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Sonic branding of meat- and plant-based foods: The role of timbre

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Declaration of conflict of interest

The authors declare that they have no conflict of interest to this work.

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Abstract

Despite the wide body of literature available on the sound symbolism of food, the role of timbre in influencing food perception is yet underexplored. Given the shared gender stereotypes between timbre (musical instruments) and foods, this research examined the relationship between masculine/feminine instruments and meat/plant attributes across four studies. We identified the masculine timbre-meat and feminine timbre-plant associations (Study 1), which hold even within the same food category (Study 2a and 2b). Interestingly, the feminine timbre-plant associations (vs. masculine) were found to be stronger at the implicit level (Study 3). Study 4 demonstrated that sogos created in feminine instruments activate the feminine concepts linked to plant appeal and results in enhancing these regardless of consumers' perceived pleasantness of the sogos. These insights suggest novel sonic branding strategies for brand managers, and advertisers in the plant-based (meat-alternative) food industry.

Keywords: Musical instruments; Timbre; Meat-based food; Plant-based food; Gender associations; Sonic logo

1. Introduction

“Brands are investing in sound like never before” (McCullough, 2021) and sonic branding is now a well-established branding strategy. A sonic logo or a brand’s sound signature (e.g., ta-dum of Netflix) is a brief melodic sound customised to represent a brand’s identity (Bonde & Hansen, 2013). Cook (1998) pointed out that a distinctive melody of one or two notes is sufficient to sync social and cultural values with a product. Given that, sonic logos (sogos) are capable of brand signalling in a way other audio assets (e.g., in-store music) cannot. Sogos help brands stay connected with consumers even when the brands are not visible (Bonde & Hansen, 2013); resonate with the brand personality and thus improve brand recognition (Bonde & Hansen, 2013; Mas, Bolls, Rodero, Barreda-Ángeles, & Churchill, 2021). Evidently, the number of brands using sonic identity has increased by 22% in the last year (McCullough, 2021; SoundOut, May 2021) and almost all leading brands (e.g., McDonald’s, Coca-Cola, Oreo) in the Food and Beverage (F&B) sector now use sonic logos (SoundOut, May 2021).

Despite this, how firms can use sogos to connote product attributes associated with the nature of the food (i.e., meat or plant; the latter is collectively used here to refer to fruits, vegetables, legumes, and mushrooms) is yet unclear. This issue is gaining importance as there is a global trend to embrace more plant-based food products (Vegan Society, 2021) and with this trend, firms need to identify attributes (e.g., sogos) which can enhance inherent food attributes. Another research gap lies in the demonstration of sogos that can influence the perception of meat or plant-based attributes of foods. This is surprising as extant literature in sound symbolism has demonstrated that the manipulation of musical parameters (e.g., frequency, loudness, timbre, melodic consonance, legato articulation, and mode) can alter sensory perceptions (e.g., tastes,

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flavours, aroma, texture, creaminess, crispiness, healthfulness, and temperature to name but few) of a variety of foods and beverages (e.g., ice-cream, cinder toffee, coffee, beer, wine, chips, apple, chocolate) (e.g., Crisinel, Cossier, King, Jones, Petrie, & Spence, 2012; Crisinel & Spence, 2010; Demattè et al., 2014; Kantono et al., 2019; Knoferle & Spence, 2012; Reinoso Carvalho et al., 2016; Spence & Wang, 2015; Techawachirakul, Pathak, & Calvert, 2022; Wang & Spence, 2017; Zampini & Spence, 2004; see Spence, 2015; Spence, Reinoso-Carvalho, Velasco, & Wang, 2019 for a review). However, there remains little understanding of how timbre can affect the perception of foods, especially the nature of foods (i.e., meats vs. plant), leaving a notable gap in this research stream.

In addressing these research gaps, the purpose of the current study is to scrutinize the association between timbre (i.e., different musical instrumental sounds) present in sogos with the meat/plant attributes of foods and examine whether sogos created using putative feminine vs. masculine instruments can alter consumers' perception related to the composition of foods (i.e., their meat vs. plant nature). Given that musical instruments and foods share similar gender stereotypes, we assume that instruments perceived as masculine (vs. feminine) would be associated more with similarly stereotyped foods. We test this framework mainly by manipulating the instrument type (masculine vs. feminine) as the independent variable and perception of food type (meat- vs. plant-based food products) as the dependent variable. Our findings demonstrate that sogos created with masculine instruments are associated more with meat-based food products and those with feminine instruments with plant-based foods. Moreover, this research shows that feminine attributes present in sogos can enhance the perception of plant appeal. Nevertheless, the congruence between the instrument and food type does not affect the preference for associated foods.

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This research makes several contributions to literature and practice. Firstly, we advance the literature on sound symbolism by demonstrating that timbre is associated with meat/plant attributes of foods due to their shared semantic association with gender. Secondly, we add to the research on multisensory marketing by demonstrating that feminine-sounding instruments can enhance the perception of foods as plant-based. Lastly, we provide insight for practitioners in selecting brand attributes (e.g., slogans) that can promote the nature of food type (i.e., plant vs. meat).

2. Theoretical background

2.1. Branding for meat-based and plant-based foods

Prior research has found that the language used to describe products can enhance food appeal in meat- and plant-based food categories (Papies, Johannes, Daneva, Semyte, & Kauhanen, 2020). For example, products described as ‘plant-based’ are perceived as healthier and more eco-friendly than those described as ‘meat alternatives’ (Sucapane, Roux, & Sobol, 2021). Relatedly, although sustainability and healthfulness are different terms, consumers typically perceive sustainable plant-based food products as healthy due to the well-established halo effect (Schiano, Harwood, Gerard, & Drake, 2020).

Given the plant-healthy correlation, the effect of sensory cues on the perception of healthy foods has also been widely documented. In terms of visual cues, green (vs. red) packaging is more strongly associated with (healthier) plant- (vs. meat-) related products (Sucapane et al., 2021) and slim-shaped packaging increases the health appeal of a product compared to wide-shaped packaging (van Ooijen, Franssen, Verlegh, & Smit, 2017). Similarly, images of slimmer (vs. wider) striped bars are matched with healthier (vs. less healthy) foods

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(Techawachirakul et al., 2022). Moreover, visual cues indicating high (vs. low) placement (i.e., upward vs. downward camera angle) of a food product leads consumers to judge a product as healthier (Wang & Basso, 2021).

Concerning auditory cues, a recent study showed that classical music (vs. Jazz, Hip-hop, Rock/Heavy Metal) evokes positive valence and subsequently increases preferences for healthy savoury and sweet foods (Motoki, Takahashi, Velasco, & Spence, 2022). This finding may be attributed to the high frequency of sounds that shape consumer preferences and prompt them to select healthier meal options (Huang & Labroo, 2021; Motoki et al., 2022). This argument is consistent with other research supporting that high-frequency sogos are semantically congruent with the concept of healthy foods (Techawachirakul et al., 2022). These authors revealed that low-pitched sogos are matched with an unhealthy burger (i.e., bacon burger) and high-pitched sogos with a healthy salad bowl. However, this research stream has not yet examined the association between musical timbre with meat vs. plant attributes of food products.

2.2. Timbre and its role in crossmodal associations

Timbre is a focal construct for this study because it is a decisive element in sogos that facilitates brand recognition and without timbre, one would find it challenging to recognise melodies (Bonde & Hansen, 2013). Timbre is the primary feature of sound that enables listeners to differentiate sounds having similarly matched attributes (e.g., similarity in loudness, and frequency) (McAdams & Giordano, 2015). Put simply, it helps us distinguish the sound of a piano from the sound of a flute, or violin. Timbre also influences consumer preferences when it fits with consumers' regulatory focus (Sunaga, Meng, & Zhuang, 2020). Thus, we operationalised the timbre of the musical instrument in the current research.

Several multisensory studies have now provided evidence that different musical instrumental sounds can play a crucial role in shaping sensory experiences in all five senses (e.g., taste, flavour, aroma, colour, shape, roughness) (e.g., Adeli, Rouat, & Molotchnikoff, 2014; Bronner et al., 2012; Crisinel & Spence, 2010; Guest, Catmur, Lloyd, & Spence, 2002). For example, participants matched musical notes played on a piano with sweet tastes and fruity aromas (e.g., raspberry, blackberry, and apricot), and those on brass instruments with bitter and sour tastes, as well as musky, smoky, and woody aromas (see Spence et al., 2019 for a review). In terms of aesthetic packaging, piano sounds (i.e., soft timbres) have been shown to be associated with cool colours (e.g., blue, green) and rounded shapes. In contrast, cymbal sounds (harsh timbres) are matched with warm colours (e.g., red, yellow) and angular shapes (Adeli et al., 2014). Moreover, instrumental timbre has also been shown to shape consumer choices. For example, when music with Spanish (vs. Italian) instruments was played in a university canteen in North America, students and faculty selected a Spanish meal (seafood paella) over an Italian meal (chicken parmesan) (Zellner, Geller, Lyons, Pyper, & Riaz, 2017).

2.3. Cognitive schemas of gender-stereotyped instruments

A large body of research has shown that musical instruments can be categorized into masculine and feminine subtypes based on the repeated co-occurrence of certain instruments with musicians of specific gender (e.g., Cramer, Million, & Perreault, 2002). The gender associations of instruments are possibly formed after observing that certain musical instruments are typically selected by male or female musicians. For example, brass (e.g., tuba) is mostly played by male musicians, while high woodwinds (e.g., flute) by females (Cramer et al., 2002). Consistent with another study linking gender roles to musical activities, boys commonly selected the tuba, trombone, bass, guitar, and percussion as their primary performing instruments whereas

girls typically selected the flute, oboe, and bassoon (Harrison & O'Neill, 2003). In fact, the association of musical instruments with gender stereotypes forms early in life and persists in adulthood (Abeles, 2009; Wrape, Dittloff, & Callahan, 2016). Given this evidence, it suggests that people develop cognitive schemas for instruments marked as masculine (vs. feminine) via the process of learned association. Therefore, based on the prevailing gender stereotypes, we classified brass (e.g., saxophone, trumpet, trombone, tuba) as masculine instruments whereas high woodwinds (e.g., flute, oboe, clarinet) and violin as feminine ones (Abeles, 2009; Elliot & Yoder-White, 1997; Eros, 2008; Hallam, Rogers, & Creech, 2008; McLeod, 2009; Stronsick, Tuft, Incera, & McLennan, 2017). It is important to note that although we categorized instrument type as masculine and feminine, we refer only to the sounds of those instruments as masculine and feminine (not masculine or feminine musical instruments per se).

2.4. Gender stereotypes of food

Similar to musical instruments, certain foods are typically considered masculine vs. feminine (Gal & Wilkie, 2010; Mooney & Lorenz, 1997; see Rodrigues, Gómez-Corona, & Valentin, 2020 for a review; Rozin, Hormes, Faith, & Wansink, 2012). Specifically, extensive research now suggests that meat is considered masculine, whereas vegetables, fruits, and dairy products as feminine in many countries (Jensen & Holm, 1999; Love & Sulikowski, 2018; Rozin et al., 2012; Ruby, 2012; Vartanian, Herman, & Polivy, 2007). For example, US and Turkish consumers commonly consider steak, hot dogs, and chicken wings as masculine, and salads, pasta, and ice cream as feminine (Ekebas-Turedi, Cilingir Uk, Basfirinci, & Pinar, 2021).

Gender stereotyping of foods possibly arises from gender role stereotypes (Rodrigues et al., 2020), specifically the ancient hunting/gathering roles of men and women in early history. The structuralist metaphor "wild male = weapons, hunting and killing" and "wild female =

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agriculture and fertility" is widely stated across cultures (LaFontaine, 1978; MacCormack, 1980). Historically, meat as a product of hunting was seen as a value meal and a limited resource. Successful hunters also gained privileged access to meat to symbolize higher social status and simultaneously reinforced their physical strength (Boesch, 1994; Gurven & Hill, 2009; Stanford, 1999). On the contrary, traditional female roles required less strength and therefore vegetables and fruits (as products of agriculture and gathering), and milk and eggs (as symbolic of female fertility), were considered the most feminine food products (Heisley, 1990). Apparently, meat was not only food for men, but a socially constructed symbol of virility, higher status/power, and masculinity (Kildal & Syse, 2017; Rothgerber, 2013), whereas vegetables/fruits were regarded as symbols of femininity (Kildal & Syse, 2017; Rodrigues et al., 2020; Rothgerber, 2013).

Besides gender roles, evidence from the cognitive perspective suggests that the masculine-meat association is established at the implicit level of cognitive processing. For example, participants respond more quickly when meat-related words are paired with strength-related attributes (e.g., virile, strong, powerful), which are related to maleness, than when paired with weakness-related attributes (e.g., diseased, weak, sick) (Love & Sulikowski, 2018). Similarly, the reaction time for meats (e.g., beef, pork) paired with masculinity (e.g., male names such as John, Robert) is faster than with femininity (e.g., Joan, Claire) (Kimura et al., 2009; Rozin et al., 2012).

It is noteworthy that despite the progress of gender equity in societies, the notion of food-gender association persists and plays a crucial role in signalling one's social identity through food choices (Rodrigues et al., 2020). According to social identity theory, individuals conform to group stereotypes to increase a sense of belonging and to differentiate themselves from those outside the group (Tajfel, 1981). Recent research suggests that individuals following vegan diets

were judged as more feminine (or unmanly) than those following omnivorous meals (Rozin et al., 2012; Thomas, 2016). Given that taking meat off the plate possibly leads to a more feminine association and decreased masculinity (Kildal & Syse, 2017; Rodrigues et al., 2020), men tend to avoid foods considered feminine (e.g., vegetarian, Rothgerber, 2013) due to the conflict with their social identity (Judge & Wilson, 2019; MacInnis & Hodson, 2017). Echoing prior research, males (vs. females) tend to have a more negative evaluation of foods linked with a dissociative (e.g., femininity) reference group (e.g., a steak labelled as a lady's cut) than a food labelled as non-gendered (White & Dahl, 2006). Taking these findings, we refer to masculine foods as meat-based food products and feminine foods as plant-based food products.

3. Overview of studies

According to the theory of spreading activation in semantic memory networks (Collins & Loftus, 1975), semantic concepts (nodes) are linked together bi-directionally in the large memory network. When one concept is activated or processed, it will stimulate a related concept within the network, and hence spread the activation to other corresponding concepts within the memory network. Given that the concepts of musical instruments and foods are semantically congruent in terms of gender ascriptions, hearing an instrumental sound could stimulate a gender-related concept, and then the activation spreads out to food that shares the same gender link. Therefore, we proposed that type of musical instrument (masculine vs. feminine) would be associated with the perception of food attributes (meat-based vs. plant-based) and conducted four studies to test this main hypothesis. The hypotheses for each study would be provided in corresponding studies.

Study 1 sought to provide evidence that songs with masculine (vs. feminine) sounding instruments are expected to be associated with meat-based (vs. plant-based) foods. In Study 2,

we extended the timbre-food associations *within* the same food category to validate the role of shared semantic associations between instrument-type and food-type. Study 3 tested the strength of the association between timbre and perceived food attributes at an implicit level by using a semantic priming paradigm. Study 4 aimed to demonstrate that the use of musical instruments can influence consumers' perception of plant attributes of an otherwise gender-ambiguous food and the perceived gender of the instrumental sounds underlies this influence.

4. Method

4.1. Participants

Participants in all the studies were recruited from the USA using the subject pool of Amazon Mechanical Turk. They were invited to take part in only one of the studies and were paid for their time and effort. Participants were required to indicate their consent at the beginning of the experiment. The sample size ($N \approx 60$ for each study) was calculated using G*Power 3.1.9 (Faul, Erdfelder, Lang, & Buchner, 2007) and demonstrated 95% power to detect a medium-sized effect (0.5 and 0.24) in Wilcoxon signed-rank tests (Study 1, 2a and 2b) and repeated measures (RM) ANOVA (Study 3). In Study 4, given power = .90, $\alpha = .05$ in within-subject mediation analysis, a sample size of $n \approx 100$ was estimated (Montaya, 2020).

All the studies were designed on Qualtrics online survey platform except Study 3 which was designed on the Inquisit 6 platform of Millisecond.com. The analyses were performed using IBM SPSS version 22.0 for Windows.

4.2. Sound stimuli

Fictitious sogos (Studies 1, 2, and 4) and 800 ms musical notes (Study 3) were used as auditory stimuli and were created using *Noteflight* (an online music composing application,

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www.noteflight.com) and *FL Studio* (a music production software). The timbre of the stimuli was manipulated at two levels (masculine vs. feminine musical instruments). The research was approved by the ethics committee of a large northern university in the UK.

5. Study 1

The purpose of this study was to examine the association between instrument type and food type at the explicit level. Given the shared traits of masculinity with masculine instruments and meat and femininity with feminine instruments and fruits/vegetables, we predicted that:

H1: Sogos with masculine (vs. feminine) instruments¹ would be associated more with meat- (plant-) based foods.

5.1. Participants

A total of 60 participants took part in this study. The data of three participants who provided the same answers for all the questions were excluded (*Males* = 34, *Females* = 22, gender unspecified = 1; *M_{age}* = 43.86 years, *SD* = 13.66, age range = 24 -70 years; omnivore = 51, vegetarian = 6).

5.2. Sogo stimuli

Twelve sogos were used in the study. Four sogos each were created with masculine (alto saxophone, trombone, trumpet, and tuba) and feminine instruments (clarinet, flute, oboe, and violin), and four sogos used as fillers were created with non-gender stereotyped instruments (bassoon, guitar, piano, xylophone) (Elliot & Yoder-White, 1997; Eros, 2008; Stronsick et al., 2017; Wrape et al., 2016) (see Table 1). Sogos with instrumental sounds of bassoon, clarinet, oboe, piano, trumpet, trombone, and violin were created using *Noteflight*. The others were

¹ It is important to note that throughout this article we refer masculine and feminine instruments as instruments whose sounds are perceived as masculine and feminine respectively.

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generated using *FL Studio* (*Saxophia* plugin for alto saxophone, *Morphine* plugin for flute, and *Sonatina Orchestra* for tuba and xylophone). The sogos were composed of a series of melodic notes taken from a published study (Techawachirakul et al., 2022) (C4 to B4 notes; frequency range 261.63 – 493.88 Hz; played at a moderate tempo of 90 beats per minute [bpm]: 6 seconds in duration). The loudness of sogos was normalized to -20 dB RMS using the *Audacity* software (<https://www.audacityteam.org/>). A sample of sogos can be found online at <https://soundcloud.com/musicclipss/sets/timbre>.

Musical instruments		
Masculine	Feminine	Neutral (Fillers)
Alto saxophone	Clarinet	Bassoon
Trombone	Flute	Guitar
Trumpet	Oboe	Piano
Tuba	Violin	Xylophone

Table 1. The list of instrumental timbre used in Studies 1 and 2 (masculine, feminine, and fillers). The instruments were classified following previous literature (Abeles, 2009; Elliot & Yoder-White, 1997; Eros, 2008; Hallam, Rogers, & Creech, 2008; McLeod, 2009).

5.3. Food stimuli

Twelve pairs of food items were selected and presented as text stimuli. Eight pairs of food items consisted of meat-based versus plant-based (i.e., fruits, vegetables, legumes) meals (see Table 2) (Ekebas-Turedi et al., 2021; Gal & Wilkie, 2010; Jensen & Holm, 1999; Kimura et al., 2009; Lipschitz, 2009; Rozin et al., 2012) and matched in gender-associated meal types (e.g., hamburger and pizza are perceived as masculine, whereas spaghetti is perceived as feminine; Ekebas-Turedi et al., 2021) and perceived healthfulness (e.g., a sandwich is considered healthier than hamburger; Mooney & Amico, 2000). Another four pairs of food items acted as fillers and consisted of beverages and desserts with no prior known gender associations.

Food items	
Meat-based	Plant-based
Steak	Salad
Beef sandwich	Vegetable sandwich
Ham burger	Mushroom burger
Grilled pork	Grilled corn
Meatball spaghetti	Tomato spaghetti
Beef stew	Lentil stew
Bacon pizza	Tomato pizza
Corned beef	Baked beans

Table 2. The list of food items used in Study 1.

5.4. Design and procedure

The experiment used a one-way within-participant design in which musical instruments were manipulated at two levels (masculine vs. feminine). Participants were told that a food company wanted to select different sogos for products that are equally tasty, healthy, and attractive. Participants were then instructed to listen to a fictitious sogo and select the food items (using a forced choice task) that they felt it was best suited for each trial. Each sogo was played automatically, one at a time and was followed by the presentation of food items (randomized). There were 12 trials in total, lasting for approximately four minutes. The target trials comprised eight sogos where gender-associated musical instruments were randomly paired with eight gender-associated food pair choices (one food item each was randomly selected from the meat- and plant-based food pool). The filler trials consisted of four sogos created with gender-neutral instruments and paired with four gender-neutral food choices. The food pairs were displayed in a random order (left vs. right) and were counterbalanced within-participant.

5.5. Results and discussion

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Meat-based choices were coded as 1 and plant-based choices as 0, summing scores (ranging from 0 – 4) across masculine instrument conditions and feminine instrument conditions for each participant. These were then converted to percentages to create two meat-choice indices (one for each instrument type). A Wilcoxon signed-rank test was then used to compare the indices between masculine versus feminine instrument conditions. The results revealed that participants expected the sogos created using masculine (vs. feminine) instruments to be associated with meat-based (vs. plant-based) foods ($M_{\text{masc timbre}} = 61.40\%^2$, $SD = 20.63$; $M_{\text{fem timbre}} = 37.71\%$; $SD = 27.60$; $z = 4.19$, $p < .001$, $r = .39$) (see Table 3 and Figure 1), supporting H1.

Data were also separately analysed for each type of instrument (i.e., masculine and feminine). For each instrument type, two choice indices (meat and plant) were created following the method mentioned above. Then, two Wilcoxon signed-rank tests (one for each instrument type) were used to compare the meat-choice versus plant-choice indices. The results revealed that participants expected sogos played in masculine instruments to be associated more with meat-based than plant-based foods ($M_{\text{meat}} = 61.40\%$, $M_{\text{plant}} = 38.60\%$, $SD = 20.63$; $z = 3.67$, $p < .001$, $r = .34$), and those played in feminine instruments which were associated more with plant-based than meat-based foods ($M_{\text{meat}} = 37.71\%$, $M_{\text{veg}} = 68.28\%$, $SD = 27.60$; $z = 3.01$, $p = .003$, $r = .28$) (see Table A.1 in Appendix A for analyses by instruments).

Consistent with our prediction, the results showed that sogos created with masculine instruments were expected to be associated with meat-based foods and those with feminine instruments with plant-based foods. These findings provide initial evidence of the association between instrumental timbre and food attributes. Study 2 aimed to further examine whether this

² M is the averaged proportion of trials that participants selected for meat-based over plant-based foods.

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association holds within the same food-category type (animal-based foods and plant-based foods).

Accepted MS

Table 3*Summary of effects of instrumental timbre (masculine vs. feminine) on food perception*

Study	<i>n</i>	Dependent variable	Mediator	Masculine instruments	Feminine instruments	<i>p</i>	
				<i>M(SD)</i>	<i>M(SD)</i>		
1	57	% selecting meat-based diets		61.40% (20.63)	37.71% (27.60)	< .001	
2a	59	% selecting masculine animal-based foods		65.79% (25.28)	35.96% (25.00)	< .001	
2b	60	% selecting masculine plant-based foods		66.25% (24.28)	38.33% (24.12)	< .001	
3	62	Response latencies to non-vegetarian words (milliseconds)		593.41 (70.81)	599.09 (73.51)	.104	
		Response latencies to vegetarian words (milliseconds)		605.83 (71.46)	596.76 (74.58)	.038	
				Effect of IV on mediator (<i>a</i>)	Effect of mediator (<i>b</i>)	Indirect effect (<i>ab</i>)	95% CI
				<i>b (SE)</i>	<i>b (SE)</i>	<i>b (SE)</i>	
4	98	Perception of plant appeal	Perceived gender	42.91 (3.76)***	.40 (.13)**	17.35 (5.61)	[6.53, 28.39]
				Congruence	Incongruence		<i>p</i>
				<i>M(SD)</i>	<i>M(SD)</i>		
4	98	Food preference for masculine instrument		57.70 (29.48)	68.00 (21.00)		.071
		Food preference for feminine instrument		55.85 (28.98)	60.08 (26.18)		.532

*** $p < .001$, ** $p < .01$.

6. Study 2

Study 1 demonstrated the association of sogos created with masculine (vs. feminine) instruments with meat-based (vs. plant-based) foods. It is likely that the results might have been affected by the choice of food category itself (e.g., it is likely that prior timbre-food associations exist for certain foods and consumers associate meat- vs. plant-based foods with a certain type of music). We thus conducted Study 2 to extend these findings to within the same food category, having a varying degree of perceived masculinity and femininity (e.g., within meats, beef is perceived as more masculine than fish; Rozin et al., 2012, and within plants, potato is considered as more masculine than peach; Heisley, 1990). If our hypothesis holds, a similar timbre-food association could be extended to within-one food category itself. Consequently, we selected two food categories, animal-based (Study 2a) and plant-based products (Study 2b), with varying masculinity and femininity appeals within. The experimental design and procedure were similar to that used in Study 1. We hypothesized that:

H2a: Sogos with masculine (vs. feminine) instruments would be associated more with masculine (vs. feminine) animal-based foods.

H2b: Sogos with masculine (vs. feminine) instruments would be associated more with masculine (vs. feminine) plant-based foods.

6.1. Study 2a (Animal-based foods)

6.1.1. Participants and procedure

A total of 59 participants took part; data of two participants were excluded³ (*Males* = 29, *Females* = 26, gender unspecified = 2; *M_{age}* = 41.23 years, *SD* = 12.03, age range = 22 -73

³ One participant completed the study in more than 12 minutes (whereas the average completion time is around 4 minutes (*SD* = 2) and the other participants provided the same response to all the questions.

years; Omnivore = 49, Vegetarian = 8). Animal-based food items were selected from a pretest and used as stimuli (see Appendix B for the pretest). The procedure was similar to Study 1.

6.1.2. Results

Following the method in Study 1, masculine food choices were coded as 1 and feminine food choices as 0, scores were summed (ranging from 0 – 4) across masculine instrument conditions and feminine instrument conditions for each participant, then converted to percentages to create two masculine-choice indices (one for each instrument type). A Wilcoxon signed-rank test was then used to compare the indices between masculine versus feminine instrument conditions. The results revealed that participants expected the sogos with masculine (vs. feminine) timbre to be associated more with masculine (vs. feminine) animal-based foods ($M_{\text{masc timbre}} = 65.79\%^4$, $SD = 25.28$; $M_{\text{fem timbre}} = 35.96\%$; $SD = 25$; $z = 5.32$, $p < .001$, $r = .50$) (see Figure 1), supporting H2a. The results were not affected by consumption preference (i.e., omnivore or vegetarian eating habits)⁵.

We also analysed the responses in each instrument type (i.e., masculine and feminine) separately. Similar to the method in Study 1, two choice indices (masculine and feminine) were created for each instrument type. Then, two Wilcoxon signed-rank tests (one for each instrument type) were used to compare the masculine-choice versus feminine-choice indices. The results demonstrated that participants expected sogos created with masculine timbre to be more associated with masculine (than feminine) animal-based foods ($M_{\text{masc foods}} = 65.79\%$, $M_{\text{fem foods}} = 34.21\%$, $SD = 25.28$; $z = 3.98$, $p < .001$, $r = .37$), and those with feminine timbre to be more

⁴ M is the averaged proportion of trials that participants selected masculine over feminine food choices.

⁵ Though the data were not normally distributed and the sample size of vegetarians was inadequate, a repeated measures ANOVA was carried out with consumption preference as a covariate. No effect of consumption preference was observed ($F(1,55) = 2.18$, $p = .15$).

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associated with feminine (than masculine) animal-based foods ($M_{\text{masc foods}} = 35.96\%$, $M_{\text{fem foods}} = 64.04\%$, $SD = 25$; $z = 3.64$, $p < .001$, $r = .34$) (see Table A.2 in Appendix A for analyses by instruments).

6.2. Study 2b (Plant-based foods)

6.2.1. Participants and procedure

A total of 60 participants completed the study ($Males = 35$, $Females = 25$; $M_{\text{age}} = 41.98$ yrs., $SD = 13.25$, age range = 22 -77 yrs.; non-vegetarian = 56, vegetarian = 4). Plant-based items were selected from a pretest and used as stimuli (see Appendix B for the pretest).

6.2.2. Results and discussion

The method outlined in Study 2a was used to create the indices (one for each instrument type) and compare them between masculine versus feminine instrument conditions. A Wilcoxon signed-rank test revealed that participants expected the sogos played in masculine (vs. feminine) musical instruments to be associated more with masculine (vs. feminine) plant-based foods ($M_{\text{masc timbre}} = 66.25\%$ ⁶, $SD = 24.28$; $M_{\text{fem timbre}} = 38.33\%$; $SD = 24.12$; $z = 4.73$, $p < .001$, $r = .43$) (see Figure 1), supporting H2b. The results were not affected by consumption preference (i.e., omnivore or vegetarian eating habits)⁷.

We also analysed the responses to each instrument type (i.e., masculine and feminine) separately using the method mentioned in Study 2a. The results showed that participants expected sogos with masculine timbre to be more associated with masculine (than feminine) plant-based foods ($M_{\text{masc foods}} = 66.25\%$, $M_{\text{fem foods}} = 33.75\%$, $SD = 24.28$; $z = 4.27$, $p < .001$, $r =$

⁶ M is the averaged proportion of trials that where participants selected masculine over feminine food choices

⁷ Though the data were not normally distributed and the sample size for vegetarians was inadequate for the analysis, a repeated measures ANOVA was carried out with consumption preference as a covariate. No effect of consumption preference was observed ($F(1,58) = .90$, $p = .35$).

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.39), and feminine instruments to be more associated with feminine (than masculine) plant-based foods ($M_{\text{masc foods}} = 38.33\%$, $M_{\text{fem foods}} = 61.67\%$, $SD = 24.12$; $z = 3.43$, $p = 0.001$, $r = .31$) (see Table A.3 in Appendix A for analyses by instruments).

While Study 1 demonstrates the association of instrumental timbre and food types (meat-based and plant-based), Study 2 further validates this association within the same food categories. Specifically, masculine (vs. feminine) instrumental timbres were matched with foods rated higher in masculinity (femininity) in both animal-based and plant-based products.

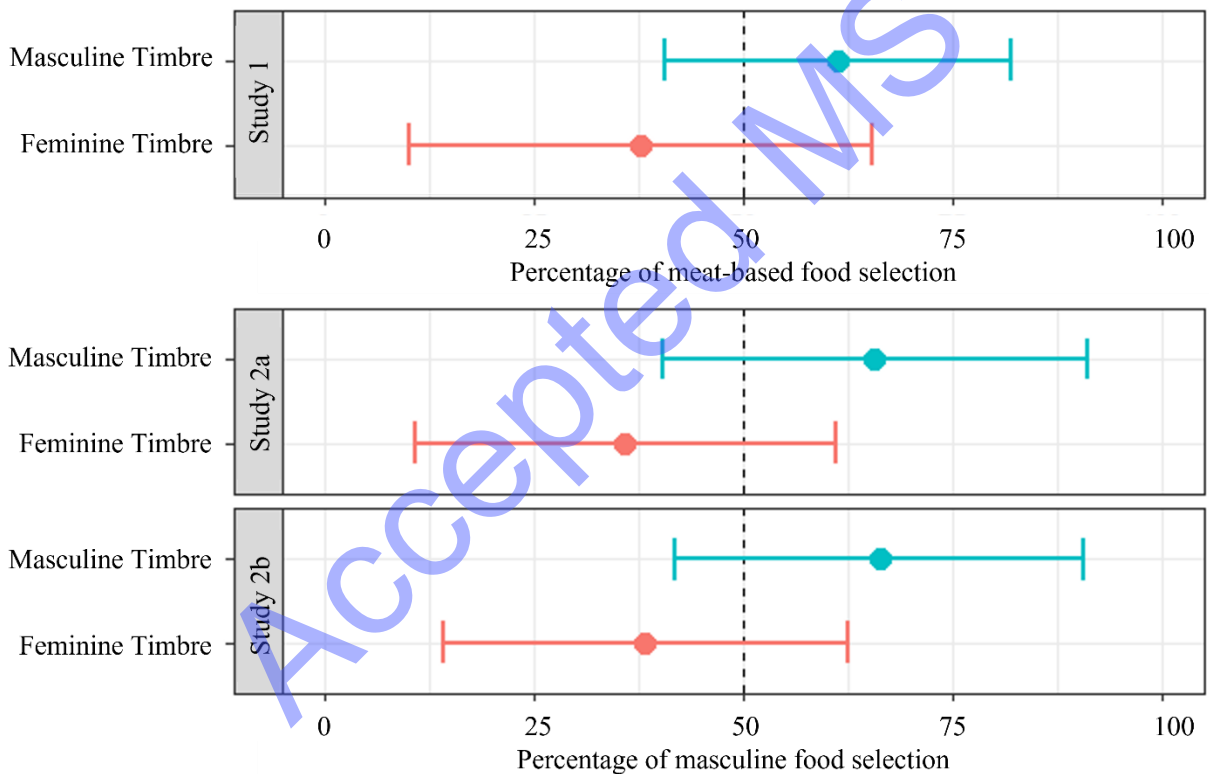


Fig. 1. An illustration of the results of food selection in each timbre type in Studies 1, 2a, and 2b. The percentage of meat-based (Study 1) and masculine (Studies 2a and 2b) food selection is shown on a 100-point scale. Dots represent the averaged percentage of food selections and the error bars indicate the standard deviation. Significant differences in matching meat-based foods with masculine timbres and plant-based foods with feminine timbres were observed in Study 1 ($p < .001$). Significant differences in matching masculine foods with masculine timbres and feminine foods with feminine timbres were observed in Studies 2a and 2b ($ps < .001$).

7. Study 3

We have so far provided converging evidence for the proposition that songs created with masculine (vs. feminine) instruments are expected to be associated with foods connoting masculinity (femininity) at an explicit level of consciousness (i.e., response to the survey/questions). Study 3 tested this association at the implicit level of processing using a semantic priming task. Such a measure focuses on the automatic activation of an evaluation (e.g., pleasant or awful) associated with a prime (e.g., flower vs. insects) (Fazio & Olson, 2003). It potentially explores the semantic associative network between schemas of musical instruments and food items occurring at an implicit level. Many marketing scholars have applied this technique to examine the unconscious processing of products and their associated attributes (Pathak, Calvert, & Lim, 2020). The task involves judging the connotation of the target. If the target words and the prime are semantically congruent, a faster latency response to the congruent conditions (vs. the incongruent ones) is observed. Therefore, we posited that if musical instruments can convey the masculinity and femininity of food products as observed in Studies 1 and 2, then it is likely that the same instrumental notes will be implicitly perceived as more congruent with one trait than the other. Hence, we hypothesized that:

H3a: Response latencies for non-vegetarian food items would be faster when preceded by masculine (vs. feminine) sound notes.

H3b: Response latencies for vegetarian food items would be faster when preceded by feminine (vs. masculine) sound notes.

7.1. Participants and stimuli

A total of 62 participants completed the study (*Males* = 34, *Females* = 28, M_{age} = 48.81 years, SD = 12.57, age range = 26 -76 years). The musical notes were composed with a C4 quarter note (frequency 261.63 Hz; tempo at 80 bpm) of 800 ms, including a 75 ms fadeout

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(Lahdelma, Armitage, & Eerola, 2020). To ensure the natural and realistic instrumental timbre, *Noteflight* was used to create the sound of clarinet, oboe, trumpet, and violin, and *FL Studio* was used to generate the sound of alto saxophone and tuba (*DSK Brass* plugin), flute (*Morphine* plugin), and trombone (*Sonatina Orchestra* plugin). All stimuli were normalised to -15 LUFS (i.e., the standard perceived loudness) using *Audacity* (<https://www.audacityteam.org/>), then amplified to 3.5 dB to control for amplitude difference arising due to timbre dissimilarity and to enhance the loudness (a sample of stimuli are available online at <https://soundcloud.com/musicclipss/sets/timbre-traits-c4-note>). A total of eight musical notes (masculine vs. feminine instrument) were used as primes (masculine instrumental sounds: alto saxophone, trombone, trumpet, and tuba; feminine instrumental sounds: clarinet, flute, oboe, and violin). A total of 16 food words (taken from Study 2) were selected as targets (Non-vegetarian food words: sausage, beef, bacon, salami, pork, ham, bologna, and turkey; Vegetarian food words: peach, cherry, strawberry, plum, cantaloupe, grape, lettuce, and tomato).

7.2. Design and procedure

A 2 (instruments: masculine vs. feminine) x 2 (target words: non-vegetarian vs. vegetarian foods) repeated-measures experimental design was used (see Figure 2) (e.g., Lahdelma et al., 2020). The task involved categorizing the presented words in respective categories (non-vegetarian vs. vegetarian) by pressing the E and I keys on the computer keyboard. The key mapping (i.e., E = non-vegetarian and I = vegetarian) was continuously displayed on top of the screen and was counterbalanced between participants. Participants were presented with a series of words comprising food items. Each word presentation was preceded by a musical note of 800ms (see the section above). If a participant pressed a wrong key, an error message (a red cross) appeared on the screen which provided a cue to give a correct response. A

few instructions were given aurally to ensure compliance with the speaker/headphone requirement in the study. Participants were asked to be as fast and accurate as possible and were familiarised with the task in a practice block of 10 practice trials. The main task comprised one block of 128 trials (8 musical notes x 16 types of foods). Each trial comprised a fixation cross that appeared for 500 ms, followed by a musical note (800 ms). At 200 ms after the onset of the musical note, the target word (non-vegetarian vs. vegetarian food items) was displayed and remained in the centre of the screen for 2000 ms during which participants can make a response (Figure 2; see Lahdelma et al., 2020 for a similar approach and experimental design using musical notes).

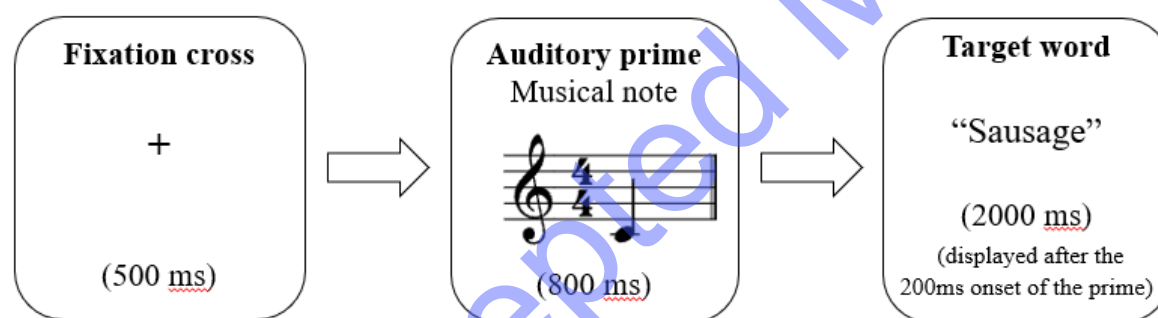


Fig. 2. The procedure of semantic priming used in Study 3.

7.3. Results and discussion

All response latencies between 250 ms and within 2 SD were log-transformed and analysed ($M_{\text{correct response}} = 95.8\%$, $SD = 3.76$) (Hermans, De Houwer, & Eelen, 2001; Lahdelma et al., 2020). There were no significant main effects of the instrument type ($F < 1$, $p > .5$) and the food type ($F = 1.13$, $p = .29$). Importantly the interaction between the instrument type and the food type was found to be significant, $F(1, 61) = 7.69$, $p = .007$ revealing a congruency effect of the instrument type on the faster detection of the type of food words. Post-hoc tests confirmed that the reaction times to words related to vegetarian food were significantly faster

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when the words were preceded by musical notes from feminine instruments ($M = 596.76$ ms, $SD = 74.58$), than when preceded by musical notes from masculine instruments ($M = 605.38$ ms, $SD = 71.46$; $t(61) = 2.12$, $p = .038$) (see Figure 3), supporting H3b. Similarly, reaction times to words related to non-vegetarian foods were faster when the words were preceded by musical notes from masculine instruments ($M = 593.41$ ms, $SD = 70.81$), than when preceded by musical notes from feminine instruments, though not significantly ($M = 599.09$ ms, $SD = 73.51$; $t(61) = 1.65$, $p = .104$), rejecting H3a.

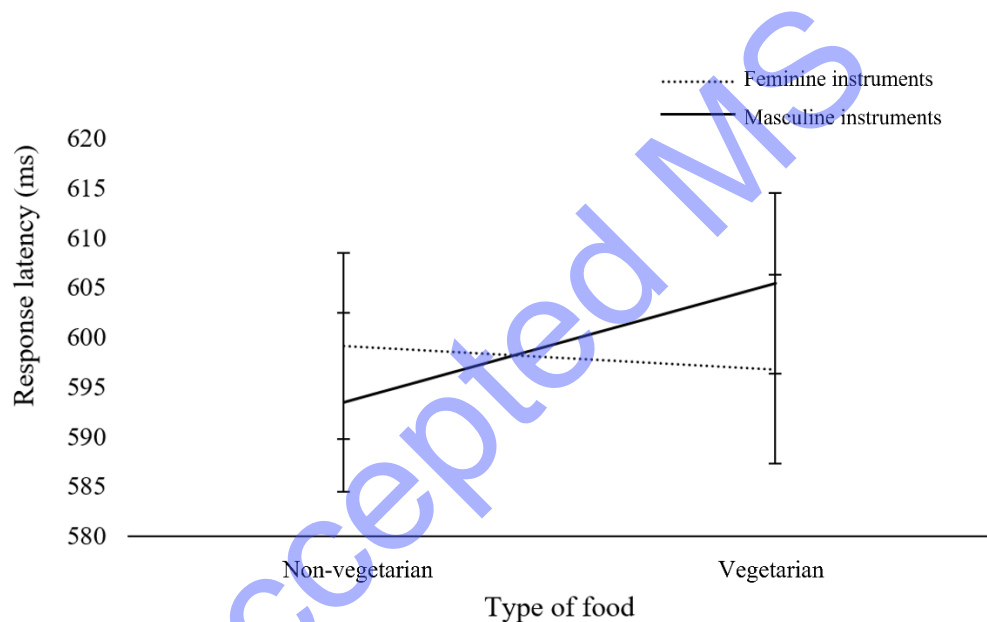


Fig. 3. Response latencies of Study 3 and the interaction of the musical instrument type and the type of word. Error bars represent the SE of means.

Study 3 confirmed the implicit semantic association between instrument type and food type. Specifically, participants responded more quickly to plant-based food items when they were primed with feminine instrumental notes than when primed with masculine instrumental notes. While the differential reaction times toward meat-based food items (faster responses to masculine food items when primed with masculine instruments) trended in the same direction, this did not meet statistical significance.

8. Study 4

Given that the association between feminine instruments and plant-based foods are stronger than those between masculine instruments and meat-based foods, we thus focused on the relationship between feminine instruments and the perception of plant-based attributes (also called plant appeal in the current paper) only and did not test the relationship between masculine instruments and perception of meat appeal. Specifically, we compared the perception of plant appeal between masculine and feminine instruments. Whether masculine instruments could increase the appeal of meat was not investigated in this study. We conducted this study to test whether feminine instruments can induce/enhance the perception of plant appeal in otherwise ambiguous foods and whether perceived gender of these cues drives the effect. We hypothesized that:

H4: Sogos created with feminine instruments would enhance the perception of plant appeal in ambiguous foods.

H5: Perceived gender of instrumental sounds would mediate the influence of feminine instruments on the perception of plant appeal.

We further examined the impact of congruency between instrument and food type on food preference. Previous studies have noted the positive impact of congruence between product attributes on the associated products (Sunaga et al., 2020; Wang, Zhang, & Jiang, 2022). For example, the congruence between angular shapes and healthy foods increases preference for the associated snacks (Wang et al., 2022). Consumers evaluate a product/service more favourably when the advertising message is congruent (vs. incongruent) with the timbre of background music (Sunaga et al., 2020). Hence, we hypothesized that:

H6: The congruence of instrument type and food type would increase the preference for the associated foods.

8.1. Participants

One hundred participants were recruited for this study; data of two participants who spent more time ($> 2SD$ from the average completion time) and provided the same response to all the questions were discarded (*Males* = 45, *Females* = 52, gender unspecified = 1; M_{age} = 39.90 years, SD = 12.55, age range = 22 - 66 years).

8.2. Sogo stimuli

In this study, new sogos were created for two reasons. Firstly, to increase generalizability, we used notes different from those used in earlier studies to create the sogos. Secondly, to enhance the ecological validity of this study, we created melodies with characteristics similar to those used in commercial sogos, which consisted of five notes with a wave-like pattern (Anzenbacher, 2016; SoundOut, 2021). Two sogos were selected after a pre-test (see Appendix C) to ensure that likability, pleasantness, and familiarity of the sogos were controlled (one created with a tuba and another with a flute with 130 bpm using the tools and procedure described in Study 3; samples of the sogos are available online at https://soundcloud.com/musicclipss/sets/s5a_timbre).

8.3. Procedure

We used a within-subject design in which we manipulated instrument type into two levels (masculine vs. feminine). Sogos created with tuba and flute were used as masculine and feminine stimuli (see Table A.1 – A.3 in Appendix A).

Participants were informed that a food company wants to select food adverts where sogos and foods are matched perfectly. Each trial started with one of the sogos being played for a few

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seconds, followed by the image of a burger to ensure that participants listened to the whole sogo tune. The image stimuli comprised images of burgers that were neutral in meat and plant-related attributes/appearance (i.e., ambiguous in food composition [meat vs. plant]). The images were selected after a pretest to ensure that the appearance of the images was matched (see Appendix D).

Next, participants evaluated food attributes using a VAS scale on the perception of plant appeal (what type of burger they think it is; 0 = Definitely meat, 100 = Definitely vegetable). After they had identified their perception of plant appeal, they then rated their food preference (how much they like the burger advertised with the sogo; 0 = Not at all, 100 = Very much). Later, participants also rated how masculine or feminine the sogos were (0 = Very masculine, 100 = Very feminine) and how pleasant the sogos were (0 = Not pleasant at all, 100 = Very pleasant). The anchors of the rating scales were counterbalanced between participants.

8.4. Results

Manipulation checks for the perceived gender of the instrumental sounds. A paired-sample *t*-test showed that the sogo created with the flute was perceived as feminine ($M_{flute} = 78.26, SD = 16.34$) and the sogo created with tuba as masculine ($M_{tuba} = 35.35, SD = 30.87; t(97) = 11.42, p < .001, d = 1.15$).

Perception of plant appeal. An RM ANOVA was performed, with instrument type as the IV, food perception as the DV, and controlled for the pleasantness of the instrumental sounds ($p > .14$). The results revealed that the burger image when presented with flute sogo was rated as a vegetable burger ($M_{flute} = 59.64, SD = 29.97$) more than when presented with tuba sogo ($M_{tuba} = 38.45, SD = 31.34; F(1,95) = 10.89, p = .001, \eta_p^2 = .10$), supporting H4.

Mediation. We performed a mediation analysis (MEMORE macro, Model 1; Montoya & Hayes, 2017), with instrument type as the IV, perception of plant appeal as the DV, and perceived gender of the instrumental sounds as the mediator, to investigate how the perceived gender mediates the relationship between the instrument type and perception of plant appeal. The indirect effect of the perceived gender was estimated using 95% percentile bootstrap intervals with 5000 bootstrap samples. In support of H5, the results showed that the direct effect of the instrument type on the perception of plant appeal was not significant ($b = 3.84$, $SE = 6.84$, $t(95) = .56$, $p = .58$). Indirect effect of the instrument type on the perception of plant appeal through perceived gender of the instrumental sounds was significant ($b = 17.35$, $SE = 5.61$, 95% CI [6.53, 28.39]). Specifically, the flute was rated as more feminine ($b = 42.91$, $SE = 3.76$, $t(97) = 11.42$, $p < .001$) and the perceived femininity was positively related to the perception of plant appeal ($b = .404$, $SE = .13$, $t(95) = 3.11$, $p = .002$) (see Figure 4). This indicated that the feminine attribute of the instrumental sounds fully mediated the relationship between the instrument type and perception of plant appeal.

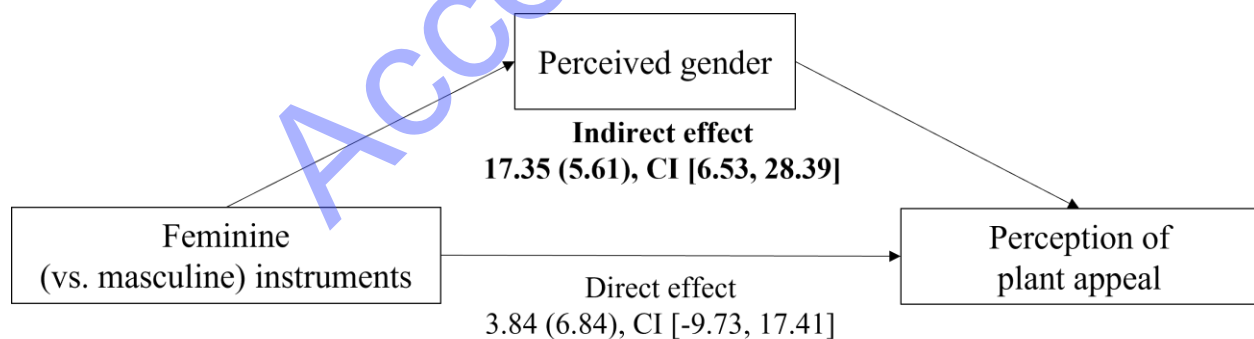


Fig. 4. The figures illustrate the mediating effect of perceived gender on the relationship between instrument type (masculine vs. feminine) and perception of plant appeal in Study 4. Unstandardized coefficients are represented. The values in parentheses indicate the standard error. The values in bold show significant effects at $p < .05$.

Food preference. First, the data in which tuba sounds were rated as more ‘meat’ and flute sounds were rated as more ‘vegetable’ were assigned as the congruence conditions and the opposite of this as the incongruent conditions. Next, the data of six participants who rated both

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instruments equally were excluded. Two independent sample *t*-tests were then performed (one for each instrument type) to compare preference for the burger between congruent versus incongruent conditions. For both types of masculine and feminine instruments, the results revealed that food preference did not differ between congruent and incongruent conditions, (Masculine instrument: $M_{meat} = 55.85$, $SD = 28.98$, $n = 67$; $M_{vegetable} = 60.08$, $SD = 26.18$, $n = 25$; $t(90) = .64$, $p = .53$, Hedges' $g = .15$; Feminine instrument: $M_{vegetable} = 57.70$, $SD = 29.50$, $n = 67$; $M_{meat} = 68$, $SD = 21$, $n = 25$; $t(60.40) = .07$, $p = .07$, Hedges' $g = .37$). The results rejected H_6 which suggests that the food preference between congruent and incongruent conditions was not any different.

8.5. Discussion

In this study, we demonstrated that slogans created with feminine (vs. masculine) instruments were perceived as more feminine, leading to the perception of 'plant appeal' in ambiguous foods. There was no influence of the pleasantness of sounds and the instrument-food congruence did not affect the preference for associated foods.

Considering that brand names could signal feminine attributes (Pogacar Angle, Lowrey, Shrum, & Kardes, 2021), we conducted follow-up studies on brand names to demonstrate that the feminine effect on food evaluation could generalize to another brand element (e.g., brand name, see Appendices E and F). The results showed the association between feminine brand names and plant-based meals (Appendix E) and a feminine brand name could enhance the perception of plant appeal in food (Appendix F).

9. Discussion

Despite the vast literature on correspondences between music and food attributes, scant research has examined the association between musical timbre (masculine vs. feminine) and the nature of food products (e.g., meat vs. plant). The current study provides the first evidence of the masculine timbre-meat and feminine timbre-plant association, and manipulation of instruments can induce a perception of desirable food attributes. We demonstrate that sogos with masculine instruments are more associated with meat-based foods, and feminine ones with plant-based foods (Study 1). This association holds even within the same food category. Specifically, sogos created in masculine (vs. feminine) instruments are expected to match with masculine (feminine) animal-based foods (Study 2a) and plant-based foods (Study 2b). However, the association between feminine instruments and plant items is stronger than between masculine instruments and meat items at the implicit level (Study 3). Accordingly, playing a sogo created with a feminine instrument (flute) helps enhance the plant appeal of the advertised foods due to the perceived femininity of the instrumental sound (Study 4).

9.1. 'Masculine timbre-meat' and 'feminine timbre-plant' correspondences in sogos

Although extant literature has noted that low-pitched sogos are matched with a bacon burger (less healthy) whereas high-pitched sogos with a spring salad (healthier), it is noteworthy that this association was investigated under the concept of healthfulness, and not as meat/plant attributes (Techawachirakul et al., 2021). Our findings identify a direct association between masculine timbre-meat and feminine timbre-plant. We first demonstrate this phenomenon using the same meal (e.g., sandwich) with different ingredients (e.g., beef vs. vegetable) and the results showed that masculine instruments are matched more with meat-based meals, and feminine instruments with plant-based counterparts.

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However, one may argue that this effect may be attributed to the food category itself. To support our argument, prior research proposed that meats and plants vary in gender association (Heisley, 1990). This notion is observed in our pretests. For example, for meats, we find that beef and pork are more masculine than fish and clam. This gender association may be developed due to the traditional men and women roles, whereby men hunted large animals and women gathered smaller animals (Bird, 1999). For plants, we found that peaches and strawberries are more feminine than potatoes and corn. This association is possibly based on their tastes and physical traits such as texture, shape, and size (Heisley, 1990). Specifically, masculinity within fruits and vegetables is thought of as hard, rough, long, large, dry, and grown in the dirt, whereas femininity is determined as soft, round, small, juicy, and sweet (Heisley, 1990). We thus extended our findings using foods within the same category and the results revealed that masculine (vs. feminine) instruments were associated more with masculine (feminine) foods regardless of the food category.

Drawing upon the convincing evidence, the shared semantic association between the features of timbre and food products can account for the timbre-food correspondence. We propose that sogos played by brass instruments and meat-based products are preferably mapped because both features connote masculinity, whereas those played by high woodwinds are preferably matched with plant-based products because they both connote femininity. Consequently, hearing a sogo played by a brass instrument (vs. flute, for instance) stimulates a masculine (feminine) concept, and activation then spreads to a meat (plant) item, consistent with the theory of spreading activation (Collins & Loftus, 1975).

To support this argument, we designed a semantic priming task to test the strength of semantic association. The findings concur with our earlier observations, showing the timbre-food

association at the implicit level. Nevertheless, it is somewhat surprising that the feminine timbre-plant association is stronger than the masculine-meat association, which implies that the latter association may be derived less from the shared trait of masculinity.

One possible explanation of the weak masculine-meat link relates to gender congruency consumption. Research suggests that men have a stronger desire (than women) to choose foods congruent with their gender identity, and women appear to be less concerned about food-gender congruency (Gal & Wilkie, 2010; Ye, Bose, & Pelton, 2017). Therefore, while men are less likely to accept vegetarian diets than women, women hold a favourable view towards meat in addition to vegetarian diets (Judge & Wilson, 2019; Love & Sulikowski, 2018; Rosenfeld & Tomiyama, 2021; Rothgerber, 2013). To some extent, meat thus is possibly viewed as a common food for both genders rather than being restricted to only masculine diets, which in turn weakens the connection with masculinity.

9.2. Femininity promotes plant appeal

Our findings further revealed that a sogo created in a feminine instrument can influence consumers' perceived plant appeal of food regardless of sogo pleasantness. The results are in accordance with prior literature which indicates crossmodal influences of music on the sensory experiences of foods (Spence, 2020; Spence & Wang, 2015). Our studies demonstrate that when the meat/plant properties are visually ambiguous, participants judge the burger as a vegetable in a significantly more intense way when the burger is presented with the feminine (vs. masculine) sogo. This phenomenon is mediated by the perceived femininity of the instrumental sound.

This finding could be attributed to the crossmodal priming effect (Spence, 2012) where the exposure to a stimulus in one sensory modality may prime expectations that crossmodally correspond with it, which in turn affects the sensory perception towards another stimulus that is

presented later (Spence, 2012; Deliza & MacFie, 1996). In our case, songs created using a flute (perceived as feminine) could have induced expectations (or primed ‘vegetable’) in consumers’ minds, and subsequently influenced the perceived plant appeal. This account is also in line with the existing evidence, for example, changing frequencies of music can modulate the taste perception of actual food items (cinder toffee) as the music frequencies share correspondences with the toffee (Crisinel et al., 2012). Given the results reinforce this perception pattern, the present research highlights the role of femininity in promoting plant appeal using popular communication tools such as songs.

9.3. The congruity effect on food preference

Although we suggested that the feminine cues influence the perception of plant appeal, it does not affect the preference for the associated foods. To illustrate, participants who paired the feminine cues with a vegetable burger (congruence) did not like the burger more than those who paired them with a meat burger (incongruence). The results are not surprising as the effect of congruence between product attributes on preference is mixed at best. Some research in marketing revealed that the congruence between attributes results in a preference for the foods (Wang et al., 2022), in contrast, other research on music and foods has shown that the congruence of music and foods did not affect food preference, though it influences food choices (Yeoh & North, 2010; Zellner et al., 2017).

There are two possible explanations for the lack of congruity effect on food preference: the initial preference for meat burgers over vegetable ones and the unfamiliarity with a vegetable burger. Firstly, some participants in the congruent condition, who judged the burger as a vegetable, might prefer meat (to vegetable) burgers in general. On the other hand, other participants who did not prefer either of the burgers might have been influenced by the priming

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of feminine cues (i.e., more pleasant). As the initial preference toward meat burgers is much stronger than vegetable burgers, their initial preference possibly outweighs the priming effect at the aggregated level. The other explanation is possible as the degree of familiarity may drive preference (Yeoh & North, 2010). Participants were probably less familiar with vegetable burgers than meat ones, leading to a lesser liking for vegetable burgers. Therefore, to examine the congruency effect on food preference, future research can consider a systematic manipulation of the congruence of music and foods to see whether the priming effect can play a role here. Also, consumers' food consumption and preference can be taken into account.

10. Research contributions

10.1. Theoretical contributions

The contribution of this research to the current literature is twofold. First, these findings advance the literature on sound symbolism by demonstrating a direct association between instrumental timbres (masculine vs. feminine) and food types (meat- vs. plant-based foods). The literature regarding sound-food correspondence has predominantly focused on aspects such as tastes, flavours, and healthfulness (see Spence et al., 2019 for a review). For example, music with high-pitched sounds is linked with healthy foods (Motoki et al., 2022; Techawachirakul et al., 2022). Although to some extent healthy foods refer to vegetables and fruits, our understanding of how sounds and music directly associate with the natural composition of foods (e.g., meat and plants) is sparse. Our findings enrich this research stream by presenting a novel perspective of masculine timbre-meat and feminine timbre-plant associations through their shared semantic association of gender.

Second, the present research adds evidence to the domain of multisensory marketing by demonstrating that sogos connoting femininity can promote the plant appeal of food products. Prior research on branding communications has examined different cues such as background music, brand names and packaging, that impact consumer perception (e.g., Huang & Labroo, 2020; Pogacar et al., 2021). Still, our understanding of how sogos can shape consumer perception is limited. Our research findings add to a growing body of literature on multisensory marketing by highlighting the influence of brand attributes (sogos and brand names) created with feminine cues on the plant appeal.

10.2. Managerial implications

Our research findings provide new insight for practitioners (e.g., food manufacturers, brand managers, advertisers, sogo and brand name developers) seeking a novel sensory branding strategy. Although consumers can visually distinguish meats from plants, the simultaneous use of sogos is advantageous to brands in many circumstances, such as in audio advertisements where brands and products are out of sight. Brands often invest in developing sogos that convey desirable brand attributes. Our findings suggest that if brands want to convey meat-related attributes, they should use brass (e.g., tuba, trombone) as the main instrument in their sogos. On the other hand, if brands want to convey plant-related attributes (vegetables/fruits), they should use high woodwinds (e.g., flute, clarinet) as the main instrument instead.

Another point to consider here is the emergence of plant-based ‘meat’ foods, which are combinations of plant (the ingredients) and meat attributes (the taste, texture, and appearance). Our findings suggest that using a sogo played by a flute can promote the appeal of plants in foods which may help consumers make an instant judgement regarding food properties without spending time reading the descriptors in the advert.

11. Limitations and future research

Firstly, past research has demonstrated the interactions and interference of timbre and pitch with each other so that participants do not selectively process one or the other alone (Allen & Oxenham, 2014; Caruso & Balaban, 2014; Stronsick et al., 2017). Although we carefully controlled frequency range by having all instruments play the same chord and octave, it is sometimes difficult to detach timbre and pitch; that is, some masculine instruments (e.g., tuba) naturally have a lower pitch range than feminine instruments (e.g., flute, oboe). One may argue that the pitch range at which an instrument is played may activate the mental associations of lower (vs. higher) pitches with masculinity (vs. femininity) (Pernet & Belin, 2012) which in turn can affect our results. However, Pernet and Belin (2012) pointed out that gender categorization relies on the pitch only when timbre information is androgynous. Given this, it is less likely that our results can only be accounted for by pitch alone, however, further investigation is needed into this issue. Secondly, we did not investigate the role of other dimensions in the differing timbres (e.g., semantic meanings, emotions). For example, feminine timbres appear to be rated lower in potency and arousal but higher in evaluation and positivity (compared to masculine timbres). The semantic/emotional associations (along with the femininity/masculinity) might have a role in the results and need to be further investigated. Thirdly, we could not find an adequate number of vegetarians in our sample to explore whether our results are affected by consumption preference (i.e., omnivore, non-vegetarian or vegetarian eating habits). Future research is needed to explore this issue further.

In conclusion, despite these limitations, our study adds new evidence directly linking the timbre of musical instruments with meat/plant attributes and provides primary guidance for

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brand managers in selecting a brand sound logo congruent with the featured attribute of the food product.

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Appendix A

Table A.1*Results of the Wilcoxon signed-rank test comparing the percentage of food selection (Study 1)*

Instruments	<i>M (%)</i>		<i>SD</i>	<i>z</i>	<i>p</i>
	Meat-based meals	Plant-based meals			
<i>Masculine</i>					
Sax	50.88	49.12	50.44	.90	.130
Trumpet	54.39	45.61	50.25	.66	.510
Trombone	68.42	31.58	46.90	2.78	.005
Tuba	71.93	28.07	45.33	3.31	.001
<i>Feminine</i>					
Violin	47.37	52.63	50.37	-.40	.690
Flute	22.81	77.19	42.33	-4.11	< .001
Clarinet	38.60	61.40	49.11	-1.72	.085
Oboe	42.11	57.89	49.81	-1.20	.230

*n = 57***Table A.2***Results of the Wilcoxon signed-rank test comparing the averaged percentage of animal-based product selection (Study 2a)*

Instruments	<i>M (%)</i>		<i>SD</i>	<i>z</i>	<i>p</i>
	Masculine food items	Feminine food items			
<i>Masculine</i>					
Sax	54.39	45.61	50.25	.66	.508
Trumpet	52.63	47.37	50.37	.40	.691
Trombone	80.70	19.30	39.81	4.64	< .001
Tuba	75.44	24.56	43.43	3.84	< .001
<i>Feminine</i>					
Violin	43.86	56.14	50.06	-.93	.354
Flute	22.81	77.19	42.33	-4.11	< .001
Clarinet	35.09	64.91	48.15	-2.25	.024
Oboe	42.11	57.89	49.81	-1.19	.233

n = 57

Table A.3

Results of the Wilcoxon signed-rank test comparing the averaged percentage of plant-based product selection (Study 2b)

Instruments	<i>M</i> (%)		<i>SD</i>	<i>z</i>	<i>p</i>
	Masculine food items	Feminine food items			
<i>Masculine</i>					
Sax	53.33	46.67	50.31	.52	.606
Trumpet	60.00	40.00	49.40	1.55	.121
Trombone	75.00	25.00	43.67	3.87	< .001
Tuba	76.67	23.33	42.65	4.13	< .001
<i>Feminine</i>					
Violin	40.00	60.00	49.40	-1.55	.121
Flute	25.00	75.00	43.67	-3.87	< .001
Clarinet	38.33	61.67	49.03	-1.81	.071
Oboe	50.00	50.00	50.42	.00	1.000

n = 60

Table A.4

Results of the paired samples *t*-tests comparing the average rating of food association (Study A)

Feminine - Masculine brand names	Food association		<i>t</i>	<i>p</i>	<i>d</i>
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)			
Nimilia - Nimeld	62.84(28.70)	52.25(28.42)	2.82	.006	.29
Tilna - Telric	57.27(30.89)	58.56(29.00)	.37	.715	.04
Seca - Siltac	58.01(30.80)	56.98(27.34)	.28	.777	.03
Nemri - Nelmin	57.49(27.78)	52.54(28.26)	1.55	.124	.16

n = 97

Appendix B

Pretest of Study 2

The objective of the pretest was to verify the masculinity and femininity appeal of animal-based and plant-based foods selected. 22 items each of animal-and plant-based foods were selected from previous literature (Heisley, 1990; Jensen & Holm, 1999; Levy, 1981; Rozin et al., 2012). Two separate pretests were conducted for animal-based and plant-based foods. Participants were shown the name of the food items (text stimuli) and were instructed to rate the extent they thought the food item was masculine or feminine (on a visual analogue scale [VAS] from 0 = very masculine to 100 = very feminine).

50 participants completed the pretest of animal-based food category (*Males* = 29, *Females* = 21; *M_{age}* = 39.18 years, *SD* = 11.87, age range = 23 - 70 years). Outliers outside 2SD were excluded; a one-sample *t*-test revealed that the following eight food items were perceived as masculine and feminine (masculine: sausage, beef, bacon, salami, pork, bologna, ham, turkey; feminine: yoghurt, cream, milk, egg, lamb, clam, butter, fish; see Table 5 for the statistical results). All perceived traits (masculine vs. feminine) differed significantly from the midpoint of 50.

Table B.1

Results of One Sample t-test showing perceived masculinity vs. femininity of the animal-based foods

Perceived trait	Food item	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Masculine	Sausage	20.25	20.67	47	-9.97	< .001
	Beef	21.09	16.37	46	-12.11	< .001
	Bacon	24.38	17.12	49	-10.58	< .001
	Salami	27.20	17.75	48	-8.99	< .001
	Pork	29.16	18.31	49	-8.05	< .001
	Bologna	34.66	17.27	46	-6.09	< .001
	Ham	35.08	20.19	49	-5.22	< .001
	Turkey	38.55	20.02	48	-4.00	< .001

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Feminine	Fish	58.00	14.81	45	3.66	.001
	Butter	58.94	18.23	48	3.43	.001
	Clam	59.74	17.52	46	3.81	< .001
	Lamb	61.81	19.84	47	4.12	< .001
	Egg	65.31	20.74	48	5.17	< .001
	Milk	65.98	21.93	48	5.10	< .001
	Cream	75.48	15.45	47	11.43	< .001
	Yoghurt	77.96	14.54	46	13.18	< .001

Another 50 participants were recruited for the other pretest of the plant-based food category; responses of four participants who provided the same rating for all questions were excluded (*Males* = 22, *Females* = 24; *M_{age}* = 40.57 years, *SD* = 11.93, age range = 24 - 74 years). Outliers outside 2 *SD* were excluded; a one-sample *t*-test revealed that the following eight food items were perceived as masculine and feminine (masculine: potato, onion, corn, mushroom, broccoli, green bean, bell pepper, asparagus; feminine: peach, cherry, strawberry, plum, cantaloupe, grape, lettuce, tomato; see Table 6 for the statistical results). All perceived traits (masculine vs. feminine) differed significantly from the midpoint of 50.

Table B.2

Results of One Sample t-test showing perceived masculinity vs. femininity of plant-based foods

Perceived trait	Food item	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>
Masculine	Potato	27.73	17.93	44	-8.33	< .001
	Onion	35.77	16.16	43	-5.84	< .001
	Corn	35.91	15.47	43	-6.04	< .001
	Mushroom	39.82	17.21	43	-3.92	< .001
	Broccoli	40.80	16.61	44	-3.71	.001
	Green bean	42.23	11.97	42	-4.25	< .001
	Bell pepper	43.49	13.41	42	-3.18	.003
	Asparagus	43.62	17.91	44	-2.39	.021
Feminine	Tomato	57.25	14.67	43	3.28	.002
	Lettuce	58.88	15.88	42	3.67	.001
	Grape	61.38	11.34	41	6.50	< .001
	Cantaloupe	63.86	13.48	41	6.66	< .001
	Plum	69.27	15.97	43	8.01	< .001
	Strawberry	75.80	12.70	44	13.63	< .001
	Cherry	79.00	14.95	44	13.01	< .001

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Peach	80.07	15.24	44	13.23	< .001
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Subsequently, the gendered animal-based and plant-based food items were selected for Study 2a and 2b respectively.

Accepted MS

Appendix C



Pretest of Study 4 – Sogo Stimuli

We conducted a pretest to ensure that all melodies used in Study 4 were controlled for likability, pleasantness, and familiarity of the tunes. As the majority of commercial sogos are composed of 5 notes (Anzenbacher, 2016) in a wave-like melodic pattern (i.e., notes up, down, and up and vice versa) (SoundOut, 2021), all the melodies in this study followed this pattern. We created 12 new and different tunes played in a piano using *Noteflight*. The tunes were of 2.5 seconds each and comprised five notes of Cmajor (C4 to B4) with moderate tempo (90 bpm). Loudness was normalised to standard perceived loudness (-15 LUFS) using *Audacity* (<https://www.audacityteam.org/>).

A total of 50 participants (*Males* = 24, *Females* = 22, 24, gender unspecified = 2; $M_{age} = 36.24$ years, $SD = 8.29$, age range = 24 -60 years) were recruited for a within-participants study. They were instructed to listen to 12 different tunes in random order and rated each of them on a VAS scale for likeability, pleasantness, and familiarity (0 = not at all, 100 = very much). Three paired sample *t*-tests (one for each attribute) revealed that no difference was found in the likeability ($t(49) = .14, p = .89$), pleasantness ($t(49) = .48, p = .63$), and familiarity rating ($t(49) = .82, p = .41$) in two melodies (see Table 7). Hence, these melodies were retained for Study 4.

Table C.1

Descriptive statistics showing the evaluations of melodies in the pretest

	Like	Pleasantness	Familiarity
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Melody 1 	43.96 (27.06)	45.86 (27.45)	34.48 (32.13)
Melody 2 	43.64 (25.51)	44.32 (25.76)	36.96 (31.39)

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Appendix D

Pretest of Study 4 – Food images

This pretest aimed to ensure that food images used in Study 4 were neutral in meat vs. plant appeal. We selected 15 images of ambiguous foods from online sources. The food images consisted of sausages, burgers, wraps, steaks, meatballs, tacos, and falafels. Participants were randomly presented with one image at a time and rated whether they thought the food is made of meat or vegetable on VAS (0 = Definitely meat, 100 = Definitely vegetable).

50 participants completed the pretest (*Males* = 25, *Females* = 25; M_{age} = 41.04 years, SD = 12.06, age range = 22- 77 years). A one-sample *t*-test was used to exclude foods that were significantly different from the midpoint of 50 as these would have implied obvious meat or plant appeal. Two burger images (see Figure D.1) that matched in the neutral attribute ($t(49) = .04$, $p = .96$, $M_{burger1} = 47.90$, $SD = 32.07$; $M_{burger2} = 48.06$, $SD = 29.13$) were finally selected for Study 4.



Fig. D.1. Both ambiguous burgers were used in Study 4 and only the right one was used in Study B.

Appendix E

Study A - Generalisation of feminine association with the plant-based meal: The case of brand name

As with sogos, firms invest considerable resources to craft a brand name that signals desirable brand attributes (Pogacar, Angle, Lowrey, Shrum, & Kardes, 2021). Prior research in linguistic symbolism has proved that sounds, stress, grammar, and length of brand name can convey the traits of masculinity and/or femininity and can subsequently influence brand perceptions and judgments (Klink, & Athaide, 2012; Mecit, Shrum, & Lowrey, 2021; Pathak & Calvert, 2020; Pogacar et al., 2021). Therefore, it is plausible to assume that brand names can also signal meat and plant attributes of food products.

In a follow-up study, we aimed to examine the association between the type of brand name (masculine vs. feminine) and food type (meat- vs. plant-based foods), and whether the congruence between the type of brand name and food type is the underlying mechanism. The significance of this study is twofold. First, it provides evidence of a direct association between brand names and meat and plant attributes. Second, it demonstrates that the gender effect observed in sogos generalises to other brand attributes such as brand names. We predicted that if the semantic correspondence between gendered cues and food type holds, this association should be observed with brand names. Thus, we used gendered brand names as proxies for the sogo stimuli used earlier and hypothesized that:

H1: Masculine (vs. feminine) brand names would be associated more with meat-based (vs. plant-based) foods.

H2: The congruence between the type of brand name and food type mediates the name-food association.

1.1. Participants

A total of 100 participants took part; data of three participants who spent time 3SD above the average completion time were excluded (*Males* = 59, *Females* = 38; *M_{age}* = 39.91 years, *SD* = 12.31, age range = 23 -71 years). Most participants were native English speakers, and two participants used Marathi and Tamil as primary languages.

1.2. Design and procedure

We used a one-way within-participant design in which brand names were manipulated at two levels (masculine vs. feminine). Gendered brand names from a prior study (Pogacar et al., 2021) were used; masculine names used were Nimeld, Telric, Siltac, and Nelmin, and feminine names were Nimilia, Tilna, Seca, and Nemri. The food stimuli were those used in Study 1 (see Table 2).

Participants were instructed to read the brand names out loud and select the food products that were best suited for those names. They then rated how strongly they thought the brand name matched the food. The evaluations were made on VAS (food association: 0 = Definitely [Name of meat-based food], 100 = Definitely [Name of vegetable-based food]; name-food congruence: 0 = No match at all, 100 = Perfectly matched) where the end-values (0 or 100) were invisible to the participants. There were 14 trials in total (including six trials with filler names), lasting for approximately three minutes. After the main task, they were presented with the target brand names again where they rated how masculine or feminine they thought the names were (0 = very masculine, 100 = very feminine). Then, they provided their demographic information. The presentation (left vs. right) of food names and the anchors of the masculine/feminine rating scale were counterbalanced between participants.

1.3. Results and discussions

Manipulation check. A paired-sample *t*-test revealed that feminine brand names were perceived as more feminine ($M_{fem} = 67.45, SD = 17.49$) and masculine brand names as more masculine ($M_{masc} = 38.86, SD = 17.82; t(96) = 12.13, p < .001, d = 1.23$).

Food association. A paired-sample *t*-test revealed that feminine brand names were associated more with plant-based foods ($M_{fem} = 58.9, SD = 18.43$) than masculine names ($M_{masc} = 55.08, SD = 18.05; t(96) = 2.22, p = .03, d = .23$) (see Table A.4 in Appendix A for analyses by names), partially supporting H1.

Perceived congruence between names and foods. Another paired-sample *t*-test was used to compare the averaged congruence between the type of brand name and foods. The results revealed that feminine brand names matched more strongly with plant-based foods ($M_{Fem} = 64.05, SD = 19.36$) and masculine names with meat-based foods ($M_{Masc} = 58.46, SD = 22.03; t(96) = 4.35, p < .001, d = .44$).

Mediation. A within-participants mediation analysis (MEMORE macro, Model 1; Montoya & Hayes, 2017) was performed with the type of brand name as the independent variable (IV), food association as the dependent variable (DV), and name-food congruence as the mediator, to investigate how the name-food congruence mediates the relationship between the type of brand name and food association. The indirect effect of the perceived congruence was estimated using 95% bias-corrected bootstrap intervals with 5000 bootstrap samples. In support of H2, the results revealed that the direct effect of the type of brand name on food association was not significant ($b = 2.08, SE = 1.86, t(94) = 1.12, p = .26$). Indirect effect of the type of brand name on food association through perceived congruence was significant ($b = 1.74, SE =$

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.78, 95% CI [.47, 3.52]). Specifically, the feminine (vs. masculine) brand names were rated as more matched with plant-based foods ($b = 5.60$, $SE = 1.29$, $t(96) = 4.35$, $p < .001$) and the congruence was positively related to the food association ($b = 2.08$, $SE = .14$, $t(94) = 2.26$, $p = .03$). These findings indicate that the name-food congruence fully mediate the relationship between the type of brand name and food association.

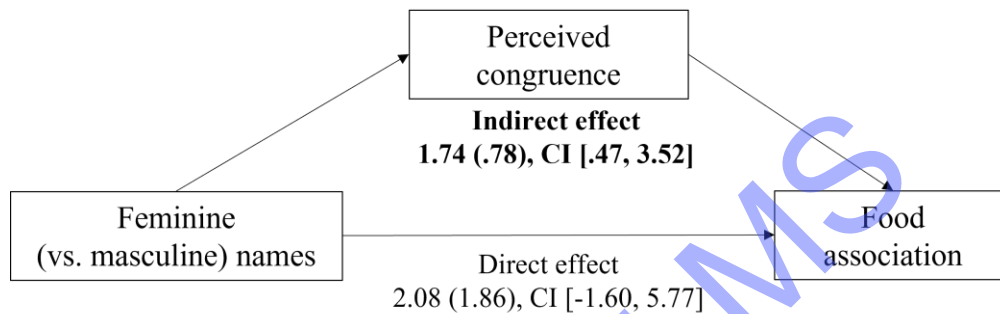


Fig. E.1. The figures illustrate the mediating effect of perceived congruence on the relationship between the type of brand name (masculine vs. feminine) and food association in Study A. Unstandardized coefficients are represented. The values in parentheses indicate the standard error. The values in bold show significant effects at $p < .05$.

This study demonstrated that feminine brand names were associated more with plant-based foods than masculine names because of a stronger congruence between feminine names and plants than between masculine names and meats. These findings affirm the generalization of our findings with sogos to another brand attribute (i.e., brand names). In a subsequent study (Appendix F), we would examine whether manipulation of brand names could alter the perception of food appeal.

Appendix F

Study B – The influence of feminine brand names on the perception of plant appeal

This study aimed to demonstrate that the effect of femininity on the perception of plant appeal could generalise to brand names. Thus, we hypothesized that:

H1: Feminine brand names would enhance the perception of plant appeal in ambiguous foods.

H2: Perceived gender of brand names mediates the influence of feminine instruments on the perception of plant appeal.

H3: The congruence of the type of brand name and food type would increase preference for the associated foods.

1.1. Participants and procedure

One hundred and four participants were recruited; data of one participant who spent 2 SD time above the average completion time was excluded (*Males* = 40, *Females* = 62, Gender not specified = 1; $M_{age} = 44.78$ years, $SD = 13.25$, age range = 22- 74 years). The procedure and design were similar to Study 4 where brand names were used as stimuli in place of slogans. *Nimilia* and *Nimeld* were used as masculine and feminine names (see Table A.4 in Appendix A)

1.2. Results

Manipulation checks for the perceived gender of the brand names. A paired-sample *t*-test revealed that the feminine brand name was perceived as more feminine ($M_{Nimilia} = 81.80$, $SD = 16.14$) and the masculine brand name as more masculine ($M_{Nimeld} = 32.70$, $SD = 26.81$; $t(102) = 14.08$, $p < .001$, $d = 1.39$).

Perception of plant appeal. A paired-sample *t*-test revealed that the burger image when presented with the feminine brand name was rated as a vegetable burger ($M_{fem} = 72.94$, $SD =$

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22.18) more than when presented with a masculine brand name ($M_{\text{masc}} = 66$, $SD = 24.34$; $t(102) = 2.83$, $p = .006$, $d = .28$), supporting H1. However, the feminine name was rated as more pleasant ($M_{\text{fem}} = 58$, $SD = 23.82$) than the masculine name ($M_{\text{masc}} = 40.36$, $SD = 26.98$; $t(102) = 6.59$, $p < .001$, $d = .65$), supporting prior studies that feminine names are generally perceived as more pleasant (Newman, Tan, Caldwell, Duff, & Winer, 2018; Pogacar et al., 2021; Stroessner & Benitez, 2019; Whissell, 2001).

Mediation. A mediation analysis (MEMORE macro, Model 1; Montoya & Hayes, 2017) was performed with the type of brand name as the IV, perception of plant appeal as the DV, and perceived gender of the brand names as the mediator, to investigate how perceived gender of the brand names mediates the relationship between the type of brand name and perception of plant appeal. The indirect effect of the perceived gender was estimated using 95% bias-corrected bootstrap intervals with 5000 bootstrap samples. In support of H2, the results showed that the direct effect of the type of brand name on the perception of plant appeal was not significant ($b = -1.26$, $SE = 4.51$, $t(100) = -.28$, $p = .78$). Indirect effect of the type of brand name on the perception of plant appeal through perceived gender was significant ($b = 8.21$, $SE = 3.89$, 95% CI [.30, 15.67]). Specifically, the feminine (vs. masculine) brand name was rated as more feminine ($b = 49.10$, $SE = 3.49$, $t(102) = 14.08$, $p < .001$) and the perceived gender was positively related to the perception of plant appeal ($b = .17$, $SE = .08$, $t(100) = 2.16$, $p = .03$) (see Fig. 3). This indicated that the feminine attribute of the brand name fully mediated the relationship between the type of brand name and perception of plant appeal.

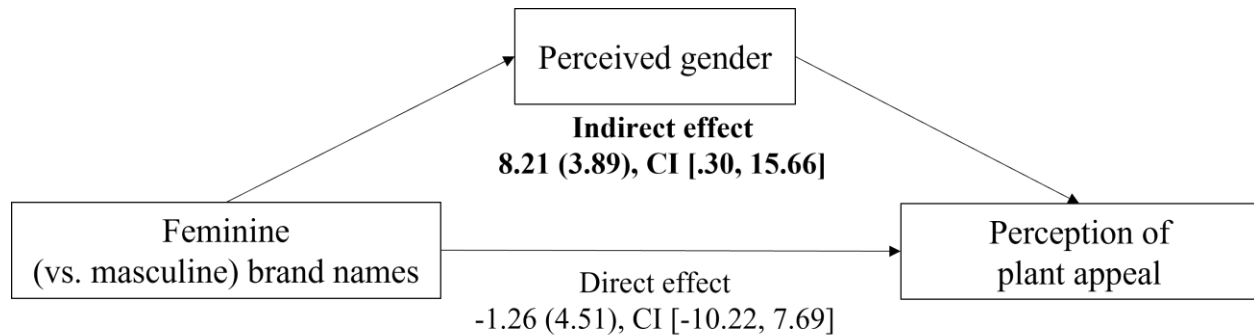


Fig. F.1. The figures illustrate the mediating effect of perceived gender on the relationship between instrument type (masculine vs. feminine) and food perception in Study B. Unstandardized coefficients are represented. The values in parentheses indicate the standard error. The values in bold show significant effects at $p < .05$.

Food preference. We used participants' food selection to create congruent and incongruent conditions. For the masculine brand name, data of those who selected it as a meat (vs. vegetable) burger were assigned as congruent (incongruent) condition. Similarly, for the feminine brand name, data of those who selected it as a vegetable (vs. meat) burger were assigned as the congruent (incongruent) condition. Two independent sample t -tests (one for each instrument type) were then performed to compare the food preference between the congruent vs. incongruent conditions. For the masculine brand name, the results revealed that participants in the congruent condition (i.e., selecting a meat burger for a masculine name) liked the burger more than those in the incongruent condition (selecting a vegetable burger more for a masculine name), $M_{meat} = 55.32$, $SD = 26.02$, $n = 25$; $M_{vegetable} = 34.10$, $SD = 26.72$, $n = 78$; $t(101) = .64$, $p = .001$, Hedges' $g = .80$. However, for the feminine brand name, the results showed that participants in the congruent condition (selecting a vegetable burger more for a feminine name) liked the burger less than those in the incongruent condition (selecting a meat burger more for a feminine name), $M_{vegetable} = 38.27$, $SD = 26.34$, $n = 85$; $M_{meat} = 71.44$, $SD = 25.35$, $n = 18$; $t(101) = 4.89$, $p < .001$, Hedges' $g = 1.27$. The results rejected H3.

The findings indicated that food preference differed between the congruent and incongruent conditions. However, we argue that these differences might have been influenced by

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the inherent meat preference of participants. Although most participants perceived the burger presented with a feminine name as a vegetable burger, their preference ratings were generally lower. As we did not ask participants about their consumption of meat vs. vegetables, their preference for meat and vegetable food products is likely a confound. It is likely that most participants had a preference for meat burgers over vegetarian burgers, which could have affected their preference for the food image stimuli where they generally rated all the images as ‘more meat’.

1.3. Discussion

Given convergent evidence of feminine instruments (Study 4) and brand names, the findings confirmed that femininity in gendered cues could enhance the perception of plant appeal in foods. Specifically, sogos with feminine (vs. masculine) instruments and feminine (vs. masculine) brand names were perceived as more feminine, resulting in the enhanced perception of plant appeal in ambiguous foods. Moreover, feminine attributes drive the effect of timbre and brand names on food perception. However, the congruence between gendered cues and food attributes does not affect the preference for associated foods.

Highlights

- Sonic logos played by masculine (vs. feminine) stereotyped instruments correspond with meat-based (plant-based) foods.
- The feminine timbre-plant association is more robust than the masculine timbre-meat association at an implicit level.
- Sonic logos with feminine instruments can enhance the perception of plant appeal embedded in meat alternative products.

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