Matching soundscapes and music with food types

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Abstract

We present the results of an on-line survey that assessed how people associate different music styles and soundscapes with food types. The participants were asked to pair a song/soundscape with one of the food types that were showed as options. They also rated – on a likert scale – how good they thought the sonic stimulus went with their choice of food. Results show that people matched most of sound-food pairs as expected, although some seem to be more influenced by cultural background than others. We believe that these insights may be useful when developing multisensory experiences that are intended to influence human decision-making. For example, a catering facility may use soundscapes to increase the consumption of a certain menu, in order to minimize the production of waste, or simply to foment a more healthy behavior when it comes to food choices.

Keywords: *taste, sound, music, perception, experience design, gastrophysics.*

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1. Introduction

Multisensory information can be used to improve the design of food and beverage products, as well as the dining experiences (See [15] for a review). By systematically manipulating the different multisensory cues that are involved in the process of eating and drinking, it is possible to significantly influence the overall eating and drinking experience (See [19] for a review). The way in which foods and drinks are perceived (i.e., to the expectations we generate prior to tasting/consumption) is mostly related to visual and orthonasal inputs [18]. Nevertheless, recent studies have shown the impact of sound on perception of the flavor of food and drinks, considering that this can add significant value to the consumer's overall multisensory eating/drinking experience (e.g., [8,9,10,11,12,13,14]; see [16,17] for reviews). For instance, two scientific reports [4,9] have demonstrated that, by following the literature (as a baseline for the production of sound stimuli), it is possible to compose music and soundscapes that systematically, and specifically, modulate the perceived flavor of food and/or drinks. One of the aforementioned reports [9] conducted a study in which three soundtracks were produced, one designed to be congruent with sweetness, another with bitterness, and the third somewhere in-between (see [6], for overviews). The results demonstrated that what people hear exerts a significant influence over their rating of taste. Interestingly, when these results were analyzed based on the participants' individual music-taste matches (rather than the average response of the whole group), significantly more robust crossmodal effects were revealed [9]. Several studies have also assessed how sonic cues can have an influence on our consumer's behavior. For instance, Areni and Kim [1], demonstrated, that customers were willing to spend significantly more for a bottle of wine when classical music was played in the background, as compared to 'Top-40' pop music. North [7] showed that people may be influenced by certain music styles while choosing wine. Caldwell and Hibbert [2] studied the effect of music tempo on consumer behavior in restaurants. More recently, Knöeferle and his colleagues [5] have analyzed the interactive effect of music tempo and mode on in-store sales.

The study presented here reports an online study, where participants had to associate different sounds with food types. Two main groups of sound stimuli were presented (one group of seven songs and another of five soundscapes). Each time, the participants were asked to match one sound stimulus with one of three available choices of food types. In total, eight food types were presented in a random order, all over the survey. Results show that the participants were able to consistently match one favorite food type with each sound stimulus (with some exceptions that are here reported as well). These preliminary results can be used as source of inspiration for the development of future experiments, where different immersive sonic installations may be used in order to potentially influence decision-making, while ordering food in restaurants and catering facilities.

2. Materials and Methods

2.1 Participants

140 participants took part in this study (49 male, 51 female, Mean age 33.2 years old SD 9.3, all of them at least 18 years old). They were individually invited to take part of an on-line survey. None of the participants reported having a cold or any other impairment of their senses of smell, taste, or hearing at the time of the study.

2.2 Stimuli

The main question asked to participants was to match different types of food (presented as visual stimuli) with different sound stimuli played through headphones/speakers. Here, they should compare and choose different choices of food while listening to the available soundtracks (songs or natural soundscapes, depending on the case).

Visual stimuli: Eight food types were presented by means of pictures: barbecue (bbq), burger, pastas, mussels, pizza, salad, sandwich and sushi. Figure 1 shows the aforementioned pictures.

Sound stimuli

Songs: Seven songs were presented in this survey as sound stimuli. They were chosen to somehow potentially match the previously chosen food types. We believed that such matching process could be induced by means of cultural/geographic connotations/associations. We presumed that the participants responses would be stereotypical, such as matching an italian opera with italian pasta dish, or a pop song with food types such as burgers and/or pizzas. The songs were all edited and cut to be aproximatelly 30 seconds long. Table 1 shows the chosen songs.

Soundscapes: Five soundscapes were produced to be presented as sound stimuli in this experiment (jungle, farm, kitchen, urban and beach). They were also produced to be approximately 30 seconds long. Here, we believed that the matching process could be induced not only by means of cultural/geographic connotations/associations, but also, for example, natural associations, such as jungle with leaves, or a farm with meat, and son on.

Table 1. Main information and categorization of the songs that were presented in this survey as sound stimuli.

Experimental Code	*Genre*	*Title*	*Author / Producer*	*Interpret*
Pop 01	Dance pop	Toxic	B. & Avant	B Spears
Japanese	Chinese	unknown	unknown	unknown
Opera	Neapolitan	O Sole Mio	E. Di Capua	L Pavarotti
Country	Country music	F&E Amen	K. Lehning	R. Travis
French	Chanson	Ne me quitte pas	J. Brel	R. Travis
Tropical	Reggae	Meia Lua inteira	C. Veloso	C. Veloso
Pop 02	R&B dance	Milshake	Neptunes	Kelis

2.3 Procedure

The on-line survey was subdivided in 4 parts. First, the participants had to provide their personal data and accept the experimental conditions. In this part, they were also advised that, to participate in the survey, they should use headphones or, at least, a good pair of speakers.

The second part was the control experiment. Here, the participants had to evaluate the mentioned eight types of food. They rated how much they liked them and how healthy they thought they were (rates based on a 7-point scale, with 1 being 'not at all, and 7 'very much').

In the third part, the participants had to associate/pair the soundscapes with food. Each soundscape was presented along with three choices of food. The eight available choices of food were distributed among all the available soundscapes. Table 2 shows which food types were available with each soundscape.

Table 2. Distribution of the food types that were presented along with each soundscape. The food types in bold, are the ones that were believed to be the preferred choices to be made by the participants.

Soundscape	*Food type 1*	*Food type 2*	*Food type 3*
Jungle	sandwich	pastas	**salad**
farm	mussels	pizza	**bbq**
kitchen	sushi	**burger**	salad
urban	**pizza**	bbq	sushi
beach	salad	pastas	**mussels**

Figure 1. Corresponding pictures of the food stimuli presented to participants during the online survey (A bbq; B pastas; C burger; D mussels; E pizza; F sandwich; G salad; H sushi).

The fourth and final part of the experiment used the same protocol as described in part three, but instead of the soundscapes, the songs were presented to the participants (as sound stimuli). Table 3 shows which food types were available with each song.

In the third and fourth part of the survey, and after the choice of the food, the participants were asked to rate how much they thought that the soundscape matched with the chosen food type (rates based on a 7-point scale, with 1 being 'not at all, and 7 'very much'). Note that, in the third and fourth part of the survey, only the names of the food types were available (and thus no pictures of food)[1].

Table 3. Distribution of the food types that were presented along with each song. The food types in bold, are the ones to be believed as the potential preferred choices, for each song.

Song	*Food type 1*	*Food type 2*	*Food type 3*
Pop 01	**pizza**	salad	sushi
Japanese	bbq	salad	**sushi**
Opera	**pastas**	salad	burger
Country	pizza	mussels	**bbq**
French	**mussels**	burger	salad
Tropical	mussels	**sandwich**	bbq
Pop 02	salad	pastas	**burger**

[1] None of the names that are here used to refer to the sound stimuli, were explicit during the survey.

3. Results

Control test: Most of the participants liked all of the food types presented as choices, as shown in the results of the control study (See Figure 2). Note that the bbq, the burger and the pizza were mostly considered as unhealthy types of food.

Matching soundscapes with food types: The majority of the participants agreed that the bbq matched best with the farm soundscape (81%), the burger matched best with the kitchen soundscape (83%), the pizza with the urban soundscape (72%), and the mussels with the beach soundscape (73%). The choices associated with the jungle soundscape were not so obvious. While 50% of the participants chose the salad as their preferred choice, 29% of the participants chose the sandwich and 21% chose the pasta as their ideal match. Table 4 shows the correspondent means and SD of their ratings on how much they thought that the soundscape matched with the chosen food type, and Table 5 shows the p values of the comparisons of the correspondent means. When analyzing the aforementioned means, we see that the combinations of burger-kitchen and mussels-beach were though to be significantly better when compared to salad-jungle, bbq-farm and pizza-urban ones.

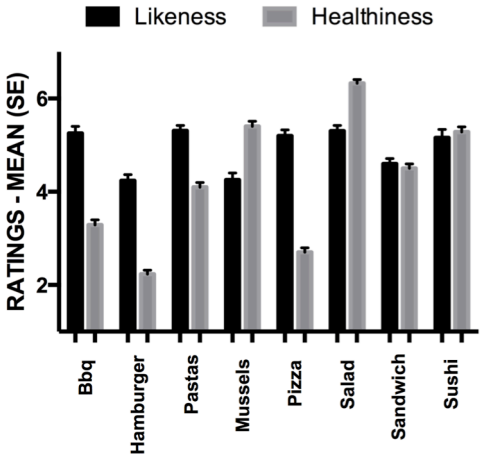

Figure 2. Means and standard deviations (SE) of the ratings of likeness and healthiness that the participants gave to the eight food types available for ratings in the control test. Note that all the ratings of likeness are between 4-6 points (on a 7 point scale), and only three healthiness ratings are equal/below the middle point of the scale (Bbq, hambuger, and pizza).

Table 4. Means and SD of the participant's ratings on how much they thought that the soundscape matched with the chosen food type. When performing a chi-square goodness-to-fit test, we find that the choices made were significantly different from chance, in all cases, for the soundscapes ($p < .005$).

Soundscape	Preferred food choice	Mean (SD)
Jungle	Salad	4 (1.5)
Farm	Bbq	4.7 (1.5)
Kitchen	burger	5.3 (1.5)
Urban	pizza	4.5 (1.6)
Beach	mussels	5.3 (1.6)

Table 5. p-values of the of the comparisons of the means shown in Table 4 (analysis based on a One-way ANOVA with Bonferroni correction).

	Jungle	Farm	Kitchen	Urban	Beach
Jungle	X	.009	<. 005	.309	<. 005
Farm	.009	X	.004	1	.017
Kitchen	<. 005	.004	X	<. 005	1
Urban	.309	1	<. 005	X	<. 005
Beach	<. 005	.017	1	<. 005	X

Matching songs with food types: Most of the participants agreed that the sushi matched best with the Japanese song (95%), the pastas dish matched best with the opera song (91%), the bbq with the country song (90%), the burger with the Pop 02 song (89%), and the pizza with the Pop 01 song (69%). The choices associated with the other two songs were not so obvious. While 49% of the participants chose the mussels, 48% of the participants chose the salad as their ideal match with the French song. Furthermore, while 55%

of the participants chose the sandwich, 34% of the participants chose the bbq as their ideal match with the tropical song.
Table 6 shows the correspondent means and SD of their ratings on how much they thought that the soundscape matched with the chosen food type, and Table 7 shows the p values of the comparisons of the correspondent means. When comparing the aforementioned means, we see that the combinations of sushi-japanese, pasta-opera, and bbq-country were though to be significantly better when compared to pizza-pop01, mussels/salad-French, sandwich-tropical, and burger-pop02.

Table 6. Means and SD of the participant's ratings on how much they thought that the soundscape matched with the chosen food type. When performing a chi-square goodness-to-fit test, we find that the choices made were significantly different from chance, in all cases for the songs ($p < .005$).

Song	Preferred food choice	Mean (SD)
Pop 01	Pizza	4 (1.6)
Japanese	Sushi	5.7 (1.5)
Opera	Pasta	5.8 (1.4)
Country	Bbq	5.4 (1.5)
French	Mussels/salad	4.2 (1.7)
Tropical	Sandwich	4.2 (1.6)
Pop 02	Burger	4.4 (1.8)

Table 7. p-values of the of the comparisons of the means shown in Table 6 (analysis based on a One-way ANOVA with Bonferroni correction).

	Pop 01	Japanese	Opera	Country	French	Tropical	Pop 02
Pop 01	X	<. 005	<. 005	<. 005	1	1	.27
Japanese	<. 005	X	1	1	<. 005	<. 005	<. 005
Opera	<. 005	1	X	.45	<. 005	<. 005	<. 005
Country	<. 005	1	.45	X	<. 005	<. 005	<. 005
French	1	<. 005	<. 005	<. 005	X	1	1
Tropical	1	<. 005	<. 005	<. 005	1	X	1
Pop 02	.27	<. 005	<. 005	<. 005	11	1	X

4. Discussion

In the study presented here, the participants associated different sounds with food types. Two main groups of sound stimuli were presented (one group of seven songs and another of five soundscapes). Results showed that the participants were able to consistently choose favorite food types with most of the sound stimulus.
In particular, the control study showed that most of the participants liked all of the food types presented as choices. The bbq, the burger and the pizza were among the highest rates when it comes to likeness, and also considered as the unhealthiest one (See Figure 2). As expected, people are aware that they enjoy food types that are widely known for being unhealthy. Unexpectedly, the salad was also rated high in likeness. Nevertheless, the salad was rated as one of the healthiest food choices, as expected. When it comes to the matches between soundscapes and food types, we see that the participants mostly agreed with the same soundscape-food associations (See Table 4). When analyzing the difference of ratings on how much they thought that the soundscape matched with the chosen food type, we see two groups, one with significantly higher means than the other (Burger-kitchen and mussels-beach - group 1A, were though to match significantly than salad-jungle; bbq-farm and pizza-urban - group 2A; see Table 5). The same pattern seems to occur with the matches between songs and food type (sushi-japanese, pasta-opera, and bbq-country - group 1B, were though to match significantly better than pizza-pop01, mussels/salad-French, sandwich-tropical, and burger-pop02 - group 2B; see Table 7).
Some of the associations here proposed might be more cultural related than others, especially for the songs, and this might have an overall effect on the way the participants perform while pairing sounds with food.

For example, it seems inherent to associate an opera song with pastas and sushi with a Japanese song. On the other hand, the bbq-country have meat as common ground (the three aforementioned matches were though to be significantly better – group 1B). Moreover, the pop songs associations seem to be more related with a social/urban context. What is more, the best matches made with the French song (in this case, two), seem to be related with healthy/sophisticated food, whereas matching the tropical song mostly with sandwich could have to do with associating a song with vacation contexts at warmer regions, and the need of practical food to bring along while being, for example, at the beach.

For the soundscapes, it seems more difficult to interpret which elements are the ones guiding associations. In particular, the mussels were the preferred match with the beach soundscape (here, we do have a clear association with water and mussels), whereas the burger seems to be more associated with some of the sounds that were highlighted in the kitchen's soundscapes (in this case, a frying pan) - the two aforementioned matches were though to be significantly better when compared to the rest, group 1A. Furthermore, choosing jungle with salad seems to have to do with elements of nature (such as vegetables and/or leaves), and a farm apparently has the link with burger and its meat (note that, cows and chickens were part of the farm's soundscape as well and, hence, they might have worked as an attentional trigger, same as in the case of the frying pan). Similarly to one of the pop songs, the urban soundscape might have been associated with the social/urban context of a city and fast food (in this case pizza). Future studies could examine how these associations are formed. The question also arises, whether participant's responses would be the same if the food would be presented on a real plate, not only by means of pictures. Since the study was developed online, it was also not possible to understand the implications of the differences on how the background noise and the quality of each reproduction system might have affected the attention and overall experience of each participant.

Nevertheless, our results provide insights for future experiments involving decision-making. Lets imagine, for example, that we develop experiences in catering facilities, were we could reproduce, on each day of the week, different playlists focusing on Pop, Country, Italian and/or Asian music genres. On each, day, the food choices of the participants might be significantly influenced by such auditory cues, opening an entire new field of studies on how sonic information can be used in order to enhance the eating/drinking experience. However, music is submitted to individual-personal preferences, which could overcome in undesirable subjective/emotional feedbacks (i.e. some participants may love pop music, whereas others may simply not like it, what could have significant hedonic implications in the overall results; see [3] for a review on sensation transference). However, as showed in this experiment, working with soundscapes could be as effective as working with songs, potentially providing successful outputs during decision-making processes involving food choices, without significant emotional implications. For instance, people may feel commonly tempted to eat unhealthy food. What if a beach soundscape could gently lead them to rethink their choices while choosing from several options?

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