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RUNNING HEAD: CONSTRUCTING HEALTHY FOOD NAMES

Constructing healthy food names:

On the sound symbolism of healthy food

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ABSTRACT

The interest in healthy food has grown rapidly amongst both consumers and food manufacturers in recent years. However, which foods should be considered healthy is sometimes ambiguous. Identifying those factors that influence the perception of healthfulness is of interest both to consumers and to food manufacturers. Previous research has shown that product-intrinsic (e.g., nutrition) and product-extrinsic (e.g., the colour of the packaging) factors can shape the consumers' perception of healthy food. However, it is less clear how brand names, one of the important product-extrinsic factors, influence perceptions. Relying on the theory of sound symbolism, we investigated whether the sounds present in fictitious brand names would influence the expected healthiness of food. Across four studies, we demonstrate that phonemic sounds with higher (vs. lower) frequencies (e.g., /f, s, i, e/ vs. /b, d, g, o, u/) are perceived to be healthier. Studies 1 and 2 demonstrate the phenomenon using general categories of "healthy" vs. "unhealthy" foods, whereas Studies 3 and 4 conceptually replicate the results using the names (or descriptions) of food products (e.g., "vegetable vs. beef sandwich") and a different study design (within-participants for Study 3 and between-participants for Study 4). We also explore the boundary conditions for this sound symbolic effect, demonstrating that higher (vs. lower) frequency sounds change the health perception of savoury food products, but not sweet ones (Studies 3 and 4). These findings provide actionable insights for those wanting to develop brand names for food products and reveal its important link with the consumers' perceptions of healthy food.

Keywords: Brand names; Sound symbolism; Healthy foods; Sensory marketing.

1. Introduction

Over the last decade, interest in the consumption of healthy food has grown amongst consumers, the food and beverage industry, and society at large (Annunziata & Vecchio, 2011; Beate & Spiller, 2014; Bigliardi & Galati, 2013; Karpyn et al., 2020; Martinez et al., 2018; Peeters, 2018). Although the objective criteria for what constitutes healthy food is still lacking, it is often defined as food with high nutritious quality (e.g., low calorie/sugar/sodium/saturated fat) (e.g., Lobstein & Davies, 2009). Consuming a diet rich in healthy food can reduce the risk of lifestyle diseases and promote the well-being of consumers (Swinburn et al., 2015; Wahl et al., 2017). Lifestyle diseases such as obesity, diabetes, and hypertension are now prevalent around the world (Lim et al., 2012), and these are at least partially the result of the excessive consumption of unhealthy foods (Lim et al., 2012). Across the world, governments are taking initiatives to encourage healthy eating habits amongst consumers by altering food policies (Hawkes et al., 2015; Reisch et al., 2017). With a growing consumer awareness, the demand for healthy foods has increased too (Grunert, 2006; Lee-Kwan et al., 2017). Given this background it is desirable for marketers to effectively communicate the healthfulness of food products by using various brand elements (e.g., packaging, brand names, etc.; Bigliardi & Galati, 2013; Menrad, 2003; Vila-Lopez & Küster-Boluda, 2020). Taken together, obtaining a better understanding of the factors associated with healthy eating and what is perceived as healthy is a topic of mutual interest to consumers, researchers, and food practitioners.

Perception of healthy food

The perception of healthy food (otherwise referred to as perceived healthfulness) have important downstream consequences including food purchase behaviour (Goetzke et al., 2014; Mai et al., 2016). The perception of a food's healthfulness can be defined as a composite of being perceived as high in nutrients, low in fat, and low in calories, in addition to being viewed as good for your body and globally healthy (Hagan, 2020 p2). A conceptual model of food choice suggests that consumers' expectations about a food (e.g., perceived healthfulness) are key determinants behind their food choice and preference (Furst et al., 1996). Perceived healthfulness is one of the main factors influencing food purchase behaviour (especially for health foods) (Goetzke, Nitzko, & Spiller, 2014; Steptoe, Pollard, & Wardle, 1995; Szakály et al., 2012). According to the research that has been published to date, the perceived healthfulness of a food is positively correlated with liking (Motoki et al., 2018; Werle et al., 2013, also see Raghunathan et

al., 2006) and willingness to pay a higher price (Plasek & Temesi 2019; Steinhäuser et al., 2019). Taken together, these findings suggest that perceived healthfulness is an important influencing factor in people's food purchase behavior.

Factors influencing the perception of healthy food

Previous research suggests that the perception of healthy food is influenced by a broad array of different factors such as, for example, ingredients (e.g., sugar, fat), product category (e.g., fruits, sweets), packaging (e.g., colour, shape), information (e.g., nutritional labels), origin of food (e.g., organic), sensory/non-sensory features (e.g., taste, portion size), and imputed/purported health benefits associated with eating specific foods (e.g., many people believe that blueberries are healthy, whereas breakfast cereals are generally thought to be unhealthy; e.g., Lusk, 2019; Plasek et al., 2020). Among these studies, the role of food-intrinsic factors (such as ingredients and product category) on the perception of healthy food has been investigated extensively (Plasek et al., 2020). For example, certain food categories such as fruit/vegetable are positively associated with perceived healthfulness, whereas sugar and fat content are negatively associated with perceived healthfulness (i.e., more sugar and fat is unhealthy) (Bucher et al., 2015, 2016). In a related vein, those foods containing vegetables/herbs (e.g., leafy green salad) are perceived as healthier than ones which contain high sugar and fat content (e.g., muffin) (Bucher et al., 2015; Spence, 2020b).

Role of brand names in influencing the perceived healthfulness of food

The brand name is one of the most important external cues for product evaluation and has been shown to affect the perceived quality of both products and brands (Dawar & Parker, 1994; Klink, 2000; Wänke et al., 2007), brand attitude (Klink, 2001, 2003; Zinkhan & Martin, 1987) and brand image (Park et al., 2020; Pathak et al., 2017, 2019; Pathak, Velasco, et al., 2020). Though the role of brand names in influencing the brand (and product) attributes has already been explored extensively, little attention has been paid to the role of brand names in bringing out the perception of healthy food (except perhaps for a few exceptions, e.g., Arredondo et al., 2009; Fenko et al., 2016).

Previous research has investigated the link between brand names and the perception of healthy food. Fenko and her colleagues investigated the effect of brand names (“Asahi”, “Ramune”) on the perceived healthiness of food products (Fenko et al., 2016), though they did not observe a significant role of the brand name. Potentially confounding matters somewhat, though, it is worth noting that Asahi is itself a famous brand name.

Arroyo and Arboleda (2021) have recently investigated the role of onomatopoeia in influencing the perception of beverage healthfulness. These authors reported that the sounds within the brand names (e.g., onomatopoeia) can alter the healthy perception of a beverage. To the best of our knowledge, except for these findings, little research has yet explored the mechanism and boundary conditions of the link between speech sounds and the perceived healthfulness of food. For example, previous research did not systematically manipulate the sounds of brand names (“Asahi” vs. “Ramune”; Fenko et al., 2016). We suspect that this may have led to the inconclusive findings that have been reported to date. Hence, by systematically manipulating the sounds of brand names, our aim in the current research, was to identify those speech sounds that may help to enhance people’s expectations concerning the healthfulness of a given food.

Sound symbolism and brand names

Sound symbolism refers to the non-arbitrary mappings that exist between phonetic sounds and their meanings (Knoeferle et al., 2017; Sidhu & Pexman, 2018) and has been shown to be an important factor behind the creation of many of the world’s most successful brand names (Abel & Glinert, 2008; Crisinel, Jones, et al., 2012; Gallace et al., 2011; Klink, 2000, 2001, 2003; Klink & Athaide, 2012; Klink & Wu, 2014; Ngo et al., 2011; Ngo & Spence, 2011; Spence, 2012, 2014; Spence & Gallace, 2011; Velasco et al., 2014). Sound symbolism has also been shown to be effective in altering the consumer perception across various food products (e.g., ice cream, beer), medications (e.g., medicine effectiveness), and even taste attributes (e.g., sweetness, bitterness, creaminess) (e.g., Abel & Glinert, 2008; Klink, 2000; Lowrey & Shrum, 2007; Motoki et al., 2020; Ngo & Spence, 2011; Ngo et al., 2011; Park et al., 2020; Pathak, Calvert, & Motoki, 2020; Pathak & Calvert, 2020; Yorkston & Menon, 2004). Despite the rich literature published in this field, research linking those sounds contained within a brand name with the perception of healthy food is relatively sparse, and this paper is an attempt to bridge this gap.

High frequency sounds and the perceived healthfulness of food

According to the frequency code hypothesis (e.g., Ohala, 1994), lower frequency sounds (e.g., the growl of large animals) tend to be associated with larger size and heaviness, while higher frequency sounds are often associated with smallness and lightness instead (e.g., twittering of birds) (Gallace & Spence, 2006; House & Fairbanks, 1953; Kawahara et al., 2018; Kingston et al., 2008; Kingston & Diehl, 1995; Ohala, 1994). This hypothesis derives from the physical law that large and heavy objects tend to emit lower frequency sounds than small and light objects. Similarly, it has been suggested that certain phonemic sounds are of lower and higher frequencies, respectively. So, for example, front vowels (i, e) and voiceless obstruents (p, t, k, s, f) are associated with higher frequencies whereas back vowels (e.g., u, o) and voiced obstruents (b, d, g, z, v) are associated with lower frequencies (House & Fairbanks, 1953; MacKay, 1978). Similarly, healthy foods are often described by consumers in terms of ‘small portions’ and ‘light foods’ (vs. large portions and heavy foods) (Bartlam, 1993; Haws & Liu, 2016). Given this evidence and the frequency code hypothesis, we predicted that those fictitious brand names containing higher frequency sounds (e.g., f, s, i, e) (vs. lower frequency sounds, e.g., b, d, g, o, u) would be perceived to be healthier (vs. unhealthier).

Product tastes (e.g., sweet, savoury) might modulate how sounds in product names influence the perception of healthy food (Hartmann et al., 2013; Keller & Siegrist, 2015). People tend to associate speech sounds (and non-speech sounds) with basic taste properties (Fónagy, 1963, 2001; Knöferle & Spence, 2012). For example, previous research has suggested that sweetness is more associated with higher frequency sounds (i.e., front vowels, fricative consonant, voiceless consonant) compared to lower ones (i.e., back vowel, stop consonants, and voiced consonants) (Motoki et al., 2020; Pathak & Calvert, 2020, also see Simner, Cuskley, & Kirby, 2010). In contrast, saltiness tends to be associated more with lower (rather than higher) frequency sounds (Motoki et al., 2020). These findings suggest the differential effects of sound frequency on sweet and savoury foods. Thus, it would seem plausible that sounds in brand names differentially influence the perception of healthy food depending on a food’s taste. Relying on this rationale, we additionally investigated the link between the dominant taste of a food (sweet, savoury) and expected healthfulness.

The present research

Based on the extensive published literature sound symbolism, this paper investigates how those sounds present in fictitious brand names influence the perception of healthy food. We manipulated the frequency of sounds and created fictitious brand names containing higher vs. lower sound frequencies. Across four studies, participants were asked about their expectations concerning the healthfulness of a food product with a brand name that incorporated higher (e.g., /f, s, i, e/) vs. lower (e.g., /b, d, g, o, u/) frequency speech sounds. Studies 1 and 2 used general categories of food products (i.e., “healthy foods”, “unhealthy foods”). Studies 3 and 4 used the actual names (or descriptions) of food products (e.g., “vegetable or beef sandwich”) and investigated whether the taste of the food (i.e., sweet vs. savoury) modulates the expectation of healthfulness.

Study 1

The purpose of Study 1 was to examine the effect of the sounds incorporated in brand names on the expected healthfulness of food. Specifically, we examined whether those brand names containing higher frequency sounds (i.e., front vowels/ fricative consonants/ voiceless consonants) would be perceived as healthier than those incorporating lower frequency sounds (i.e., back vowels/ stop consonants/ voiced consonants).

Method

Design and participants

The study consisted of a 2 (vowels: front, back) $\times$ 2 (affricate consonants: fricative, stop) $\times$ 2 (voicing of consonants: voiceless, voiced) in which all factors were manipulated systematically on a within-participants basis. The participants were informed that they would be shown the fictitious brand names of certain food products, and that they had to rate them on the expected healthfulness, tastiness, calorie count, and the presence of three macronutrients (fat, protein, carbohydrates). The results of the three macronutrients are shown in Appendix A. Ratings were collected on a visual analog scale (VAS) ranging from 0 (not at all) to 100 (very much). In total, there were thirty-two trials (see Table 1) and the order of brand names and food attributes was randomized between participants.

One hundred participants were recruited on Lancers (<https://www.lancers.jp/>) for a monetary compensation of 100 JPY and completed the survey on Qualtrics

(<https://www.qualtrics.com/jp/>) (the data from 24 participants were excluded as they failed to respond to at least one question). The data from 76 participants were analysed and reported (25 females, mean age of 41.36 years, $SD = 8.56$). The sample size was based on previous similar research on crossmodal associations between tastes and sound symbolism (Motoki et al., 2020). The study was approved by the ethics committee of Miyagi University, Japan (No. 707) and was conducted in accordance with the Declaration of Helsinki.

Stimuli

A total of thirty-two fictitious brand names (i.e., four sets of names) were created by systematically varying vowels (front/back) and two types of consonants (fricative/stop and voiced/voiceless) (Motoki et al., 2020) [i.e., 2 vowels (front, back) x 2 consonants (fricative, stop) x 2 consonants (voiceless, voiced)] (see Table 1).

Table 1. The fictitious brand names used in Study 1.

			Vowel				
			Front		Back		
			<i>i</i>	<i>e</i>	<i>a</i>	<i>o</i>	<i>u</i>
Fricative	Voiceless	<i>f</i> <i>s</i>	Sefi, Fise, Sife, Fesi		Sufo, Fosu, Sufa, Faso		
	Voiced	<i>z</i> <i>v</i>	Zevi, Vize, Zive, Vezi		Zuvo, Vozu, Zuva, Vazo		
Stop	Voiceless	<i>p</i> <i>t</i> <i>k</i>	Tepi, Pite, Tike, Kepi		Tupo, Potu, Tuka, Kapo		
	Voiced	<i>b</i> <i>d</i> <i>g</i>	Gebi, Bige, Bide, Debi		Gubo, Bogu, Buda, Dabo		

Statistical analysis

An analysis of variance (ANOVA) was conducted to assess the effects of vowels and two types of consonants on the expected food attributes. We focused on the main effects of each factor. When a significant interaction was obtained, post-hoc tests (Shaffer's modified sequentially-rejective Bonferroni procedure) were performed to analyse it in detail. All statistical analyses were conducted using the R software (R core Team, 2017) and ANOVA and subsequent multiple testing were done through anovakun (a function of R software).

Results

The results are presented in Figure 1 and Table 2.

Healthfulness

Analysis of the results revealed a main effect of the vowels, the fricative/stop consonants, and voiceless/voiced consonants, indicating that the participants expected those food products with brand names containing front vowels, fricative consonants, and voiceless consonants to be healthier than matched brand names containing back vowels, stop consonants, and voiced consonants, respectively. The interaction between vowels and fricative/stop consonants ($F_{1,75} = 9.559, p = .003, \eta_p^2 = 0.113$) revealed that the fricative and stop consonants were rated as healthier when the names included front, rather than back, vowels. Front and back vowels were rated as healthier when the names included fricative (vs. stop) consonants.

There was also an interaction of the fricative/stop consonants and voiceless/voiced consonants ($F_{1,75} = 26.187, p < .001, \eta_p^2 = 0.259$). Voiceless and voiced consonants were rated as healthier when the names included fricative (vs. stop) consonants. Stop consonants were rated as healthier when the names included voiceless (vs. voiced) consonants, whereas fricative consonants did not differ between voiceless and voiced consonants.

Calorie count

There was a significant main effect of the fricative/stop consonants as well as the voiceless/voiced consonants, indicating that participants rated those food brand names with stop (vs. fricative) consonants and voiced (vs. voiceless) consonants as being more calorie-dense, respectively. The interaction of vowels and fricative/stop consonants ($F_{1,75} = 10.146, p = .002, \eta_p^2 = 0.119$), revealed that those names with stop consonants were rated as likely to be more calorie-dense when the names included back, rather than front, vowels. By contrast, those names with fricative consonants did not differ between front and back vowels. Those foods with brand names containing back vowels were expected

to be more calorific when the names included stop (vs. fricative) consonants, while names with front vowels did not differ between fricative and stop consonants.

There was an interaction of the fricative/stop consonants and voiceless/voiced consonants ($F_{1,75} = 89.738, p < .001, \eta_p^2 = 0.545$), revealing that those names containing voiceless and voiced consonants were expected to relate to products that were more calorie-dense when these included stop (vs. fricative) consonants. Meanwhile, those food brand names containing fricative and stop consonants were expected to refer to foods that were more calorific when voiced (vs. voiceless) consonants were included.

A significant three-way interaction indicated that the two-way interaction was modified by the vowels ($F_{1,75} = 7.912, p = .006, \eta_p^2 = 0.095$). When the brand names included front vowels, a significant interaction between the fricative/stop consonants and voiceless/voiced consonants was observed ($F_{1,75} = 17.691, p < .001, \eta_p^2 = 0.191$). Voiceless (vs. voiced) consonants increased the expected calorie count of stop consonants ($F_{1,75} = 11.746, p = .001, \eta_p^2 = 0.135$), whereas the expected calorie count of names with fricative consonants did not differ between voiceless and voiced consonants ($F_{1,75} = 0.991, p = .323, \eta_p^2 = 0.013$). When the brand names included back vowels, a significant interaction between the fricative/stop consonants and voiceless/voiced consonants was also observed ($F_{1,75} = 45.015, p < .001, \eta_p^2 = 0.375$). The presence of voiceless (vs. voiced) consonants in the fictitious brand names increased the expected calorie count of those names containing both the fricative ($F_{1,75} = 4.531, p = .037, \eta_p^2 = 0.057$) and stop ($F_{1,75} = 45.015, p < .001, \eta_p^2 = 0.375$) consonants.

Tastiness

There was a significant main effect of the vowels, the fricative/stop consonants, as well as the voiceless/voiced consonants, indicating that the participants rated those names with front (vs. back) vowels, fricative (vs. stop) consonants, and voiceless (vs. voiced) consonants as likely to be tastier. There was also an interaction of the vowels and voiceless/voiced consonants ($F_{1,75} = 23.170, p < .001, \eta_p^2 = 0.236$). Those names with voiceless and voiced consonants were rated as tastier when the brand names included front (rather than back) vowels. Front vowels were rated as tastier when the names included front (vs. back) vowels, while back vowels did not differ between voiceless and voiced consonants.

The interaction between the fricative/stop consonants and voiceless/voiced consonants ($F_{1,75} = 12.456, p = .001, \eta^2_p = 0.142$) revealed that those names incorporating voiceless and voiced consonants were expected to be tastier when these included fricative (vs. stop) consonants. Names with fricative consonants were rated as tastier when these included voiceless (vs. voiced) consonants, while stop consonants did not differ between voiceless and voiced consonants.

A significant three-way interaction indicated that the two-way interaction was modified by the vowels ($F_{1,75} = 84.347, p < .001, \eta^2_p = 0.529$). When the brand names included front vowels, a significant interaction between the fricative/stop consonants and voiceless/voiced consonants was observed ($F_{1,75} = 34.246, p < .001, \eta^2_p = 0.314$). The presence of voiceless (vs. voiced) consonants in the brand names increased the expected tastiness of those foods having fictitious brand names containing stop consonants ($F_{1,75} = 57.864, p < .001, \eta^2_p = 0.436$), whereas the tastiness of names with fricative consonants did not differ between voiceless and voiced consonants ($F_{1,75} = 1.939, p = .168, \eta^2_p = 0.025$). When the brand names included back vowels, a significant interaction between the fricative/stop consonants and voiceless/voiced consonants was also observed ($F_{1,75} = 68.677, p < .001, \eta^2_p = 0.478$). The presence of voiceless (vs. voiced) consonants in the fictitious brand names of the foods also increased the expected tastiness of foods linked to brand names including fricative consonants ($F_{1,75} = 38.940, p < .001, \eta^2_p = 0.342$), whereas voiced (vs. voiceless) consonants increased the expected tastiness of brand names including stop consonants ($F_{1,75} = 27.926, p < .001, \eta^2_p = 0.271$).

Figure 1. The results of Study 1. Effect of vowels and consonants on the expected healthfulness/tastiness/calorie count of food products. Ratings were on a 0-100 visual analogue scale, anchored with the labels ‘not at all’ and ‘very much’. Error bars represent standard errors.

Table 2. The results of Study 1. Statistical summaries of ANOVAs with vowel, fricative/stop consonant, and voiceless/voiced consonants as independent factors.

	Effect	<i>F</i>	<i>p</i> -value	η^2
Healthfulness	Vowel	30.93	<.001	0.292
	Fricative/stop	47.18	<.001	0.386
	Voiceless/voiced	26.98	<.001	0.265
	Vowel $\times$ Fricative/stop	9.56	.003	0.113
	Vowel $\times$ Voiceless/voiced	2.08	.154	0.027
	Fricative/stop $\times$ Voiceless/voiced	26.19	<.001	0.259
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	3.80	.055	0.048
Tastiness	Vowel	47.34	<.001	0.387
	Fricative/stop	50.76	<.001	0.404
	Voiceless/voiced	11.26	.001	0.131
	Vowel $\times$ Fricative/stop	2.98	.088	0.038
	Vowel $\times$ Voiceless/voiced	23.17	<.001	0.236
	Fricative/stop $\times$ Voiceless/voiced	12.46	.001	0.142
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	84.35	<.001	0.529
Calorie count	Vowel	3.19	.078	0.041
	Fricative/stop	21.91	<.001	0.226
	Voiceless/voiced	6.25	.015	0.077
	Vowel $\times$ Fricative/stop	10.15	.002	0.119
	Vowel $\times$ Voiceless/voiced	0.10	.750	0.001
	Fricative/stop $\times$ Voiceless/voiced	89.74	<.001	0.545
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	7.91	.006	0.095

Discussion

Taken together, the results of Study 1 revealed that those fictitious food brand names containing higher frequency sounds (i.e., front vowels, fricative consonants, and voiceless consonants) were expected to be healthier when compared to those fictitious brand names containing lower frequency sounds (i.e., back vowels, stop consonants, voiced consonants).

Moreover, interactive effects of speech sounds on the expected healthfulness were observed. For example, front (vs. back) vowels increased the expected healthfulness of the fictitious brands incorporating both fricative and stop consonants. Fricative (vs. stop) consonants also increased the expected healthfulness of the fictitious brands incorporating both front and back vowels as well as voiceless and voiced consonants. These results indicate the additive effects of higher frequency sounds on the expected healthfulness.

In Study 2, we aimed to replicate this finding using a different set of stimuli. Based on the results of Study 1, different brand names were created by using higher vs. lower frequency sounds.

Study 2

The main aim of Study 2 was to examine the effect of those sounds present in brand names on the expected healthfulness ratings using a different stimulus set. Specifically, we examined whether people would expect those brand names containing higher frequency sounds (i.e., front vowels/ fricative consonants/ voiceless consonants) to be healthier than those that incorporated lower frequency sounds (i.e., back vowels/ stop consonants/ voiced consonants).

Method

One hundred and nine respondents participated in Study 2 (43 females, mean age of 41.51 years, $SD = 9.76$) in exchange for 100 JPY as compensation. By using the forced responses on the Qualtrics survey (participants must answer the question before moving to the next item of the survey), the data from all of the participants were used.

Twelve pairs of fictitious brand names (see Table 3) were created in such a way that each pair contained low-frequency consonants and vowels, namely, f, s, i, e (vs. high-frequency consonants and vowels, namely, b, d, g, o, u) (e.g., Fipase vs. Bopagu) (Klink & Wu, 2014). The vowel /a/ was not used, given that /a/ has an intermediate frequency and at times differs from lower frequencies, which are a characteristic feature of the other back vowels (e.g., o, u) (see Svantesson, 2017, for a review). The participants were told that they would see a few fictitious brand names of food products and that they were to indicate the expected attributes (i.e., healthfulness, taste, salt content, sugar content, fat content, calorie count) of a food with that name (see Figure 2). The ratings were made on

a seven-point evaluation from 1 = BNH totally agree ([brand names with higher frequency sounds (BNH)]) to 7 = BNL totally agree ([brand names with lower frequency sounds (BNL)]) (see Figure 2). The ratings were converted as follows: 1: totally agree (lower frequency sounds), 2: agree (lower frequency sounds), 3: slightly agree (lower frequency sounds), 4: neutral, 5: slightly agree (higher frequency sounds), 6: agree (higher frequency sounds), 7: totally agree (higher frequency sounds). We analysed whether the participants' responses differed from mid-point (4) of the scale using a one-sample t-test, $p < .008$ (.05/6).

Which product is healthier, and by how much?

Fipase
Bopagu

Fipase Totally agree ☐	Fipase Agree ☐	Fipase Slightly agree ☐	Neutral ☐	Bopagu Slightly agree ☐	Bopagu Agree ☐	Bopagu Totally agree ☐
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Figure 2. An example of the task in Study 2. The participants had to indicate which fictitious product brand name sounds healthier, and by how much (tastier/more salt/more sugar/more calories).

Table 3. The fictitious brand names used in Study 2. Bold letters indicate higher or lower frequency sounds.

Higher frequency sounds (f, s, i, e)	Lower frequency sounds (b, d, g, o, u)
Fipase	Bopagu
Sepafi	Gupabo
Finase	Bonagu
Fevasi	Buvago

Senfi	Gunbi
Finse	Bingu
Semanfi	Gumanbi
Fimanse	Bimangu
Sinfen	Dongun
Finsen	Gundon
Sekafi	Dukabo
Fikase	Bokadu

Results

One-sample t-test demonstrated that the participants expected fictitious brand names containing higher frequency sounds to be healthier than those names containing lower frequency sounds ($M = 4.74$, $t_{108} = 8.810$, $p < .001$, $d = 0.844$). Moreover, those foods with brand names containing higher frequency sounds were perceived as tastier ($M = 4.53$, $t_{108} = 6.931$, $p < .001$, $d = 0.664$), having fewer calories ($M = 3.15$, $t_{108} = -9.224$, $p < .001$, $d = -0.884$), lower salt content ($M = 3.41$, $t_{108} = -8.143$, $p < .001$, $d = -0.780$), and a lower fat content ($M = 3.19$, $t_{108} = -9.567$, $p < .001$, $d = -0.916$) than names with lower frequency sounds. Sugar content ratings of the names did not differ from the mid-point of the scale ($M = 4.08$, $t_{108} = 0.883$, $p = .379$, $d = 0.085$) (see Figure 3).

Figure 3. The results of Study 2. An illustration of the results of name appropriateness with each taste attribute. The name appropriateness was illustrated using a scale ranging from 1 (totally agree with lower frequency sounds) to 7 (totally agree with higher frequency sounds). Black circles represent the mean data and the error bars indicate the standard deviation. Significant differences from the mid-point (4) are observed for healthfulness, tastiness, salt content, fat content, and calorie count. $p < .008$ (.05/6).

Discussion

The findings of Study 2 replicated those of Study 1, demonstrating that the fictitious brand names of foods incorporating higher (vs. lower) frequency sounds are expected to be healthier. Moreover, the fictitious brand names of foods incorporating higher frequency sounds are expected to be tastier, with fewer calories, less salt content, and less fat content compared to names with lower frequency sounds. There were no significant differences in the expected sugar content between both categories of fictitious brand names.

Study 3

The purpose of Study 3 was to examine the effect of those sounds present in fictitious brand names on the perceived healthfulness using the descriptions of specific food products (e.g., vegetable sandwich). Specifically, we examined whether brand names containing higher frequency sounds (e.g., Fipase/Sinfen/Finase) would be perceived as more appropriate for healthy food products than those containing lower frequency sounds (e.g., Bopagu/Dongun/Bonagu).

Method

Design and participants

One hundred and eighteen respondents took part in Study 3 (48 females, mean age of 41.15 years, $SD = 9.62$) in exchange for 50 JPY as compensation. The brand names created in Study 2 were used as stimuli (see Table 1).

The participants read the following instruction: “A global company is about to launch some new food products internationally and is looking to determine the appropriate brand names and their impressions. There is no right answer, so just follow your instincts.” The participants were then shown the fictitious names and were asked to make their choices and rate them (see Figure 4). The ratings were made by a seven-grade evaluation from BNH totally agree ([brand name with higher frequency sounds (BPH)]) to BPL totally agree ([brand name with lower frequency sounds (BPL)]) and converted into 7-points as in Study 2 (1: totally agree ([brand name with lower frequency sounds]) to 7: totally agree ([brand name with higher frequency sounds])). Food product names included healthy and unhealthy savoury foods as well as healthy and unhealthy sweet foods (see Table 4). Healthy and unhealthy foods were chosen based on previous research. Consumers tend to regard foods with low fat, soy foods, seafood, vegetables, salad, yogurt and whole grain as healthy and foods with high fat, sugar and meat as unhealthy (Bucher et al., 2015; Bus & Worsley, 2003; Motoki et al., 2019b; Plasek et al., 2020; Schyver & Smith, 2005). A total of six trials were used for each category of food product. The mean ratings of six food items were calculated within each condition (i.e., healthy savoury foods, unhealthy savoury foods, healthy sweet foods, unhealthy sweet foods). We analysed whether responses differed from the mid-point (4) of the scale using a one-sample t-test, $p < .013$ ($.05/4$). Responses were also analysed using an ANOVA (2 food types: healthy, unhealthy) $\times$ (2 taste types: savoury, sweet).

Which of the product names is more appropriate for a beef burger?

Fipase Bopagu

Fipase Totally agree ☐	Fipase Agree ☐	Fipase Slightly agree ☐	Neutral ☐	Bopagu Slightly agree ☐	Bopagu Agree ☐	Bopagu Totally agree ☐
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Figure 4. An example of the task used in Study 3.

Table 4. The food items used in Study 3.

Healthy savoury foods	Unhealthy savoury foods	Healthy sweet foods	Unhealthy sweet foods
Soy hamburger	Beef burger	Yogurt	Pudding
Vegetable sandwich	Beef sandwich	Whole grain bread	White bread
Vegetable chips	Potato chips	Low-fat milk	Chocolate milk
Seafood pasta	Meat pasta	Soy milk latte	Strawberry milk latte
Chicken salad	Garlic chicken	Soy pulp cookie	Butter cookie
Baked fish	Baked beef	Soy serial bar	Chocolate bar

Results

One-sample t-tests demonstrated that those brand names containing higher frequency sounds were perceived to be more appropriate for healthy savoury ($M = 4.38$, $t_{117} = 6.134$,

$p < .001$, $d = 0.565$), healthy sweet ($M = 4.56$, $t_{117} = 7.853$, $p < .001$, $d = 0.723$), and unhealthy sweet products ($M = 4.80$, $t_{117} = 11.293$, $p < .001$, $d = 1.040$) than those containing lower frequency sounds. Moreover, fictitious brand names containing higher (vs. lower) frequency sounds were perceived as less appropriate for unhealthy savoury foods ($M = 3.71$, $t_{117} = -4.109$, $p < .001$, $d = -0.378$) (see Figure 4).

Figure 4. The results of Study 3. An illustration of the results of name appropriateness with each rating. The name appropriateness was illustrated using a scale ranging from 1 (totally agree with lower frequency sounds) to 7 (totally agree with higher frequency sounds). Each circle represents mean ratings of brand name appropriateness (with standard deviation). Significant differences from the mid-point (4) were observed for all ratings at $p < .013$ (.05/4).

The results of the ANOVA revealed significant main effects of the type of food ($F_{(1, 117)} = 15.164$, $p < .001$, $\eta_p^2 = 0.115$) and tastes ($F_{(1, 117)} = 92.906$, $p < .001$, $\eta_p^2 = 0.443$). Fictitious brand names containing higher frequency speech sounds were perceived to be more appropriate for healthy (vs. unhealthy) and sweet (vs. savoury) foods. Furthermore, the interaction between the type of food and tastes was found to be significant ($F_{(1, 117)} = 101.105$, $p < .001$, $\eta_p^2 = 0.464$). Unhealthy sweet (vs. healthy sweet) food was perceived

to be more appropriate for higher frequency speech sounds ($F_{(1, 117)} = 14.053, p < .001, \eta_p^2 = 0.107$). In contrast, the participants perceived healthy savoury (vs. unhealthy savoury) foods as being more appropriate for higher frequency speech sounds ($F_{(1, 117)} = 73.864, p < .001, \eta_p^2 = 0.387$) (see Figure 5).

Figure 5. The results of Study 3. Interaction between the type of food / dominant taste on the rated appropriateness of the brand name.

Discussion

The results of Study 3 conceptually replicated the findings reported in Studies 1 and 2, and demonstrates that brand names with higher (vs. lower) frequency sounds are perceived to be more appropriate for healthy foods. Specifically, those fictitious brand names with higher (vs. lower) frequency sounds were perceived to be more appropriate for healthy (vs. unhealthy) savoury foods. In the case of sweet foods, those brand names with higher (vs. lower) frequency sounds were perceived as being more appropriate for both healthy and unhealthy sweet foods. Thus, the effect of brand names with higher (vs.

lower) frequency sounds on the expected healthfulness is observed in savoury foods, but not in sweet foods.

Study 4

To reveal the robustness and generalizability of our findings, Study 4 was designed to replicate the results using a between-participants experimental design. In particular, Study 4 investigated how those sounds present in brand names influence the appropriateness of sweet and savoury healthy food products. Moreover, we also examined the effects of those sounds that are present in brand names on people's expectations of the nutrient content (calorie/sugar/fat) associated with the perception of (un-)healthy foods. Specifically, we investigated whether those brand names including higher frequency sounds (front vowels/ fricative consonants/ voiceless consonants) would be expected as lower in both calories and fat content (i.e., expected to be healthier).

Method

Design and participants

The experimental design was 2 frequency of sounds (higher/lower) x 2 food types (healthy/unhealthy) x 2 taste types (savory/sweet) with sounds as between-participants factor and food and taste types as within-participants factors. The main dependent variable was name appropriateness.

Two hundred and twenty-eight respondents ($n = 228$) participated (102 females, mean age of 41.28 years, $SD = 9.77$) in exchange for 50 JPY as compensation. By using the forced responses on the Qualtrics survey, the data of all participants were used. The fictitious brand names created in Study 3 were used as stimuli.

The participants read the following instruction: "A global company is about to launch some food products internationally and is looking for appropriate brand names and their impressions. There is no right answer, and so just follow your instincts." They were then asked to indicate how appropriate is [product name] for the brand name for [food product]. An example is "How much appropriate is Fipase for the brand name for beef burger?" The ratings were made by 7-point likert scale for 1: not at all to 7: very much. In addition to the product name appropriateness, the participants were asked to indicate the expected

nutrient content (calorie, sugar, salt, fat): “How many calories [How much sugar/salt/fat] do you think [food product] named [product name] would have?” by means of 7-point likert scale for 1: not at all to 7: very much. An example is “How many calories do you think a beef burger named Fipase would have?”

Results

Brand name appropriateness

The results revealed significant main effects of those sounds present in brand names ($F_{1, 226} = 17.399, p < .001, \eta_p^2 = 0.072$) and the type of food ($F_{1, 226} = 45.733, p < .001, \eta_p^2 = 0.168$). Those names with higher (vs. lower) frequency sounds and savoury (vs. sweet) foods were perceived as being more appropriate for those brand names for food products. Notably, a three-way interaction between sounds, food types, and tastes was observed ($F_{1, 226} = 33.399, p < .001, \eta_p^2 = 0.129$). By splitting the data into savoury and sweet foods, the interaction between sounds and food types was explored. For savoury foods, an interaction between sounds and food types was observed ($F_{1, 226} = 31.099, p < .001, \eta_p^2 = 0.121$). Names with higher (vs. lower) frequency sounds were perceived to be more appropriate for healthy savoury foods ($F_{1, 226} = 8.013, p = .005, \eta_p^2 = 0.034$), but no difference was observed for unhealthy savoury foods ($F_{1, 226} = 1.302, p = .255, \eta_p^2 = 0.006$). For sweet foods, interaction between sounds and food types was also observed ($F_{1, 225} = 3.913, p = .049, \eta_p^2 = 0.017$). Those fictitious brand names incorporating higher (vs. lower) frequency sounds were perceived as being more appropriate for both healthy ($F_{1, 225} = 32.870, p < .001, \eta_p^2 = 0.127$) and unhealthy sweet foods ($F_{1, 225} = 52.038, p < .001, \eta_p^2 = 0.187$).

Calorie count expectation

The analysis revealed significant main effects of sounds ($F_{1, 226} = 12.553, p = .001, \eta_p^2 = 0.053$), the type of food ($F_{1, 226} = 381.584, p < .001, \eta_p^2 = 0.628$), and taste ($F_{1, 226} = 18.777, p < .001, \eta_p^2 = 0.077$). Higher (vs. lower) frequency sounds, healthy (vs. unhealthy) foods, and sweet (vs. savoury) foods were perceived as likely to contain fewer calories. Moreover, significant interaction between name sounds and taste was observed ($F_{1, 226} = 13.087, p < .001, \eta_p^2 = 0.055$). The participants expected lower calorie count in names of

both savoury ($F_{1,226} = 19.748, p < .001, \eta_p^2 = 0.080$) and sweet foods ($F_{1,226} = 5.586, p = .019, \eta_p^2 = 0.024$) in names with higher (vs. lower) frequency sounds.

Expected salt content

The analyses revealed significant main effect of sounds ($F_{1,226} = 7.551, p = .007, \eta_p^2 = 0.032$), the type of food ($F_{1,226} = 76.366, p < .001, \eta_p^2 = 0.253$), and taste ($F_{1,226} = 76.366, p < .001, \eta_p^2 = 0.253$). Those names with higher (vs. lower) frequency sounds, healthy (vs. unhealthy) foods, and sweet (vs. savoury) foods were perceived as being less salty. Moreover, a significant interaction between food type and taste was observed ($F_{1,226} = 31.843, p < .001, \eta_p^2 = 0.124$). The participants expected more saltiness in unhealthy (vs. healthy) savoury ($F_{1,226} = 115.555, p < .001, \eta_p^2 = 0.338$) and sweet ($F_{1,226} = 7.652, p < .001, \eta_p^2 = 0.033$) foods.

Expected sugar content

The analyses revealed significant main effects of the type of food ($F_{1,226} = 261.109, p < .001, \eta_p^2 = 0.536$) and taste ($F_{1,226} = 151.563, p < .001, \eta_p^2 = 0.401$). Healthy foods (vs. unhealthy foods) and savoury foods (vs. sweet foods) were perceived as being less sweet. Moreover, a significant interaction between food types and tastes was observed ($F_{1,226} = 98.467, p < .001, \eta_p^2 = 0.304$). Participants expected more saltiness in unhealthy (vs. healthy) savoury ($F_{1,226} = 69.147, p < .001, \eta_p^2 = 0.234$) and sweet ($F_{1,226} = 275.832, p < .001, \eta_p^2 = 0.550$) foods.

Expected fat content

The analyses revealed significant main effects of sounds ($F_{1,226} = 13.986, p < .001, \eta_p^2 = 0.058$) and the type of food ($F_{1,226} = 339.885, p < .001, \eta_p^2 = 0.601$). Higher frequency sounds (vs. lower frequency sounds) and healthy foods (vs. unhealthy foods) were perceived as less fatty. No significant interactions were observed.

Discussion

The results of Study 4 conceptually replicate the findings of Studies 1-3, demonstrating that brand names with higher (vs. lower) frequency sounds are perceived as more appropriate for healthy foods. Specifically, brand names with higher (vs. lower) frequency sounds were perceived to be more appropriate for healthy savoury foods (vs. unhealthy savoury foods). The fictitious brand names of foods incorporating higher (vs. lower) frequency sounds were perceived to be more appropriate for both healthy and unhealthy sweet foods. Moreover, participants expected fewer calories, less saltiness, and reduced fat content from those brand names that incorporated higher (vs. lower) frequency sounds.

Figure 6. The results of Study 4. Results of the analysis highlighting the influence of frequency of sounds, food types, and taste types on ratings of name appropriateness and nutrient expectations (calorie, salt, sugar, and fat). Ratings were on a 7-point scale ('not at all' to 'very much'). Error bar represents standard error.

5. General discussion

The research reported here investigated the effect of sound symbolism in brand names on the perception of healthy food. A robust effect of the higher (vs. lower frequency) sounds in brand names on the perceptions of healthy food was documented. Across four studies, we demonstrated that those names containing higher frequency sounds (f, s, i, e) were perceived as being healthier than those names containing lower frequency sounds (b, d, g, o, u). The results of Studies 1 and 2 demonstrated these findings using a general category of food products (“healthy or unhealthy foods”). Studies 3 and 4 conceptually replicated the results by using actual food products (“vegetable or beef sandwich”) and a different study design (within-participants for Study 3 and between-participants for Study 4). Moreover, we revealed the boundary conditions of the effects of sounds in brand names on the perception of healthy foods. The higher (vs. lower) frequency sounds induced the perception of healthfulness for savoury foods, but not for sweet foods (Studies 3 and 4). These findings therefore reveal the extrinsic factor shaping consumers’ perception of healthy food and provide practical implications to food manufacturers in creating brand names that can better convey the perception of healthy food to consumers.

Perceptions of healthy food influenced by numerous factors

This study added new evidence concerning those factors influencing the expected healthiness of food. A recent review paper identified six factors influencing the perception of healthy food (Plasek et al., 2020) namely, communicated information, origin of the product, taste and sensory attributes, shape and colour of the packaging, ingredients, and product category. Although earlier studies found that factors related to packaging can influence the perception of healthy food, these studies mainly investigated the role of the visual attributes of the packaging (e.g., shape, colour) (da Rosa et al., 2019; Festila & Chrysochou, 2018; Kunz et al., 2020; Mai et al., 2016; Mead & Richerson, 2018; Plasek et al., 2020; Schnurr, 2019; Tijssen et al., 2017; Togawa et al., 2019; Wąsowicz et al., 2015; Yazar et al., 2019; Ye et al., 2019). To the best of our knowledge, to date no research has explored the effect of name sounds on the perceived healthfulness of a food product packaging. Taking cues from the literature on sound symbolism, the present study demonstrated that sounds present in the brand names can influence the perception of healthy food. Specifically, higher (vs. lower) frequency sounds in a brand name increase

the perception of healthy food. Together, the present findings advance our knowledge about the link between phonetic sounds and their influence on the perception of healthy food.

The manipulations of brand names based on phonetics

The present study shows that manipulations of vowels and consonants within a brand name can influence the perceived healthfulness of food products. Previous research used the words (i.e., “Asahi”, “Ramune”) not based on the manipulation of phonetics (i.e., vowels and consonants) (Arroyo & Arboleda, 2021; Fenko et al., 2016). Fenko and her colleagues did not find significant effect of brand names on perceived healthfulness (Fenko et al., 2016). Meanwhile, Arroyo and Arboleda recently reported that onomatopoeic sounds (e.g., “Ahhh”) can *diminish* perceived healthiness of beverages depending on the bottle color (Arroyo & Arboleda, 2021). Given these findings, it remains unclear whether and how various sounds present in brand names can *enhance or diminish* the perception of healthfulness. Some recent research in sound symbolism has shown that the phonetics’ manipulations of vowels (e.g., front vs. back) and consonants (e.g., voiceless vs. voiced) can have a significant impact on food product attributes such as taste (Motoki et al., 2020; Pathak, Calvert, & Lim, 2020; Pathak, Calvert, & Motoki, 2020; Pathak & Calvert, 2020). By manipulating the vowels and consonants, our findings add to the extant literature and demonstrate that higher (vs. lower) frequency sounds enhance the perceived healthiness of food products (i.e., consumers regard higher frequency sounds in brand names as more appropriate for health food products). Our findings demonstrate the importance of brand names and phonetics in the healthy food perception (which so far had been linked mostly to food-extrinsic sources e.g., green colour in packaging).

Sensory marketing for healthy food and practical implications

With more awareness and policy initiatives, current consumers express increasing interest in making healthy food choices and leading a healthier lifestyle (Grunert, 2006). Although the field of sensory marketing has attracted much attention in recent years (Biswas, 2019; Krishna, 2012; Krishna et al., 2016; Spence, 2020a), to date, little of the research has focused on healthy food (e.g., Crisinel, Cosser, et al., 2012; Lowe & Haws, 2017; Motoki et al., 2019a; North et al., 1997; Reinoso-Carvalho et al., 2019; Spence, 2012; Spence et

al., 2019; Spence & Wang, 2015; Wang et al., 2020; Wang & Spence, 2019 but see Biswas et al., 2019; Huang & Labroo, 2020). The use of sensory stimuli (e.g., speech sounds) to influence eating behaviour might also raise ethical issues (Spence, 2015, 2020a). It is presumably socially (and ethically) more acceptable to nudge consumers towards making healthier food choices than indulgent ones (Spence, 2020b). The research reported here provides new insights into this field. Brand names are an important part of a product's packaging, and a vast majority of consumers are attracted to a package just by the brand name (Rebollar et al., 2015). The idea that sounds contained within a brand name can influence food choices, can potentially be used by marketers to nudge consumers towards making healthier eating behaviour.

Limitations and directions for future research

Although our study demonstrates that high frequency sounds in brand names affect the perception of healthy food, we did not directly examine the spillover effect of high frequency brand names on behavioral responses such as willingness to eat or willingness to buy. However, we believe that the spillover effect might occur. Previous research has shown that congruency of sound symbolism and product attributes (e.g., front vowels and small portion size) increases consumer preference (Ketron & Spears, 2019; Lowrey & Shrum, 2007). Thus, it might be possible that congruent information (i.e., higher frequency sounds and healthy foods) increases consumer preference (e.g., willingness to eat or willingness to buy).

Why do people associate certain product names with healthfulness? One possible explanation underlying the associations can be shared connotations (e.g., valence, lightness) between phonetic features and food stimuli (e.g., Sidhu & Pexman, 2018; Spence, 2020c). For example, it has been suggested that taste-sound associations can arise from a similar valence associated with both tastes and sounds (e.g., Kantono et al., 2016; Motoki et al., 2020). In our study, higher frequency sounds and healthfulness were preferred and perceived as lighter than lower frequency sounds and unhealthy attributes (akin to a taste-sound relationship). That said, further research is needed to investigate the underlying psychological mechanism connecting higher (vs. lower) frequency sounds with the perceived healthfulness.

It also worth noting as previous research has shown that consumer's interest in healthy eating and/ or motivation to process health claims can affect the eating behaviour (Fenko

et al., 2016; Grunert et al., 2010; Hung et al., 2017; Loebnitz & Grunert, 2018). For example, interaction effect of general health interest and brand names on perceived healthfulness and purchase intention was reported by Fenko et al. (2016). Specifically, the effect of brand names on perceived healthfulness was only observed in those consumers with lower interest in healthy eating (Fenko et al., 2016). Given this finding, brand names including higher (vs. lower) frequency sounds might be more effective for consumers with low (vs. high) involvement in healthy eating and further research is therefore needed to investigate this issue in detail.

It should also be noted that all of the results reported here are from Japanese participants. Given that onomatopoeia and sound symbolism seems more common in the Japanese language than in other countries/languages (e.g., see Hanada, 2020; Sakamoto & Watanabe, 2016), it might be expected that Japanese participants would be more sensitive to these than those in other countries. Further research is therefore needed to replicate our findings in non-Japanese participants.

Conclusion

To our best knowledge, this is the first study to demonstrate the influence of sound symbolism in brand names on the perception of healthy food. These findings therefore highlight a novel factor in nudging consumers' towards healthy eating behaviour and provide practical implications for food manufacturers and marketers to create sound symbolically 'healthy' brand names.

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Appendix Table A. The results of Study 1. Statistical summaries of ANOVAs with effects of vowel, fricative/stop consonant, and voiceless/voiced consonants on the expected carbohydrate/fat/protein content of food products.

	Effect	<i>F</i>	<i>p</i> -value	η^2
Carbohydrate	Vowel	2.06	0.156	0.027
	Fricative/stop	0.38	0.537	0.386
	Voiceless/voiced	2.09	0.153	0.027
	Vowel $\times$ Fricative/stop	8.60	0.004	0.103
	Vowel $\times$ Voiceless/voiced	1.18	0.281	0.016
	Fricative/stop $\times$ Voiceless/voiced	13.78	<.001	0.155
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	4.08	0.047	0.052
Fat	Vowel	15.32	<.001	0.170
	Fricative/stop	21.46	<.001	0.223
	Voiceless/voiced	10.94	0.001	0.127
	Vowel $\times$ Fricative/stop	18.64	<.001	0.199
	Vowel $\times$ Voiceless/voiced	0.08	0.784	0.001
	Fricative/stop $\times$ Voiceless/voiced	43.30	<.001	0.366
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	9.26	0.003	0.110
Protein	Vowel	3.27	0.075	0.042
	Fricative/stop	8.44	0.005	0.101
	Voiceless/voiced	3.48	0.066	0.027
	Vowel $\times$ Fricative/stop	4.26	0.043	0.054
	Vowel $\times$ Voiceless/voiced	0.75	0.388	0.010
	Fricative/stop $\times$ Voiceless/voiced	12.96	0.001	0.147
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	8.46	0.005	0.101

Appendix Table B. The results of Study 1. Statistical summaries of the interactive effects of vowels and consonants on the expected carbohydrate/fat/protein content of food product.

	Effect	Enhancing sound	Comparison sound	<i>F</i>	<i>p</i> -value	η^2
Carbohydrate	Vowel $\times$ Fricative/stop	Back & Fricative	Front & Fricative	0.41	0.524	0.005
		Back & Stop	Front & Stop	11.25	0.001	0.131
		Front & Stop	Front & Fricative	1.27	0.264	0.017
	Fricative/stop $\times$ Voiceless/voiced	Back & Stop	Back & Fricative	6.09	0.016	0.075
		Voiceless & Stop	Voiceless & Fricative	2.63	0.109	0.034
		Voiced & Stop	Voiced & Fricative	5.70	0.020	0.071
		Voiced & Fricative	Voiceless & Fricative	2.07	0.155	0.027
		Voiced & Stop	Voiceless & Stop	10.69	0.002	0.125
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	Back, Stop & Voiceless	Back, Fricative & Voiceless	0.30	0.582	0.004
		Back, Stop & Voiced	Back, Fricative & Voiced	17.30	<.001	0.187
Fat	Vowel $\times$ Fricative/stop	Back & Fricative	Front & Fricative	0.01	0.938	0.000
		Back & Stop	Front & Stop	34.27	<.001	0.314
		Front & Stop	Front & Fricative	2.44	0.123	0.032
	Fricative/stop $\times$ Voiceless/voiced	Back & Stop	Back & Fricative	43.16	<.001	0.365
		Voiceless & Stop	Voiceless & Fricative	1.62	0.207	0.021
		Voiced & Stop	Voiced & Fricative	59.35	<.001	0.442
		Voiced & Fricative	Voiceless & Fricative	2.37	0.128	0.031
		Voiced & Stop	Voiceless & Stop	44.86	0.002	0.374
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	Front, Fricative & Voiced	Front, Fricative & Voiceless	0.16	0.692	0.002
		Back, Fricative & Voiced	Back, Fricative & Voiceless	6.24	0.012	0.077
Protein	Vowel $\times$ Fricative/stop	Back & Fricative	Front & Fricative	0.07	0.786	0.001
		Back & Stop	Front & Stop	8.50	0.005	0.102
		Front & Stop	Front & Fricative	2.38	0.127	0.031
	Fricative/stop $\times$ Voiceless/voiced	Back & Stop	Back & Fricative	14.74	<.001	0.164
		Voiceless & Stop	Voiceless & Fricative	0.79	0.376	0.011
		Voiced & Stop	Voiced & Fricative	17.29	<.001	0.187
		Voiced & Fricative	Voiceless & Fricative	1.17	0.282	0.015
		Voiced & Stop	Voiceless & Stop	14.64	<.001	0.163
	Vowel $\times$ Fricative/stop $\times$ Voiceless/voiced	Back, Stop & Voiceless	Back, Fricative & Voiceless	0.21	0.652	0.003
		Back, Stop & Voiced	Back, Fricative & Voiced	30.42	<.001	0.289

Appendix Figure A. The results of Study 1. Effect of vowels and consonants on the expected carbohydrate/fat/protein content of food products. Ratings were on a 0-100 visual analogue scale (anchored with ‘not at all’ and ‘very much’). Error bar represents standard error.

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HIGHLIGHTS

- We studied the role of the sound symbolism on constructing healthy food names.
- Phonemic sounds with higher (vs. lower) frequencies are perceived to be healthier.
- Higher (vs. lower) frequency sounds change the health perception of savoury food.
- The role of sounds is not observed in the health perception of sweet food.