate categories. After following this procedure approximately three times, we had acquired seven classifications: sweet, bitter, astringent, sour, cold, ice, cool. We used a 9-point rating scale that ranged from “not at all” to “very much” in order to rate to what extent the participants considered a particular taste to characterize the cold tea used in the present formal experiment.

Experiment 1

Methods

Participants

Participants were 22 freshmen (9 male, 13 female; mean age 18.62 years) enrolled in a professional college devoted to management science. All participants had two functioning hands and were naive as to the purpose of the study, and reported being free from diseases that might impact sense perception.

Product selection

We started with liquid food containers of approximately the same shape and size as those that are available in local stores and used them with similar functionality. The cup materials were cone-shaped, without a handle, and approximately the same size. The containers chosen were glass cups (Size: medium; Volume: 220 ml; Height: 9.8 cm; Upper Outer Diameter: 6.5 cm; Lower Outer Diameter: 4.8 cm; Color: colorless and transparent), paper cups (Size: medium; Volume: 216 ml; Height: 9.0 cm; Upper Outer Diameter: 7.0 cm; Lower Outer Diameter: 4.0 cm; Color: colorless and not transparent), and organic plastic cups (Size: medium; Volume: 228 ml; Height: 9.5 cm; Upper Outer Diameter: 7.5 cm; Lower Outer Diameter: 4.5 cm; Color: colorless and transparent) (see Fig. 1).

The cold tea chosen was the brand Jia Duo Bao, which currently leads China’s tea drink market. The cold tea used in the present experiment was produced in Wuhan, China on July 5, 2012. The original packaging was made of aluminum cans, each with a volume of 310 ml. The tea’s main ingredients were water, sugar, grass jelly, chrysanthemums, and so on. Experimental assistants bought whole cold tea—ensuring it was from the same batch, with the same production date—in a local supermarket. The experimental measuring cups chosen were two organic plastic cups with a scale (Range: 5 ml; Volume: 30 ml) and colorless transparency.

Procedure

The experiment began in early November 2012 and was held from 9:30 a.m. to 11:20 a.m. on each weekday for two weeks. Participants were recruited at the college. Individuals who were willing to participate were taken into a behavior laboratory, which was kept in a condition of constant illumination and at a constant temperature of 26 °C. What is more, during the experiment participants were not allowed to touch any of the objects that were used except when required.

First, participants were required to taste three different new types of drink (each in the amount of 15 ml) and evaluate the taste experiences. All three new drinks were actually the same drink. Before the start of each experiment, the experimental assistants covered the participant’s eyes with a blindfold and confirmed that the participant could not see. The experimental assistants then guided the participant to grasp the cup by both hands and gently rub it back and forth three times (see Fig. 2). The experimental assistants then instructed the participant to pinch his/her nose with one hand, and with another hand lift the cup to drink (having been cautioned not to swallow). After putting the drink into his/her mouth, the participant was instructed to release his/her nose and carefully taste the drink, holding the liquid in his/her mouth for approximately 10 s. The participant then spit into the original cup and evaluated the taste of the liquid food product. A cup of natural bottled water (about 80 ml, or approximately two or three full mouthfuls) was available for rinsing between liquid food samples. After rinsing, participants were required to use the same procedure to taste other new types of drink (each 15 ml) and evaluate the taste experiences. Before participants imbibed any kind of drink, the experimenter would loudly instruct the experimental assistants which one the participant should drink. The order in which tasting drinks and evaluation items were presented was balanced. Finally, participants had to indicate to what extent they were familiar with one of the three kinds of drink (actually the same) by random selection. Responses were recorded on a 9-point rating scale ranging from “not at all” to “very much so.” The whole experiment took about 20 min. After collecting the data from the participant, the participant was thanked for his/her cooperation and given a small amount of money or a gift of the same value as a reward.

Data analysis

To obtain an overall impression of the characteristics of participants’ taste experiences, we performed a factor analysis...
with Varimax rotation for all taste categories, using responses from a single participant (N = 46, 30 male, 16 female) on the seven taste items. The KMO level of .80 and the significance of the Bartlett test indicated that factor analysis was appropriate for the data. The results identified three factors with eigenvalues >1, and these three factors, when accumulated, accounted for 70.31% of the total variance. Sweet, cold, cool, and ice had loading of .63–.79 on the first factor, named the SWEET dimension. Bitter and astringent had loading of .84 and .84 respectively on the second factor, named the BITTER dimension. Sour solely had loading of .93 on the third factor, named the SOUR dimension. In factor analyses, the seven taste items with high factor loadings on corresponding factors, respectively, were used to construct the sum of the three factors for the formal experiment.

In order to determine whether the materials of the liquid food containers exerted a significant effect on participants’ perceived taste experiences, data were analyzed using 3 (liquid food categories) × 3 (materials of liquid food container: glass, organic plastic, paper) repeated measures analysis of variance (ANOVA), which considered liquid food categories and the materials as independent variables and taste experiences as dependent variables.

Results

Participants were familiar with the taste of the drinks (M = 6.27, SD = 1.72). The correlations between the tasting familiarity of the drink and the actual tasting experiences (SWEET: r = .11, p > .05; BITTER: r = .07, p > .05; and SOUR: r = -.08, p > .05) were all not significant. Both the main effects of liquid food categories and the container materials were not significant, and no further interaction effects were obtained for the familiarity of the three drinks’ taste. After the experiment, interviews of the participants found that the participants did not suspect that the three new kinds of liquid food were actually the same drink; moreover, four participants kindly reminded the experimenter to pay more attention to the differences between those new drinks and one drink already sold on the market.

Taste evaluation: BITTER dimension

Repeated measures ANOVA showed no main effects for liquid food categories (p = .74) and no interaction for liquid food categories and the materials of liquid food containers (p = .54). Moreover, the main effect for the materials of liquid food containers was also not significant (F2,44 = .10, p = .79, η² = .01).

Taste evaluation: SOUR dimension

Repeated measures ANOVA showed no main effects for liquid food categories (p = .37) and no interaction for liquid food categories and the materials of liquid food containers (p = .40). Moreover, the main effect for the materials of liquid food containers was also not significant (F2,44 = .72, p = .49, η² = .03).

Taste evaluation: SWEET dimension

Repeated measures ANOVA showed no main effects for liquid food categories (p = .34) and no interaction for liquid food categories and the materials of liquid food containers (p = .12). However, the main effect for the materials of liquid food containers was significant (F2,44 = 7.39, p = .002, η² = .25, dglass-paper = .44, dglass-plastic = .87, dpaper-plastic = .15), suggesting that participants did perceive the SWEET tastes of the liquid food (cold tea) differently.

As the SWEET dimension included the four sub-dimensions of sweet, cold, cool, and ice, cases with the four sub-dimensions as dependent variables needed further inspection. As far as the sub-dimension of the sensation of sweet was concerned, repeated measures ANOVA showed that the main effects for liquid food categories (p = .78), interaction for liquid food categories with the materials of liquid food containers (p = .57), and the main effect for the materials of liquid food containers were not significant (F2, 44 = .16, p = .85, η² = .01). For the sub-dimension of the sensation of cool, repeated measures ANOVA showed that main effects for liquid food categories (p = .81), interaction for liquid food categories with the materials of liquid food containers (p = .75), and the main effect for the materials of liquid food containers were also not significant (F2,44 = .96, p = .39, η² = .04).

However, with respect to the sub-dimension of the sensation of the ice, repeated measures ANOVA showed no main effects for liquid food categories (p = .47) and no interaction for liquid food categories with the materials of liquid food containers (p = .62). Yet, the main effect for the materials of liquid food containers was significant (F2,44 = 9.63, p < .001, η² = .30, dglass-paper = .54, dglass-plastic = .69, dpaper-plastic = .19), suggesting that participants did perceive the icy taste of the liquid food differently. According
to the Bonferroni test, the taste experiences of the liquid food in the glass cup scored higher than in the paper cup ($MD = 1.09, SE = .36, p = .02$) and the organic plastic cup ($MD = 1.44, SE = .39, p = .004$) (see Fig. 3), suggesting that although participants tasted the same drink contained by different materials, they perceived the drink contained by the glass cup as icier than the drink contained in the paper and plastic cups.

In addition, in terms of the sub-dimension of the sensation of cold, repeated measures ANOVA showed no main effects for liquid food categories ($p = .37$) and no interaction for liquid food categories with the materials of liquid food containers ($p = .64$). However, the main effect for the materials of liquid food containers was also significant ($F_{2, 44} = 1.12, p = .005, \eta^2_p = .22, d_{glass-paper} = .52, d_{glass-plastic} = .75, d_{paper-plastic} = .19$), suggesting that participants did perceive the cold taste of the liquid food (cold tea) differently. According to the Bonferroni test, the taste experiences of the liquid food in the glass cup scored higher than in the paper cup ($MD = 1.17, SE = .48, p = .07$) and the organic plastic cup ($MD = 1.60, SE = .48, p = .008$) (see Fig. 3), suggesting that although consumers tasted the same drink contained by different materials (glass, paper, and plastic), they perceived the drink contained by the glass cup as colder than the drinks contained in the paper and plastic cups.

**Experiment 2**

**Methods**

In Experiment 1, the weight of the glass, paper, and plastic cups was not constant. The weight of the glass cup (about 150 g) was far greater than that of the paper cup (about 5 g) and the plastic cup (about 4 g). Therefore, the significant results in the Experiment 1 could have been due to the effect of large differences between the weights of the cups, rather than the textures of the materials from which they were made. Several studies have shown that taste judgments can be affected by the weight of a container. Container weight has been shown to influence participants’ impressions and decisions (Ackerman et al., 2010). Piqueras-Fiszman et al., 2011 have also reported that uniform yoghurt samples were perceived as being significantly dense when consumed from a heavier bowl rather than from a lighter but otherwise identical bowl.

Thus, we carried out Experiment 2, which was designed to ensure that only the texture of the cups’ different materials influenced participants’ taste experiences, eliminating differing cup weights as a factor. Taking our cue from a study by Piqueras-Fiszman and Spence (2012a), in which “a hidden several g [gram] lead weight was attached to the base of the bowls” to keep their weights constant, we pressed a glass base into the plastic cup (Height: about 5 cm; Weight: about 145 g), which had roughly the same diameter as the plastic cup. As a result, the two cups (glass and plastic) were identical in weight in each condition.

Participants were 24 first-year graduate students (7 male, 17 female; mean age 24.13 years) enrolled at Hunan University located in Hunan province, China, who were devoted to education and psychology. The containers chosen were the glass cups and the organic plastic cups that had been used in the Experiment 1. In Experiment 2, we used the same procedure and data analysis as in Experiment 1.

**Results**

The results demonstrated that only with respect to the sub-dimension of the sensation of ice, the main effect for the materials of liquid food containers was significant ($F_{1,29} = 5.36, p = .028, \eta^2_p = .16, d_{glass-plastic} = .35$), suggesting that participants perceived the icy taste of the liquid food (cold tea) differently. The taste experiences of the liquid food in the glass cup scored higher than in the organic plastic cup ($MD = 0.73$) (see Fig. 4). However, with respect to the sub-dimension of the sensation of cold, the main effect for the materials of liquid food containers was no longer significant ($F_{1,29} = 3.13, p = .09, \eta^2_p = .10, d_{glass-plastic} = .24$), suggesting that participants did not perceive the cold taste of the liquid food (cold tea) differently. The taste experiences of the liquid food in the glass cup scored a little higher than in the organic plastic cup ($MD = 0.44$).

**General discussion**

The present study investigated whether or not the materials of liquid food packaging/containers (glass, paper, plastic) would exert a significant influence on participants’ perceived tasting experiences. The results of Experiment 1 and Experiment 2 revealed that participants perceived cold tea contained in glass cups as SWEETER than cold tea contained in plastic cups. Further analysis showed that this result was mainly caused by the sensation of ice. The results preliminary confirmed and demonstrated that the haptic perception of touching the glass cup (glass material) influenced participants’ tasting judgments, which implies a crossmodal correspondence between haptic perception induced by different packaging/container materials and the taste experiences of the liquid food contained in them.
The participants' misjudgments provide the most unexpected explanation for the results of the present study. Yet, there is little evidence to prove that these misjudgments were possible at a conscious level. The time interval from touching the different cups and tasting from them to the moment of tasting evaluation was at least a few seconds in length, which provided participants with enough time to make correct judgments at a conscious level. What is more, we clearly asked participants to evaluate the tastes of the liquid food and to not attend to their haptic perception of different cup materials. However, we cannot exclude the possibility that something occurred in participants at a subconscious level that might complicate our explanation of the phenomena we observed. For example, Ramachandran and Hubbard (2001) proved conclusively through five sets of experiments that such cross-activation is genuinely sensory in nature. Spence (2012) has also argued that the influence of packaging shape on food taste should be considered as running at an implicit or functionally subconscious level. As for the present study, participants were required to execute only habitual actions while they tasted each drink. As a result, they could not have been aware of the food packaging's meaning for the experimental content or for the taste experiences that might have been caused by haptic perception.

As far as occurrence at the subconscious level is concerned, "sensation transference"—defined as "the phenomenon whereby certain sensory attributes of a product perceived via one or more of the senses can bias a consumer's perception of other product attributes derived from other sensory modalities" (Piqueras-Fiszman & Spence, 2012b)—may provide the most likely explanation for the results of the present study. Experiment 1 and Experiment 2 showed that participants perceived the cold tea contained in the glass cup as icier than when it was contained in the plastic cup. Yet, for us, it is believable that participants' icy taste experiences might have been influenced not by sensation transfer from the cold tea contained in the cups but from the texture property of the cups. Schifferstein (2009) reported that there might be a sensation transfer from the cold-warm property of a liquid foodstuff to the cold-warm perception of touching a cup. However, in Schifferstein (2009) study, cups were filled one-half or one-third of the way full with tea (65 °C or 60 °C) and Sprite (12 °C or 10 °C). Although that study did not report the temperatures of the outside of the cups or the room, we speculate that the temperature of the tea may have been a little higher and the temperature of the Sprite may have been a little lower than the outside temperature of the cup and the room temperature. Given these conditions, heat could easily have been conducted from the liquid foodstuff to the feeling (sensation of touch) of the cups, especially for glass materials.

In Experiment 1, however, air-conditioning in the lab kept the temperature of the cold tea and the cups at almost the same level, which may have prevented warm-cold sensation transfer. Furthermore, the cold tea consumed by participants only filled a very small portion of each cup's capacity (about 15 ml: 220 ml). What is more, the cold tea contained in the glass cup to be colder than the cold tea contained in the plastic cup—the opposite of the result obtained in Experiment 1. Thus, an alternative explanation is that the taste experience of cold tea was influenced by the weight of the cups: participants' different liking for cups with different weights may have mediated their taste experiences. That is, the heavier the container was, the more the participants liked the foodstuff in it, and the sweeter the participants perceived the foodstuff to be. If this alternative explanation were demonstrated to hold true, we would say that affective (or hedonic) ventriloquism effects (cited by Spence & Gallace, 2011b) had impacted the present study's tactile (multisensory) design. This would explain why changing the feel of the liquid foodstuff's packaging influenced participants' overall multisensory product evaluation (such as the taste experience: sweet). Piqueras-Fiszman et al., 2011 also revealed significant main effects from the weight of serving bowls on participants' liking of yoghurt samples, which increased as the weight of the bowl increased. Another recent study completed by the current study's authors (Tu & Yang, in press) revealed that the more participants liked the packaging color of a foodstuff, the sweeter the participants perceived its taste to be.

The results of our present study have important implications for liquid food packaging design and for liquid food presentations in bars and restaurants. The outcomes mean that liquid food producers and providers should pay more attention to the dynamic consistency between tasting experiences and the materials of the packaging/containers that may affect them. They have the ability to change the taste of food products not only by direct means (altering the recipe), but also by indirect means: adjusting the packaging/container materials of the food. The results have also shown that compared to plastic and paper materials, glass material is better able to transfer the haptic perceptions of cold and ice (Experiment 1) and perceptions of ice (Experiment 2), which are essential for enhancing customers' taste experience of drinking on a hot summer's day. Imagine a very hot day when consumers crowd into a restaurant, ready to quench their thirst, but find only drinks contained in paper and plastic materials. However, on a very cold winter's day, the only way to boost the warming taste of a beverage would be to use materials that added components of wood and cotton.

Concluding, the results of the research reported here demonstrate that crossmodal correspondence really does exist between the taste of liquid food and the materials in which it is packaged. Our study also found that touching glass material conveys sensations of cold and ice (Experiment 1) and sensations of ice (Experiment 2). What will be needed in future research is to explore how haptic perceptions of other materials influence taste experiences and how particular hand-movement patterns influence other haptic perceptions (such as warmth and softness) (Lederman & Klatzky, 1987). Future research might also consider what ways individual differences in “need for touch” (NFT) while shopping affect brand judgments, choice preferences, and information searching as well as product evaluation (Peck & Childers, 2003a). We speculate that NFT would play a moderate role in the decision-making process in selecting food products.
role in influencing the haptic transfer of taste experiences, assuming that the participants who scored higher in NFT would be more affected by touching. In coming years, as trade networks grow, haptic perception will likely be taken more and more seriously, and studies about the crossmodal correspondence between touch and taste will be fruitfully used to enhance tasting experiences as well as to develop product loyalty, brand name, and brand differentiation.

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