Current Research in Food Science 5 (2022) 423–431

Contents lists available at ScienceDirect

Current Research in Food Science

journal homepage: www.sciencedirect.com/journal/current-research-in-food-science

The impact of contextual information regarding the origin of food on consumers' judgments

Roberta Etzi [a,c], Matteo Girondini [a,c,*], Gemma Massetti [a,d], Alberto Gallace [a,b,c]

[a] Mind and Behavior Technological Center, Department of Psychology, Università Milano-Bicocca, Italy
[b] Best 4 Food, Università Milano-Bicocca, Italy
[c] Department of Psychology, Università Milano-Bicocca, Italy
[d] Department of Medicine and Surgery, Università Milano-Bicocca, Italy

ARTICLE INFO

Keywords:
Vision
Taste
Country-of-origin-labeling
Food
Skin conductance

ABSTRACT

Explicit and implicit responses to food and beverage are known to be modulated by expectations generated by contextual factors. Among these, labelling regarding the country of origin has been systematically shown to impact on consumers' evaluations of products. However, it is not clear yet whether the presence of food origin biases also affects humans' physiological (i.e., implicit) responses, as well as whether different conditions of sensory appreciation of products are equally influenced. The present preliminary study investigated the psychophysiological responses to food samples paired to labels of declared (i.e., Italy, Spain/Germany, EU) or undeclared origins. Food items (i.e., olives and cracker) were presented in visual or taste conditions to thirty Italian participants, whose behavioral (i.e., liking, willingness to buy, and estimated cost) and physiological (i.e., skin conductance responses) responses were collected. The results indicated that the food samples elicited stronger liking and willingness to buy responses by participants and were estimated as more expensive, when being firstly experienced through vision than taste. No differences in the physiological arousal state were found as a function of food origin or sensory condition of presentation.

1. Introduction

The perception of food is inherently multisensory (Spence and Piqueras-Fiszman, 2014), so often is the act of grocery shopping. When standing in front of the vegetable boxes at the supermarket, visual appearance is undoubtedly one of the first aspects that the consumer considers in their buying decision. By getting closer and touching the product, the consumer can smell its aroma, and appreciate its compactness. The multisensory experience will then be completed at home when the food will be turned into a meal, and the consumer will finally be able to evaluate the texture and enjoy the flavor. Nevertheless, pleasantness experiences are not always so straightforward. Sometimes the information experienced by two sensory modalities is not hedonically congruent. For instance, a bruised fruit might be rated as visually unpleasant but still delicious while tasted. Thus, expectations based on a specific sensory hint might prove wrong when experiencing the product via other senses (Piqueras-Fiszman and Spence, 2015; Yeomans et al., 2008; Spence, 2020). In such cases, the multitude of sensory inputs are weighted and combined as a result of a multisensory integration process, and a hedonic final judgment is finally made (de Eguilaz et al., 2018; Spence and Gallace, 2011; Spence, 2012b). However, grounding evaluations and expectations upon a single sensory modality, as in the case of the bruised fruit, sometimes might prevent more direct contact with the product and consequently the willingness to buy it. New strategies to attract the consumer's attention and engage them need then to be found. This is especially relevant in the era of online shopping – hugely increased during the COVID-19 pandemic – in which visual aspects of products are usually the unique sensory attributes represented, to the detriment of a more complete multisensory experience (Hisano, 2019; Koch et al., 2020; Chang and Meyerhoefer, 2021).

Food perception and evaluation are not solely based upon intrinsic product attributes (i.e., food colour, shape, texture), but also upon extrinsic product properties (i.e., packaging, price, country of origin; Enneking et al., 2007; Fernqvist and Ekelund, 2014; Piqueras-Fiszman and Spence, 2015; Wang et al., 2019). For instance, most of the time, direct contact with food is prevented or favoured by its packaging. Although the package represents a barrier to direct contact with food, product designers exploit what might be seen as a limit instead of a

* Corresponding author. Mind and Behavior Technological Center, Department of Psychology, Università Milano-Bicocca, Italy.
E-mail address: m.girondini@campus.unimib.it (M. Girondini).

https://doi.org/10.1016/j.crfs.2022.02.003
Received 20 December 2021; Received in revised form 7 February 2022; Accepted 7 February 2022
Available online 15 February 2022

means to enrich the consumer's experience. Sensory and semantic congruent sensory information with the food contained in the package can be, in fact, delivered by taking advantage of the power of the crossmodal correspondence effect (e.g., Becker et al., 2011; Biggs et al., 2016; Spence, 2011; Velasco et al., 2014). As described by the affective ventriloquism effect, hedonic qualities of the product delivered through a sensory modality can be recalled via another sense (Spence and Gallace, 2011). Similarly, it is well known how tactile attributes such as the solidity or resistance of a material influences judgments in other domains (Maggioni et al., 2015; Risso et al., 2019), or how the product or brand name can evoke specific thoughts about the quality and the price and can generate expectations (Etzi et al., 2016; Gallace et al., 2011; Spence, 2012a).

The presence of labels plays a fundamental role in food perception as well. One might think about how consumers' expectations are influenced by those product labels which refer to quality certifications, nutritional elements, and healthiness – factors towards which the consumers are becoming more and more aware, as well as demanding – (Piqueras-Fiszman and Spence, 2015; Provencher and Jacob, 2016; Richetin et al., 2021; Skaczkowski et al., 2016). Among the extrinsic product attributes, the geographic origin of food has been demonstrated to be a crucial factor over the years when dealing with consumers' buying choices (see Al-Sulaiti and Baker 1998; Bilkey and Nes, 1982; Newman et al., 2014; Verlegh and Steenkamp, 1999 for reviews). Country-of-origin labelling is mandatory in several nations across the world (see Regulation No 1169/2011 for EU countries) and provide consumers with a guarantee about the provenance of the food product. On this aspect, the 'genetic barcode system', which allows to track the origin details about a food item (despite the fact this system is not that intuitive since it implies the mediation of a smartphone), certainly represents a useful tool (e.g., Campanaro et al., 2019; Galimberti et al., 2019).

Multiple factors related to the country of origin of food are taken into consideration when making a purchase. Products coming from specific nations might be preferred over others as a function of production expertise, cultural and personal knowledge and even food/cooking information (e.g., about the Mediterranean diet). The sum of these concepts is well explained by the trusted reference to "Made in … " products, which is spread worldwide and is often considered a guarantee of high-quality food (Fortis and Sartori, 2016; Ricci et al., 2019). Moreover, consumers' choices might also be based on considerations regarding the specific product under examination. Then, food coming from countries where that product is typically produced/cooked or is linked to an older tradition (and even clichés) would be preferred (e.g., cheese from France, pasta from Italy, noodles from China, chocolate from Belgium, coffee from Colombia and so on).

Consumer ethnocentrism, the phenomenon whereby consumers prefer products realized in the country for which they feel a sense of belongingness and identity, can also explain purchase intentions (Shimp & Sharma; 1987; Watson and Wright, 2000). Besides, consumer ethnocentrism is also related to the preference for domestic and locally produced food, a tendency that can further be reinforced by a sensitivity to the environmental sustainability issue and low-cost production (Aprile et al., 2016; Conner et al., 2010; Feldmann and Hamm, 2015). When dealing with the expectations based on the country of origin of food, it is fundamental to note that these labels can generate cognitive biases. In fact, several experiments have shown how consumers' food judgments can be modulated as a function of the country of origin indicated on the packaging, acting as reinforcement (Mueller and Szolnoki, 2010; Stefani et al., 2006). Moreover, these judgments are also affected by the positive or negative overall image which the country itself is able to communicate (Ricci et al., 2019).

Although the effect of the country of origin labels on explicit responses has been extensively covered in the last decades, on the opposite, very little is known about the more implicit physiological consumers' responses. The relevance of the use of autonomous nervous system (ANS) measures in food and beverage research is being increasingly highlighted in the literature (e.g., Spinelli and Niedziela, 2016; Torrico et al., 2019; Verastegui-Tena et al., 2018; Verastegui-Tena et al., 2018; Walsh, Duncan, Bell, O'Keefe and Gallagher, 2017). Physiological responses to food and beverage have been shown to vary as a function of contextual factors such as the environment (Xu et al., 2019) and the presence of other sensory stimuli (Kantono et al., 2019). Valence (i.e., liking) and arousal (i.e., intensity) mediate ANS effects on the presentation of food and beverage. A number of studies have focused on these aspects; nevertheless, the results are somehow contrasting, likely because of differences in the paradigms adopted. For instance, de Wijk et al. (2012) showed that variations of skin conductance responses (SCRs) are elicited at first sight of a disliked food. Later, De Wijk et al. (2014) found that liking is associated with increased heart rate (HR) and skin temperature (ST), and to a lesser degree to increased skin conductance. Moreover, Danner et al. (2014) found higher skin conductance levels (SCLs) and pulse volume amplitude (PVA) to dislike vs. liked samples. Rousmans, Robin, Dittmar and Vernet-Maury (2000) revealed higher skin resistance (SR) amplitude, HR, ST and skin blood flow (SBF) for unpleasant evaluated primary tastes. Beyond liking, the ANS effects of food acceptability were also examined. Lagast et al. (2020) found higher HR and lower latencies of SCRs to sensory non-accepted (i.e., bitter caffeine) vs. accepted (sweet sucrose) solutions, but crucially not in the frontal alpha asymmetry (FAA). However, to the best of our knowledge, it seems that the ANS effects of food origin labels have not been investigated yet, with the exception of the study of Mora et al. (2020), who reported a higher – but crucially not significant – arousal response (measured through skin conductance activity) to the protected design of origin (PDO) vs. no-PDO apple cider.

The purpose of the work was to verify, in a preliminary study, the impact of the country-of-origin labels on consumers' behavioural and physiological responses to two food products experienced via vision or taste. Hence, two foodstuffs – olives and crackers – were presented paired to their declared (i.e., Italy, Spain/Germany, EU) or undeclared origins to a group of Italian participants. In order to also assess the role of expectations generated by vision over taste and vice-versa, the order of presentation of visual and taste blocks was varied (Biswan et al., 2021). Behavioural ratings (i.e., liking, willingness to buy, and estimated cost) were asked to the participants, and their arousal response (i.e., skin conductance responses; SCRs) to the food samples were recorded. Grounding on the studies mentioned above (e.g., Newman et al., 2014; Verlegh and Steenkamp, 1999), we expected that the information about the country of origin of food would result in greater liking, willingness to buy, and estimated cost than the undeclared origin items. About the arousal state, we predicted higher SCRs to the food with the undeclared origin, resulting from the tendency to distrust and avoid food which provenance is obscure (Bitzios et al., 2017; Verbeke et al., 2007). Finally, differences between visual and taste modalities related to their order of presentation were expected. In particular, prior visual experiences might generate expectations on the subsequent taste experience, while the opposite (i.e., tasting affecting visual judgments) seems less likely.

2. Experiment

2.1. Methods

2.1.1. Participants

Thirty Italian volunteers (seven males; mean age: 23 ± 4 years; age range 20–35 years; 27 right-handed) were recruited in the experiment. The participants reported having normal or corrected-to-normal vision. Normal olfactory perception and absence of respiratory problems were also checked before testing the participants to avoid any impairment of taste perception. The study was conducted according to the principles of the Declaration of Helsinki and was approved by the local ethical committee. The volunteers received course credits as a reward for their

study participation.

2.1.2. Sample size

The sample size for this study was calculated a priori, using G*Power 3.1 (Faul et al., 2009), with $\alpha = 0.05$ power $(1\text{-}\beta) = 0.80$, and small sample size (0.3). The estimated sample size was twenty-four participants, but taking in account possible artifacts due to physiological measurement, we decided to recruit thirty participants in our sample size.

2.1.3. Stimuli

Crackers and olives were chosen as food samples because they represent common food in Italy and are easily manageable in a laboratory setting (see Allison et al., 2004 for the use of crackers as sample; see Caporale et al., 2006; see also Dekhili and d'Hauteville, 2009 for the use of olive oil). Three pictures, randomly paired with the country-of-origin labels, were presented for each product. Black and green variants of olives and salty or unsalted crackers were shown (Fig. 1). As for the taste condition, pitted olives from the brands Auchan, Esselunga, Polli, and salted crackers from the brands Pavesi, Delser, Esselunga were selected.

2.1.4. Procedure

Upon their arrival, the participants were welcomed and instructed about the experimental procedure. Then, they were comfortably sat at a table in front of a screen, and in order to record the participant's electrodermal activity (EDA), two Ag-AgCl electrodes were attached to the index and ring finger of their non-dominant hand. The ProComp 5 Infiniti™ system (Thought Technology, Montreal, QC) was used to record the EDA data through a second computer, which screen was only visible to the experimenter. The BioGraph Infiniti software was used to process the data collected. Mark events were manually provided by the experimenter. During the experiment, the experimenter seated at the participants' left side, and the vision of the experimental equipment was covered by a black curtain. The food samples were paired with labels, varying in their specificity about the country of origin. Olives and crackers were then presented as: 1) produced in the participants' home country (Italy); 2) produced in another country (Spain for olives, and Germany for crackers – for this category, different origins were chosen on the base of current data on food production/consumption; that is for each product we selected the country were production and consumption were higher in EU –); 3) produced in the EU; 4) undeclared country of origin. While the first three labels were also accompanied by the flag of the country, the latter had no flag (Fig. 2).

Unisensory visual and taste conditions were administered in two counterbalanced blocks. Namely, half of the participants started with the visual block and then proceeded with the tasting block, and vice versa for the other half. In the visual block, for each trial, the participants were presented with 4 s-long pictures: for the first 2 s an indication about the country of origin of the item (paired with a flag in the case of declared origins) was visible on the bottom of the screen, then for the last 2 s a picture of the product also appeared and stayed at the top of the image (Fig. 3A). In the taste condition, the participants were blindfolded and were required to taste a small piece of product placed trial by trial on a plate on the table by the experiment. These pieces were freshly prepared by the experimenter a few minutes before the taste condition. The food samples presented were never visible to the participants because prepared behind the black curtain and served when the participant wore the blindfold. For each trial, the experiment informed the participant about the origin of the product and placed it on the plate so that the participant could take it and taste it. They had been previously trained about the specific position of the plate on the table. On average the participants took 5–6s to evaluate each sample presented (Fig. 3B). For each sensory condition, 24 trials (2 food samples by 4 countries of origin by 3 repetitions) were presented in a pseudorandomized order. Each of the three repetitions corresponded to a food sample variant (pictures or real food samples). For both visual and gustatory conditions, after each trial, the participants filled in three visual analogue scales (VASs) about liking ("How much do you like this product?"), willingness to buy ("Would you wish to purchase this product?") and estimated cost of the product ("How much would you pay for this product?"). The first two were anchored by the labels "not at all" and "very much", while the last one by the labels "0€" and "5€". Each scale was presented separately from the others, and their order of presentation was pseudorandomized. These were presented with E-prime 2.0 (Psychology Software Tools, Pittsburgh, PA).

2.1.5. Data analysis

As far as the analysis of VAS data is concerned, a mixed repeated measure analysis of variance (rmANOVA) with the within factors of *product* (olives vs. crackers), *sensory modality* (vision vs. taste), *origin* (Italy vs. Spain/Germany vs. Europe vs. unknown) and the between factor *presentation order* (vision first vs. taste first) was performed. Significant results were further analyzed with HSD Tukey's corrected post-hoc tests. Correlational analyses among the three scales were also run. As regards the electrodermal activity measurements, data were further elaborated using the Matlab-based script Ledalab (version 3.4.8) by adopting a continuous decomposition approach (Benedek and Kaernbach, 2010). Skin conductance response (SCR) was used as an index for the analysis. Visual and gustatory conditions were analyzed separately given that the taste condition implies a higher number of motor artifacts. In the visual condition, the temporal window taken into consideration for the data analysis was from 2 to 6 s after the onset of the stimulus. In

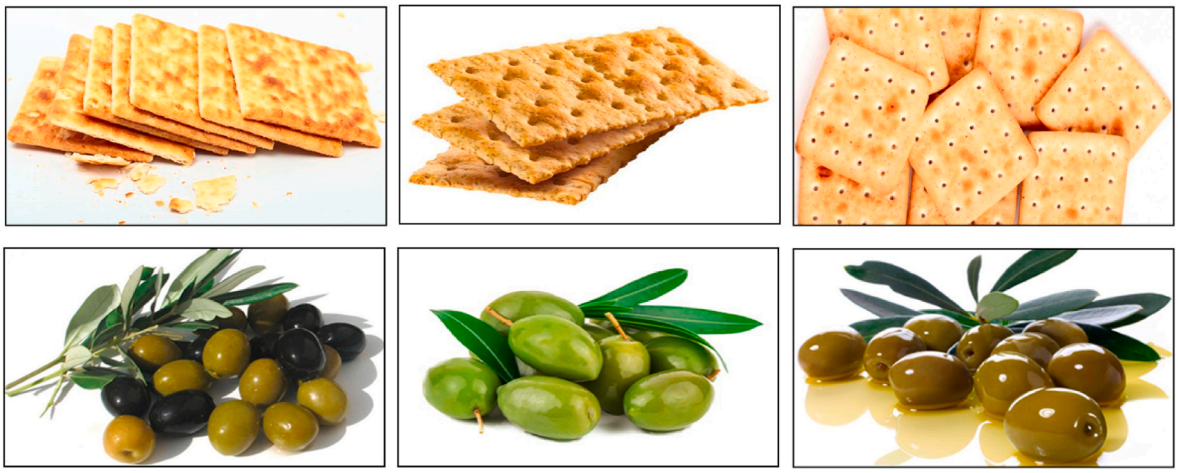

Fig. 1. Pictures of crackers and olives adopted as visual stimuli in the experimental paradigm.

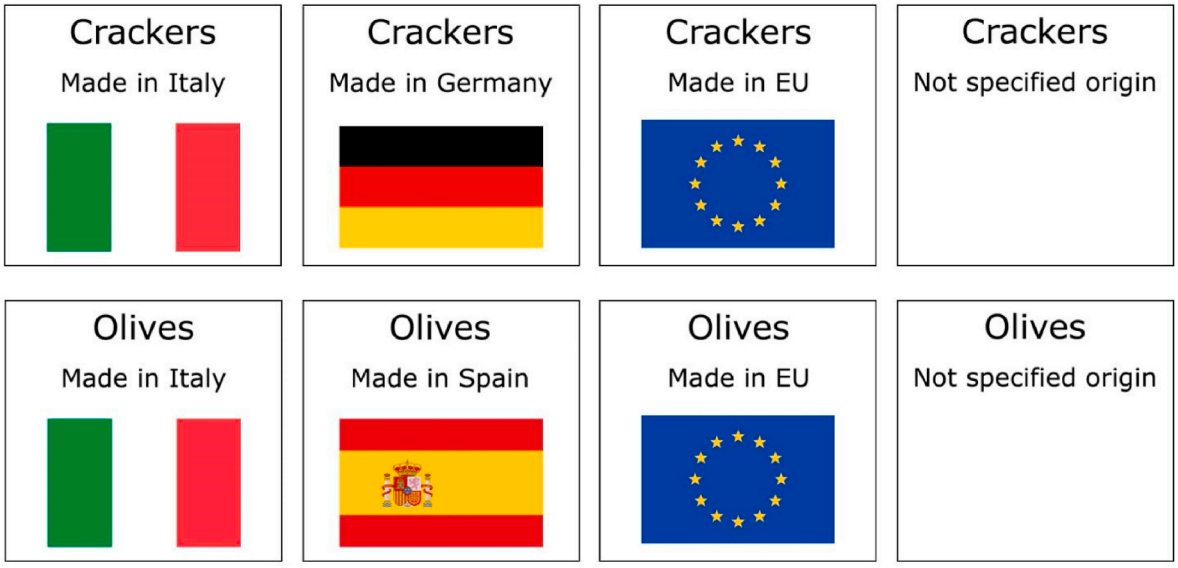

Fig. 2. Country of origin labels presented in the visual condition.

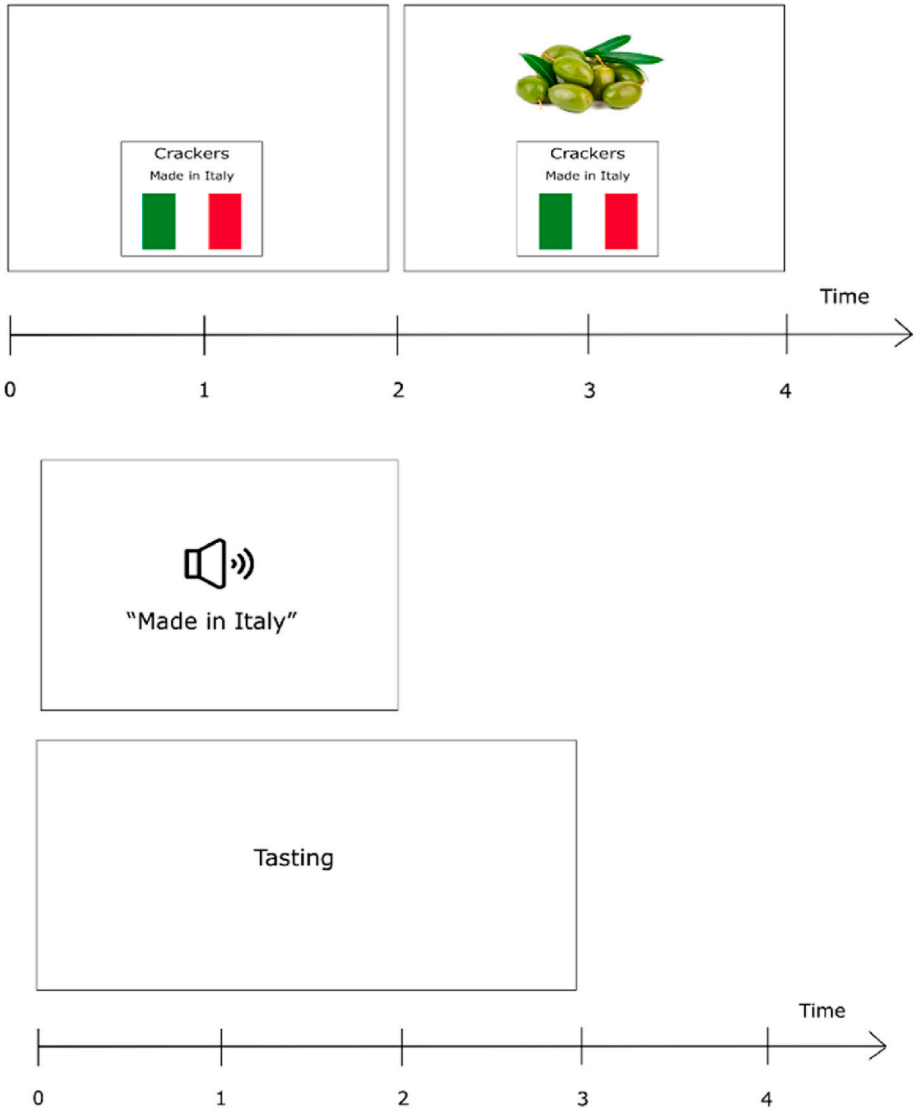

Fig. 3. Visual and taste timelines.

the gustatory condition, the temporal window was set in the range 3–5 s to avoid the motor artifacts due to chewing in the first seconds of stimulus presentation. In order to minimize such artifacts on the data, a 1 Hz low-pass filter was also applied. A series of ANOVAs with *product* (olives vs. crackers), *sensory modality* (vision vs. taste), *origin* (Italy vs. Spain/Germany vs. Europe vs. unknown), and *presentation order* (vision first vs. taste first) as main factors were run. HSD Tukey corrected post-hoc tests were run here as well. Skin conductance analyses in response to the visual condition were run on 29 out of 30 participants because of a technical problem during the data collection.

3. Results

Liking. The significant main effect of *product* [$F(1, 28) = 6.51$, $p = .01$] indicated that olives were liked by participants more than crackers. The interaction between *product* and *sensory modality* [$F(1, 28) = 8.09$, $p = .008$] confirmed that the previous result was present both for the visual and gustatory condition and also revealed that olives were liked more when seen in the picture than when tasted ($p = .01$), with no difference for crackers ($p = .91$; see Fig. 4). The main effect of the *origin* was significant as well [$F(3, 84) = 16.28$, $p < .001$], revealing that the products of unknown origin were liked less than the products with declared origins (IT, SP/GE, EU, all ps $< .001$), with no difference among the other origins (all ps $> .05$). Moreover, the interaction between *origin* and *sensory modality* [$F(3, 84) = 2.93$, $p = .03$] suggested that the difference between unknown and known origins was present for both sensory modalities (all ps $< .001$). Visually-presented Italian products were liked more by participants than those declared as coming from Spain/Germany ($p = .01$), with a trend also indicating differences between Italian and EU origins ($p = .09$). However, as suggested by the significant interaction between *origin* and *presentation order* [$F(3, 84) = 6.90$, $p < .001$], the difference between the unknown origin and the other known origins was present only for those participants who experienced the visual condition (all ps $< .001$) before the gustatory one (all ps $> .05$). Given that the three-ways interaction among *origin*, *sensory modality* and *presentation order* [$F(3, 84) = 3.62$, $p = .01$] was significant, we decomposed the analysis according to the *presentation order* factor. In the sub-sample of participants who started with the visual condition, a main effect of origin [$F(3, 42) = 15.22$, $p < .001$] was found, confirming that products of unknown origin were liked less than all the three known origins (all ps $< .001$). The interaction between *sensory modality* and *origin* [$F(3, 42) = 4.35$, $p = .009$] suggested that this was true for both sensory modalities (all ps $< .001$). In the gustatory condition, only a main effect of *sensory modality* [$F(1, 14) = 7.96$, $p = .01$] was found, with higher ratings for visual than gustatory judgments. All the non-significant effects of the Liking scale are reported in Table 1.

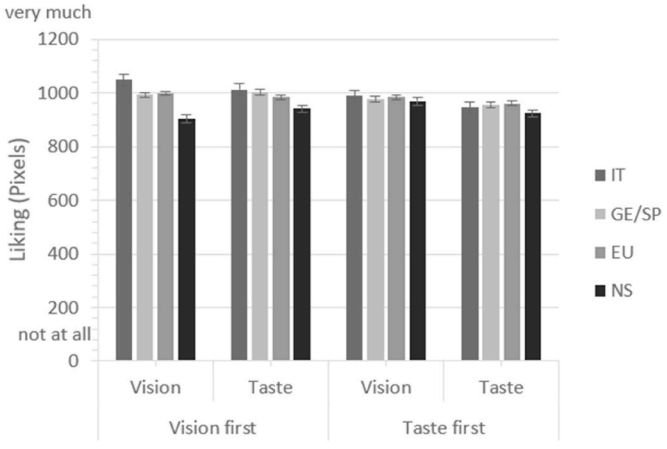

Fig. 4. Mean ratings to liking scale. Error bars represent the error of the means. IT = Italian; GE = German; SP = Spanish; EU = European Union; NS = Non-Specified (Undeclared).

Willingness to buy. The main effect of *product* [$F(1, 28) = 5.78$, $p = .02$] indicated that olives elicited a stronger willingness to buy than crackers. The effect of *origin* was significant as well [$F(3, 84) = 22.09$, $p < .001$] and indicated that the unknown origin product received lower ratings than all products from other countries (all ps $< .001$), with no differences among the others (all ps $> .05$; see Fig. 5). As revealed by the interaction between *origin* and *presentation order* [$F(3, 84) = 10.12$, $p < .001$], this difference among unknown and known origins was present only for those participants who experienced the visual condition (all ps $< .001$) before of the gustatory (all ps $< .05$). Besides, a stronger willingness to buy was found for those participants who started with the visual condition and only when Italian origin was compared with EU origin ($p = .05$), with a trend suggesting the same effect vs. Spain/Germany ($p = .07$). The interaction among *product, origin* and *presentation order* was significant as well [$F(3, 84) = 3.08$, $p = .03$] and was decomposed according to the *presentation order* factor. A significant effect of *origin* [$F(3, 42) = 19.25$, $p < .001$] and of *product* * *origin* [$F(3, 42) = 4.30$, $p = .009$] were found for those participants starting with the visual condition. Unknown origin products elicited less willingness to buy than the others (all ps $< .001$), with a trend indicating a stronger willingness to buy for Italian vs. EU origin ($p = .08$). The preference for known origins vs. unknown was present for both olives and crackers (all $p < .001$). Moreover, a stronger willingness to buy for Italian vs. Spain and vs. EU (both ps $< .001$) in the case of olives, and between Italian vs. EU ($p = .004$) in the case of crackers, but not between Italy and Spain ($p = .25$), were found. In the ANOVA for those participants starting with the gustatory condition, only the main effect of *origin* was significant [$F(3, 42) = 3.45$, $p = .02$], indicating that unknown origin received lower ratings as compared to EU ($p = .04$), with a trend indicating the same effect vs. Italian and vs. Spain/Germany (both ps $= .06$). All the non-significant effects are reported in Table 1.

Estimated cost. The main effects of *product* [$F(1, 28) = 10.76$, $p = .002$] and *origin* [$F(3,84) = 19.11$, $p < .001$] were significant. Olives were estimated to be more expensive than crackers. Moreover, unknown origin products received lower ratings than the other known origins products (all ps $< .001$; see Fig. 6), in addition to a trend that showed higher estimated costs for Italian than SP/GE ($p = .06$). However, the interaction effect between *origin* and *presentation order* [$F(3,42) = 3.45$, $p = .02$] revealed that the higher estimated cost associated with known products vs. unknown (all ps $< .001$), and to Italian vs. Spain/Germany ($p = .05$), was valid only for those participants starting with the visual condition, and not for the gustatory (all $p > .05$). All the non-significant effects are reported in Table 1.

Skin conductance response. For the visual condition, all the effects were not significant ($p > .05$; see Fig. 7). For the gustatory condition, only the main effect of product [$F(1, 28) = 6.19$, $p = .01$] was significant, indicating that crackers were responsible for a higher SCR than olives (see Fig. 8). The other effects were not significant (see Table 2).

4. Discussion

The result of the present work confirmed that the label regarding the origin of food has a significant impact on consumers' judgments and purchase intentions (Mueller and Szolnoki, 2010; Newman et al., 2014; Stefani et al., 2006; Verlegh and Steenkamp, 1999). In particular, our study extended these findings by examining the role of the sensory modality (vision or taste) of food appreciation and its impacts on both the consumer's behavioral and physiological responses. Interestingly, the country-of-origin bias emerged in response to those food samples which were first experienced by vision rather than by taste. Namely, higher liking, willingness to buy, and estimated cost were found for declared vs. undeclared origins, when food samples were visually presented first. By contrast, when the first experience was mediated by taste, preventing the participants from seeing the food sample and only

Table 1
Results of the statistical analyses performed for the liking, willingness to buy, estimated cost scales. Asterisks indicate statistical significance ($p < .05$).

	Liking			Willingness to buy			Estimated cost		
	d.f.	F	p	d.f.	F	p	d.f.	F	p
Product	1, 28	6.51	0.01*	1, 28	5.78	0.02*	1, 28	10.76	0.002*
Origin	3,84	16.28	<0.001*	3, 84	22.09	<0.001*	3, 84	19.11	<0.001*
Order	1, 28	0.91	0.34	1, 28	0.23	0.63	1, 28	0.01	0.89
Sense	1, 28	2.19	0.14	1, 28	2.21	0.14	1, 28	3.04	0.09
Product * Origin	3, 84	0.60	0.61	3, 84	1.63	0.18	3, 84	0.70	0.55
Product * Order	1, 28	0.46	0.50	1, 28	0.78	0.38	1, 28	1.10	0.30
Product * Sense	1, 28	8.09	0.008*	1, 28	3.80	0.06	1, 28	2.80	0.10
Origin * Order	3,84	6,90	<0.001*	3, 84	10.12	<0.001*	3, 84	8.04	<0.001*
Origin * Sense	3, 84	2.93	0.03*	3, 84	1.40	0.24	3, 84	2.19	0.09
Order * Sense	1, 28	2.07	0.16	1, 28	1.84	0.18	1, 28	0.19	0.65
Product * Origin * Order	3, 84	1.73	0.16	3, 84	3.08	0.03*	3, 84	0.73	0.53
Product * Origin * Sense	3, 84	0.43	0.72	3, 84	0.47	0.69	3, 84	0.18	0.90
Order * Origin * Sense	3, 84	3.62	0.01*	3, 84	1.20	0.31	3, 84	1.95	0.12
Order * Product * Sense	1, 28	1.89	0.18	1, 28	2.05	0.16	1, 28	2.28	0.14
Product * Order* Origin * Sense	3, 84	1.19	0.31	3, 84	0.62	0.60	3, 84	0.90	0.44

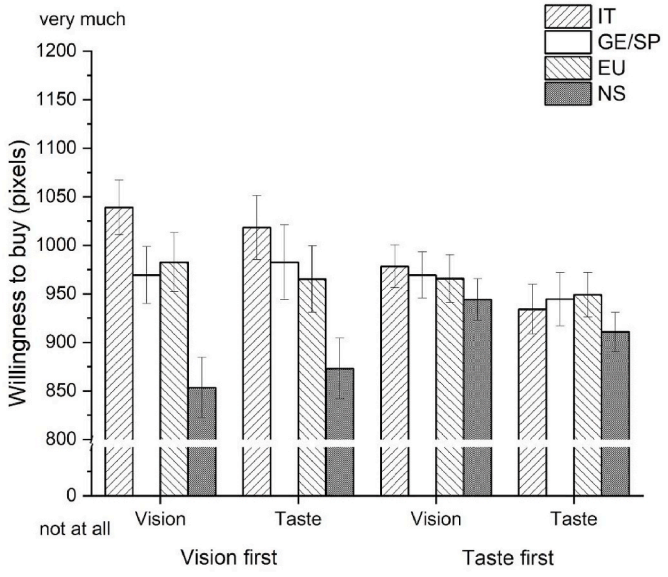

Fig. 5. Mean ratings to willingness to buy scale. Error bars represent the error of the means.

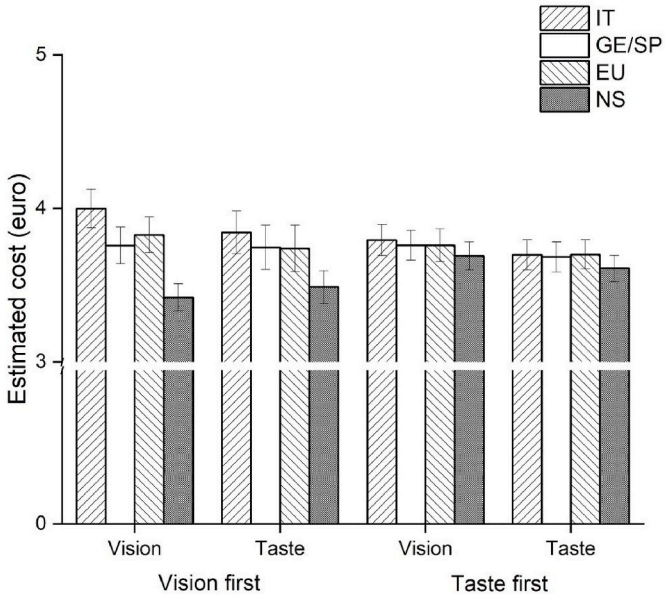

Fig. 6. Mean ratings to estimated cost scale. Error bars represent the error of the means.

being told about its country of origin, the participants' judgments about the products did not change as a function of the origin label. It seems then that the taste condition acted as a sort of disconfirmation of the country-of-origin bias, which instead was strongly present for the visual experience. Our results would seem to support the importance of "try before buy" experience to mitigate the effect of cultural and social bias in products evaluation (Stryja and Satzger, 2018).

It is unclear, however, if this effect depended on the vision of the picture or on the presence of the flag indicating the origin. It is possible that visual elements are trusted more than auditory-verbal indications, like those used in the taste condition. In fact, here the modalities of presentation of the food samples varied depending on the sensory modality stimulated. It also needs to be noted that the condition whereby someone tastes something without seeing it is rather rare, excluding exclusive gastronomy experiences (Spence and Piqueras-Fiszman, 2012). Generally, the visual experience of food acts as a sort of filter, sometimes followed by smell, and often only those items which overcome this selections phase are actually brought to the mouth. It also needs to be considered whether a food item presented with no information about its country of origin can be trusted in terms of safety (Liu et al., 2019; Lobb and Mazzocchi, 2007), especially in those countries where food origins must be declared mandatorily on the packaging.

While the undeclared origin was generally disliked by all the participants, even though more for those starting with the visual experience, the results regarding the contrasts between Italy and the other specific European nations (Spain for olives and Germany for crackers) or the more generic EU origin indication, are more uncertain. For instance, Italian items were liked more than Spanish/German products (with a similar trend for Italy vs. EU, perhaps suggesting an only partial identification of the average Italian consumer with EU identity) in the visual condition; similarly, Italian items induced stronger willingness to buy than EU (with a similar trend for Italy vs. Spain/Germany).

In this case, it needs to be considered that all the participants in the presented study were Italian, and this aspect undoubtedly affected the judgments. In fact, as demonstrated by the consumer ethnocentrism bias, people tend to prefer items produced in their home country (Shimp & Sharma; 1987; Watson and Wright, 2000). This bias can depend on the belief that home country products are effectively better than others, to support the economy of the own country, and for environmental issues (Aprile et al., 2016; Conner et al., 2010; Feldmann and Hamm, 2015). Moreover, the concept of 'Made in Italy' for foods is particularly strong all over the world and, of course, especially in Italy (Fortis and Sartori, 2016; Ricci et al., 2019). In this sense, it is difficult to distinguish

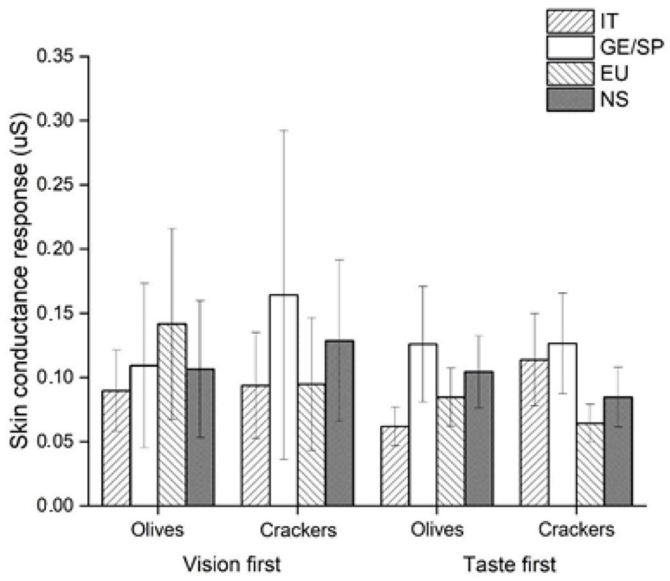

Fig. 7. Mean skin conductance responses to visual condition. Error bars represent the error of the means.

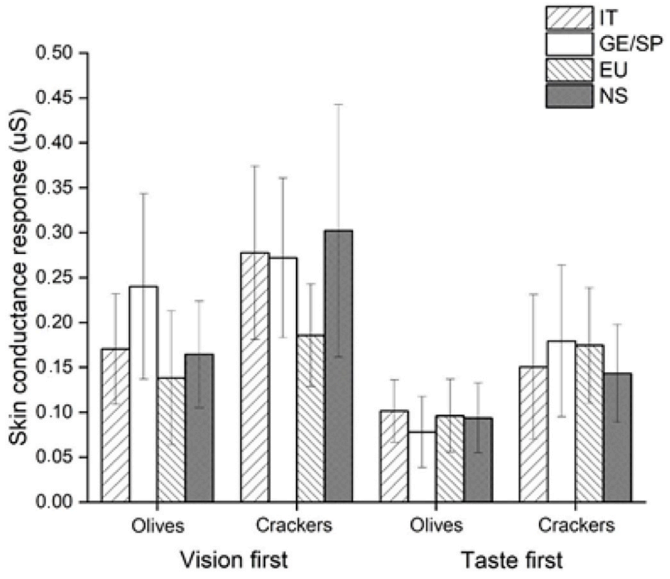

Fig. 8. Mean skin conductance responses to gustatory condition. Error bars represent the error of the means.

Table 2
Results of the statistical analyses performed for skin conductance responses to visual and gustatory conditions. Asterisks indicate statistical significance ($p < .05$).

	Vision			Taste		
	d.f.	F	p	d.f.	F	p
Product	1, 27	0.38	0.53	1, 28	6.19	0.01*
Origin	3, 81	0.74	0.52	3, 84	0.72	0.53
Order	1, 27	0.11	0.73	1, 28	1.15	0.29
Product * Origin	3,81	0.62	0.59	3, 84	0.08	0.97
Product * Order	1, 27	0.08	0.76	1, 28	0.03	0.85
Origin * Order	3,81	0.17	0.91	3, 84	1.13	0.33
Product * Origin * Order	3, 81	0.46	0.70	3, 84	0.57	0.63

between in-group bias or the "made in Italy" effect. However, the stronger influence on subjective judgment in visual condition, rather than taste condition, suggest that this effect is present in the step before trying the food, and, at the end, modulated by its tasting experience. It is worth mentioning here that food packaging might also affect food perception and evaluation, but, for this study, we decided to keep the visual appearance of the packaging as simple as possible (compatibly with the available food chosen for the experiment) and concentrate only on the "provenience" of food. However, we believe that this aspect should be directly manipulated (with the help of packaging designers) in future studies.

Differently from the cognitive evaluation, the physiological arousal responses were not modulated by the food product's origin country. Thus, implicit responses were not affected by the country of origin of the food samples, neither when experienced via vision, nor when experienced via taste. The lack of significant effects of the food country origin on SCRs is in line with the study of Mora et al. with PDO and not-PDO apple cider (2020). One might expect to find such differences given that cognitive expectations – and overall missed expectations – are known to impact on physiological responses (Cacioppo et al., 2007). However, it is likely that more ecological settings would have better chances to make emerge such effects, for example by presenting the participants with real products and packaging instead of pictures. Moreover, particular attention should be paid when including a gustative condition in the experimental paradigm, given that the motor artifacts due to chewing can be responsible of covering, at least in part, potential arousal effects (see Posada-Quintero and Chon, 2020 for a discussion of the current consistency of SCR in presence of motor artifacts). On this point, studies about the arousal response to tasting food items, show that skin conductance is more able to capture novelty and valence effects, while cardiac activity is more suitable for disconfirmation of expectations (Verastegui-Tena et al., 2018). In sum, modifications of the experimental procedures or the use of other methods to verify the presence of implicit biases (e.g., Implicit Association Test, IAT) should be considered in order to investigate this aspect further.

In general, the results of this kind of studies can be of high interest in the applicative fields of marketing, food and packaging design, and advertising. -In fact, several insights about the modality of advertising and presentation of food products can be drawn from these results. The advertising and packaging of those products which origin country is particularly relevant (e.g., Italian pasta) should visually highlight the origin aspect to attract the consumer's attention. The installation of banquets placed inside the stores with the possibility of tasting the product might instead be more strategic in those cases in which the origin of the product is not very appealing, and the aim is to focus the consumer's attention on the taste of the food. Hence, different strategies should be adopted depending on the product to be promoted, as well as on the results of a user research process aimed at assessing how consumers perceive and respond (both cognitively and emotionally) to that specific product.

5. Limits and future work

This preliminary study presents undoubtedly several limits. In particular, despite a significant effect of the origins of food and the type of food (also regarding the sensory modality) on participants' evaluations, the physiological analysis missed the research proposal. This could be due to the relatively small sample size tested, or to some uncontrolled motor artifacts (e.g., the participants movements were not controlled through electromyography).

It is worth mentioning that in our study we did not test the role of national differences on food evaluation. It would be interesting in future studies to address the role of this factor by means of transcultural studies. The same can be said for demographic or economical differences among participants. That is, we might expect different susceptibility to the information presented through the label, for older and younger, as

well as for more or less wealthy participants.

Our preliminary results highlight the role of the expectation induced by the information regarding the country of origin on participants' food evaluations. Future studies have to investigate the role of other food features which can mitigate or enhance this kind of influence. For example, another sensory modality extremely important concerning food is smell (e.g., Maggioni et al., 2019; Micaroni et al., 2019). Including olfactory manipulations in our experimental paradigm should be then sought after. Moreover, another possible variable to be manipulated could be related to how easily identifiable as 'regional' a given food is. Most likely, using very regional products, the visual bias on food labeling should be greater than olive and cracker used in our conditions. That is, more easily distinguishable Italian food (such as Burrata, Soppressata, but also Lardo di Colonnata, Mozzarella di Bufala Campana, Cassata Siciliana etc for Italian products, but the same can apply to Cheddar Cheese, Foie gras, etc) should perhaps lead to greater effects on people's evaluations when mislabeled (i.e., Mozzarella Campana - an origin certified and controlled product from the Italian region Campania – might labeled as a product coming from North America).

Moreover, further studies should also include more or less immersive and interactive technologies to better investigate the role of specific sensory aspects affecting consumers' choices. In fact, Virtual Reality (VR) could be an economical, yet effective tool to simulate realistic (and even completely novel) products in multisensory marketing scenarios and to evaluate the weight of several sensorial components of the whole evaluation experience (Lombart et al., 2020). Similarly, Augmented Reality (AR) could allow us to easily show useful or appealing information for consumers directly by scanning a product within the physical environment where it is presented/consumed (and thus creating additional specific contexts; see for example Blumenthal, 2008; Spence and Piqueras-Fiszman, 2012; Spence and Piqueras-Fiszman, 2014; Risso & Gallace, submitted).

CRediT authorship contribution statement

Roberta Etzi: Conceptualization, Methodology, Writing – original draft. **Matteo Girondini:** Conceptualization, Writing – original draft. **Gemma Massetti:** Conceptualization, Writing – original draft, Supervision. **Alberto Gallace:** Conceptualization, Methodology, Writing – original draft, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Al-Sulaiti, K.I., Baker, M.J., 1998. Country of origin effects: a literature review. Market. Intell. Plann. 16, 150–199.

Allison, A.M.A., Gualtieri, T., Craig-Petsinger, D., 2004. Are young teens influenced by increased product description detail and branding during consumer testing? Food Qual. Prefer. 15 (7–8), 819–829.

Aprile, M.C., Caputo, V., Nayga Jr., R.M., 2016. Consumers' preferences and attitudes toward local food products. J. Food Prod. Market. 22 (1), 19–42.

Becker, L., van Rompay, T.J., Schifferstein, H.N., Galetzka, M., 2011. Tough package, strong taste: the influence of packaging design on taste impressions and product evaluations. Food Qual. Prefer. 22 (1), 17–23.

Benedek, M., Kaernbach, C., 2010. A continuous measure of phasic electrodermal activity. J. Neurosci. Methods 190 (1), 80–91.

Biggs, L., Juravle, G., Spence, C., 2016. Haptic exploration of plateware alters the perceived texture and taste of food. Food Qual. Prefer. 50, 129–134.

Bilkey, W.J., Nes, E., 1982. Country-of-origin effects on product evaluations. J. Int. Bus. Stud. 13 (1), 89–100.

Biswas, D., Labrecque, L.I., Lehmann, D.R., 2021. Effects of sequential sensory cues on food taste perception: cross-modal interplay between visual and olfactory stimuli. J. Consum. Psychol. 31 (4), 746–764.

Bitzios, M., Lisa, J.A.C.K., Krzyzaniak, S.A., Mark, X.U., 2017. Country-of-origin labelling, food traceability drivers and food fraud: lessons from consumers' preferences and perceptions. Eur. J. Risk Regulat. 8 (3), 541–558.

Blumenthal, H., 2008. The big fat duck cookbook. Bloomsbury.

Cacioppo, J.T., Tassinary, L.G., Berntson, G. (Eds.), 2007. Handbook of Psychophysiology. Cambridge university press.

Campanaro, A., Tommasi, N., Guzzetti, L., Galimberti, A., Bruni, I., Labra, M., 2019. DNA barcoding to promote social awareness and identity of neglected, underutilized plant species having valuable nutritional properties. Food Res. Int. 115, 1–9.

Caporale, G., Policastro, S., Carlucci, A., Monteleone, E., 2006. Consumer expectations for sensory properties in virgin olive oils. Food Qual. Prefer. 17 (1–2), 116–125.

Chang, H.H., Meyerhoefer, C.D., 2021. COVID-19 and the demand for online food shopping services: empirical Evidence from Taiwan. Am. J. Agric. Econ. 103 (2), 448–465.

Conner, D., Colasanti, K., Ross, R.B., Smalley, S.B., 2010. Locally grown foods and farmers markets: consumer attitudes and behaviors. Sustainability 2 (3), 742–756.

Danner, L., Haindl, S., Joechl, M., Duerrschmid, K., 2014. Facial expressions and autonomous nervous system responses elicited by tasting different juices. Food Res. Int. 64, 81–90.

de Eguilaz, M.H.R., de Morentin Aldabe, B.M., Almiron-Roig, E., Pérez-Diez, S., Blanco, R.S.C., Navas-Carretero, S., Martínez, J.A., 2018. Multisensory influence on eating behavior: hedonic consumption. Endocrinol., Diabet. Nutr. (English Ed.) 65 (2), 114–125.

De Wijk, R.A., He, W., Mensink, M.G., Verhoeven, R.H., De Graaf, C., 2014. ANS responses and facial expressions differentiate between the taste of commercial breakfast drinks. PLoS One 9 (4), e93823.

de Wijk, R.A., Kooijman, V., Verhoeven, R.H., Holthuysen, N.T., de Graaf, C., 2012. Autonomic nervous system responses on and facial expressions to the sight, smell, and taste of liked and disliked foods. Food Qual. Prefer. 26 (2), 196–203.

Dekhili, S., d'Hauteville, F., 2009. Effect of the region of origin on the perceived quality of olive oil: an experimental approach using a control group. Food Qual. Prefer. 20 (7), 525–532.

Etzi, R., Spence, C., Zampini, M., Gallace, A., 2016. When sandpaper is 'Kiki'and satin is 'Bouba': an exploration of the associations between words, emotional states, and the tactile attributes of everyday materials. Multisensory Res. 29 (1–3), 133–155.

Faul, F., Erdfelder, E., Buchner, A., Lang, A.G., 2009. Statistical power analyses using G* Power 3.1: tests for correlation and regression analyses. Behav. Res. Methods 41 (4), 1149–1160.

Feldmann, C., Hamm, U., 2015. Consumers' perceptions and preferences for local food: a review. Food Qual. Prefer. 40, 152–164.

Fernqvist, F., Ekelund, L., 2014. Credence and the effect on consumer liking of food–A review. Food Qual. Prefer. 32, 340–353.

Fortis, M., Sartori, A., 2016. Food & wine: quality, tradition and innovation. In: The Pillars of the Italian Economy. Springer, Cham, pp. 283–317.

Galimberti, A., Casiraghi, M., Bruni, I., Guzzetti, L., Cortis, P., Berterame, N.M., Labra, M., 2019. From DNA barcoding to personalized nutrition: the evolution of food traceability. Curr. Opin. Food Sci. 28, 41–48.

Gallace, A., Boschin, E., Spence, C., 2011. On the taste of "Bouba" and "Kiki": an exploration of word–food associations in neurologically normal participants. Cognit. Neurosci. 2 (1), 34–46.

Hisano, A., 2019. Visualizing Taste: How Business Changed the Look of what You Eat, vol. 53. Harvard Studies in Business Hi.

Kantono, K., Hamid, N., Shepherd, D., Lin, Y.H.T., Skiredj, S., Carr, B.T., 2019. Emotional and electrophysiological measures correlate to flavour perception in the presence of music. Physiol. Behav. 199, 154–164.

Koch, J., Frommeyer, B., Schewe, G., 2020. Online shopping motives during the COVID-19 pandemic—lessons from the crisis. Sustainability 12 (24), 10247.

Lagast, S., De Steur, H., Gadeyne, S., Hödl, S., Staljanssens, W., Vonck, K., et al., 2020. Heart rate, electrodermal responses and frontal alpha asymmetry to accepted and non-accepted solutions and drinks. Food Qual. Prefer. 82, 103893.

Liu, R., Gao, Z., Nayga Jr., R.M., Snell, H.A., Ma, H., 2019. Consumers' valuation for food traceability in China: does trust matter? Food Pol. 88, 101768.

Lobb, A.E., Mazzocchi, M., 2007. Domestically produced food: consumer perceptions of origin, safety and the issue of trust. Acta Agricult. Scand. Sect. C 4 (1), 3–12.

Lombart, C., Millan, E., Normand, J.M., Verhulst, A., Labbé-Pinlon, B., Moreau, G., 2020. Effects of physical, non-immersive virtual, and immersive virtual store environments on consumers' perceptions and purchase behavior. Comput. Hum. Behav. 110, 106374.

Maggioni, E., Cobden, R., Obrist, M., 2019. OWidgets: a toolkit to enable smell-based experience design. Int. J. Hum. Comput. Stud. 130, 248–260.

Maggioni, E., Risso, P., Olivero, N., Gallace, A., 2015. The effect of a container's weight on the perception of mineral water. J. Sensory Stud. 30 (5), 395–403.

Micaroni, L., Carulli, M., Ferrise, F., Gallace, A., Bordegoni, M., 2019. An olfactory display to study the integration of vision and olfaction in a virtual reality environment. J. Comput. Inf. Sci. Eng. 19 (3), 31015.

Mora, M., Elzo-Aizarna, J., Rozas-Fuertes, S., Velilla-Echeita, L., Vázquez-Araújo, L., 2020. Implicit reaction vs explicit emotional response: protected designation of origin in apple cider. Food Qual. Prefer. 79, 103773.

Mueller, S., Szolnoki, G., 2010. The relative influence of packaging, labelling, branding and sensory attributes on liking and purchase intent: consumers differ in their responsiveness. Food Qual. Prefer. 21 (7), 774–783.

Newman, C.L., Turri, A.M., Howlett, E., Stokes, A., 2014. Twenty years of country-of-origin food labeling research: a review of the literature and implications for food marketing systems. J. Macromarketing 34 (4), 505–519.

Piqueras-Fiszman, B., Spence, C., 2015. Sensory expectations based on product-extrinsic food cues: an interdisciplinary review of the empirical evidence and theoretical accounts. Food Qual. Prefer. 40, 165–179.

Posada-Quintero, H.F., Chon, K.H., 2020. Innovations in electrodermal activity data collection and signal processing: a systematic review. Sensors 20 (2), 479.

Provencher, V., Jacob, R., 2016. Impact of perceived healthiness of food on food choices and intake. Curr. Obes. Rep. 5 (1), 65–71.
Ricci, E.C., Stranieri, S., Casetta, C., Soregaroli, C., 2019. Consumer Preferences for Made in Italy Food Products: the Role of Ethnocentrism and Product Knowledge.
Richetin, J., Demartini, E., Gaviglio, A., Ricci, E.C., Stranieri, S., Banterle, A., Perugini, M., 2021. The biasing effect of evocative attributes at the implicit and explicit level: the tradition halo and the industrial horn in food products evaluations. J. Retailing Consum. Serv. 61, 101890.
Risso, P., Maggioni, E., Etzi, R., Gallace, A., 2019. The effect of the tactile attributes of a container on mineral water perception. Beverages 5 (1), 23.
Rousmans, S., Robin, O., Dittmar, A., Vernet-Maury, E., 2000. Autonomic nervous system responses associated with primary tastes. Chem. Senses 25 (6), 709–718.
Shimp, T.A., Sharma, S., 1987. Consumer ethnocentrism: construction and validation of the CETSCALE. J. Market. Res. 24 (3), 280–289.
Skaczkowski, G., Durkin, S., Kashima, Y., Wakefield, M., 2016. The effect of packaging, branding and labeling on the experience of unhealthy food and drink: a review. Appetite 99, 219–234.
Spence, C., 2011. Crossmodal correspondences: a tutorial review. Atten. Percept. Psychophys. 73 (4), 971–995.
Spence, C., 2012a. 10 multi-sensory integration and the psychophysics of flavour perception. Food Oral Process.: Fundamentals Eating and Sens. Percept. 203.
Spence, C., 2012b. Managing sensory expectations concerning products and brands: capitalizing on the potential of sound and shape symbolism. J. Consum. Psychol. 22 (1), 37–54.
Spence, C., 2020. Gastrophysics: nudging consumers toward eating more leafy (salad) greens. Food Qual. Prefer. 80, 103800.
Spence, C., Gallace, A., 2011. Multisensory design: reaching out to touch the consumer. Psychol. Market. 28 (3), 267–308.
Spence, C., Piqueras-Fiszman, B., 2012. Dining in the Dark. The Psychologist.
Spence, C., Piqueras-Fiszman, B., 2014. The Perfect Meal: the Multisensory Science of Food and Dining. John Wiley & Sons.
Spinelli, S., Niedziela, M., 2016. Emotion measurements and application to product and packaging development. In: Integrating the Packaging and Product Experience in Food and Beverages. Woodhead Publishing, pp. 77–119.
Stefani, G., Romano, D., Cavicchi, A., 2006. Consumer expectations, liking and willingness to pay for specialty foods: do sensory characteristics tell the whole story? Food Qual. Prefer. 17 (1–2), 53–62.
Stryja, C., Satzger, G., 2018. Try before you buy: how to design information systems to enhance consumer willingness to test sustainable innovations. J. Technol. Manag. Innovat. 13 (1), 19–26.
Torrico, D.D., Fuentes, S., Viejo, C.G., Ashman, H., Dunshea, F.R., 2019. Cross-cultural effects of food product familiarity on sensory acceptability and non-invasive physiological responses of consumers. Food Res. Int. 115, 439–450.
Velasco, C., Wan, X., Salgado-Montejo, A., Woods, A., Oñate, G.A., Mu, B., Spence, C., 2014. The context of colour–flavour associations in crisps packaging: a cross-cultural study comparing Chinese, Colombian, and British consumers. Food Qual. Prefer. 38, 49–57.
Verastegui-Tena, L., van Trijp, H., Piqueras-Fiszman, B., 2018. Heart rate and skin conductance responses to taste, taste novelty, and the (dis) confirmation of expectations. Food Qual. Prefer. 65, 1–9.
Verbeke, W., Frewer, L.J., Scholderer, J., De Brabander, H.F., 2007. Why consumers behave as they do with respect to food safety and risk information. Anal. Chim. Acta 586 (1–2), 2–7.
Verlegh, P.W., Steenkamp, J.B.E., 1999. A review and meta-analysis of country-of-origin research. J. Econ. Psychol. 20 (5), 521–546.
Walsh, A.M., Duncan, S.E., Bell, M.A., O'Keefe, S.F., Gallagher, D.L., 2017. Breakfast meals and emotions: implicit and explicit assessment of the visual experience. J. Sensory Stud. 32 (3), e12265.
Wang, Q.J., Mielby, L.A., Junge, J.Y., Bertelsen, A.S., Kidmose, U., Spence, C., Byrne, D. V., 2019. The role of intrinsic and extrinsic sensory factors in sweetness perception of food and beverages: a review. Foods 8 (6), 211.
Watson, J.J., Wright, K., 2000. Consumer ethnocentrism and attitudes toward domestic and foreign products. Eur. J. Market. 34 (9/10), 1149–1166.
Xu, Y., Hamid, N., Shepherd, D., Kantono, K., Spence, C., 2019. Changes in flavour, emotion, and electrophysiological measurements when consuming chocolate ice cream in different eating environments. Food Qual. Prefer. 77, 191–205.
Yeomans, M.R., Chambers, L., Blumenthal, H., Blake, A., 2008. The role of expectancy in sensory and hedonic evaluation: the case of smoked salmon ice-cream. Food Qual. Prefer. 19 (6), 565–573.