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In search of a consumer-focused food classification system. An experimental heuristic approach to differentiate degrees of quality

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ABSTRACT

The present paper focuses on the problems that arise in food classification systems (FCSs), especially when the food product type has different levels or grades of quality. Despite the principal function of these systems being to assist the consumer (to inform, clarify and facilitate choice and purchase), they frequently have the opposite effect. Thus, the main aim of the present research involves providing orientations for the design of effective food classification systems. To address this objective, considering the context of food product consumption (related to heuristic processing), we conducted an experimental study with 720 participants. We analysed the usefulness of heuristic elements by a factorial 2 (category length: short and long) × 3 (visual signs: colours, numbers and images) design in relation to recall and recognition activities. The results showed that the elements used to make the classification more effective for consumers vary depending on whether the user seeks to prioritize the recall or the recognition of product categories. Thus, long categories with images significantly improve recognition, and short categories with colours improve recall. A series of recommendations are provided that can help to enhance FCSs and to make them more intuitive and easier to understand for consumers. Implications with regard to theory and practice are discussed.

1. Introduction

As a consequence of globalization, consumers are now offered a wide range of food products, with different varieties and quality levels. This produces an informative overload in the market which hinders purchase decisions (Eppler & Mengis, 2004). Food classification systems (FCSs) are a reference to assist the consumer. FCSs comprise denominations of the different categories and information associated with each product[1]; their basic function is to inform the market about the different types, qualities and characteristics of each food product. However, problems often arise from the use of terms that are ambiguous, similar, and technical or complex, which, in short, provoke confusion or false beliefs among consumers (Walsh & Yamin, 2005).

FCSs are usually designed by technical committees' proposals, which consult experts or members of the involved sector.[2] As a consequence, there can be a gap between the theoretical objective of the system (to inform, clarify, help with choice, eliminate confusion, enhance nutrition, etc.) and how these classifications are really interpreted by consumers.

The problem stems from not taking consumers into account in the design. Moreover, when rules are established to set up or modify an FCS, they are not tested on consumers to determine their usefulness. As Morse (1966, p. 53) noted more than 50 years ago: *"The chaotic systems currently in use have been carefully and conscientiously developed –but not from the viewpoint of the consumer"*.

The Danish market constitutes an unequivocal example of the magnitude of the problem. Smith et al. (2013) found that 27% of 821 administrative cases reviewed reflected allegations of confusing names on foodstuffs. A special problem arises when a product type has different levels or grades of quality. This is the case in Spain, which is the

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[1] For example, the classification system for olive oils composed of three categories: (1) Extra virgin olive oil: higher category oil obtained directly from olives and only by mechanical procedures; (2) Virgin olive oil: olive oil obtained directly from olives and only by mechanical procedures. (3) Olive oil contains exclusively refined olive oils and virgin olive oils: oil that exclusively contains olive oils that have been subjected to a refining treatment and oils directly obtained from olives.

[2] In the European context, the European Commission drafts reports modifying or changing classifications that may finally be discarded when the final Regulations are approved (for an example, in the case of olive oil, see: the proposal for a Council regulation amending Regulations No 136/66/EEC and (EC) No 1638/98 as regards the extension of the period of validity of the aid scheme and the quality strategy for olive oil (COM(2000) 855 – C5–0026/2001–2000/0358(CNS)).

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world's biggest producer of olive oil. However, among the majority of Spanish consumers there is confusion and erroneous beliefs regarding the qualitative and sensory differences of the different categories of olive oils (Cabrera, Arriaza, & Rodríguez-Entrena, 2015; Marano-Marcolini, Parras-Rosa, & Lopez-Zafra, 2015; Navarro et al., 2010; Parras, 2000). In fact, despite price differences are insignificant, the lowest quality category (olive oil contains only refined olive oils and virgin olive oils) is the most demanded, in detriment to the extra-virgin olive oil category, which is the highest quality (Marano-Marcolini & Torres-Ruiz, 2017). This problem not only affects the consumer, but also damages companies interested in differentiating their production through quality and in the implementation of policies aimed at improving the quality of food.

There are two ways to solve these problems. The first is increasing the level of consumer knowledge.However, this is a utopian vision due to the large quantity of food products on the market and the complexity of their characteristics (chemical composition, effects on disease and health, manufacturing mode, etc.). A second option is to develop a general system as general as possible, for products that have different grades of quality among their categories, that are tested on consumers and easy to learn and remember. Furthermore, it is important to determine its usefulness when applied to a large quantity of food products.

In the literature, the term FCS indicates not only the empirical way in which consumers classify food products in their day-to-day lives (snacks, full meals, homemade or pre-cooked food, occasional consumption …) but also proposals or technical documents related to nutrition, marketing and international harmonisation (Ireland & Møller, 2000; Pennington, 1995). Food classifications are relevant for the organization and communication of information within different areas of food science, such as nutrition, marketing, unit operations and microbiology (Costa, Dekker, Beumer, Rombouts, & Jongen, 2001). In this context, we consider FCSs to be restricted to official food classifications, of compulsory establishment in the market in order to provide information to consumers, and to the elements of the agro-food chain, homogenising and harmonising production and marketing, varieties and/or qualities.

To facilitate consumer buying processes, Morse (1966) discussed the need to establish product “grades”, providing a basis to compare products of a similar type and quality with a standard. This author emphasizes the importance of grades to inform consumers adequately, protect them against deception and assure them the free choice of products in the market.

However, the application of grades or categories is not exempt from problems. For example, types (private, industry and government), level of enforcement (voluntary, permissive and mandatory) or terminology to grade the products (adjectives, numbers and letters) should be determined. In this context, Morse suggests using systematic, uniform and standardized consumer grades.

Despite the underlying logic of Morse's proposals, the existing grades have been mainly developed from a technical point of view (Costa et al., 2001), without considering the impact of the recommendations on consumers. Thus, little progress in the development of consumer-oriented FCSs has been made. Moreover, we note that there is no proposal about the method for objectively analysing their usefulness for consumers. Usefulness of any system depends on its ease of use, that is, if it is easy to learn, remember, and use in comparing products with different characteristics.

In recent decades, there have been notable contributions related to the context of buying and using information in the food sector, where elements such as implication, the processing of superficial information or the use of heuristics are highlighted. Heuristics are simple mental shortcuts that people often use to make rapid decisions. They imply focusing on one aspect and ignoring others, which is useful to save time but in some cases may produce systematic deviations (Gigerenzer & Gaissmaier, 2011; Gigerenzer & Goldstein, 1996). In the context of food products, purchasing decisions tend to be routine with a low level of involvement (Tanner & Raymond, 2016), characterised by a lack of cognitive processing of information,[3] which leads consumers to simplify their decision and to misuse heuristics (i.e. Hamlin, 2010; Scheibehenne, Miesler, & Todd, 2007). Additionally, consumers are exposed to a great amount of information (i.e. Dunbar, 2010; Hall & Osses, 2013), which they must process and use to make decisions in crowded places, such as supermarkets or hypermarkets, where it is difficult to reflect upon the information the product offers. Furthermore, consumers are also pressured by time limits to process all this information (i.e. Loebnitz, Mueller Loose, & Grunert, 2015; Reutskaja, Nagel, Camerer, & Rangel, 2011). Thus, this environment encourages consumers to use simplification mechanisms that, rather than reflecting upon the information provided, resort to visual elements that act as heuristics to associate certain attributes with the product. That is, images or symbols are used to simplify the decision-making process, provided that these signs have previously been learned (Hoek, Roling, & Holdsworth, 2013; Miklavec, Pravst, Raats, & Pohar, 2016; Sütterlin & Siegrist, 2015).

Under these assumptions, it is important to consider that the FCS must contain not only information that can be analytically analysed but also the terms and elements (in general) that possess connotations and are “interpreted” or that can even act as cognitive heuristics, according to the suggestions proposed by the heuristic models (Chaiken, 1980; Chaiken, 1987; Kahneman & Frederick, 2005; Zuckerman & Chaiken, 1998). A clear example of the use of these elements are the Michelin stars rank for restaurants or, in the agri-food sector, the numerical code to inform on the method of breeding eggs (0 = ecological production, 1 = chicken coat, 2 = raised on the floor, or 3 = raised in a cage).[4] According to these models, when consumers are not motivated, have no knowledge or do not know how to make a judgment or decision, they take mental shortcuts to make a simpler and faster decision. Heuristic processing seems to be predominant in the purchase of food products due to the usefulness of the heuristic models in the food purchasing decisions made by consumers. Thus, in the literature, the effects of different signs used as heuristics by consumers, such as colours, logos, emoticons and signs, have been studied mainly in nutrition labelling studies (Becker, Bello, Sundar, Peltier, & Bix, 2015; Emrich, Mendoza, & L'Abbé, 2012; Feldman, Harwell, & Brusca, 2013; Olstad, Vermeer, McCargar, Prowse, & Raine, 2015; Sharf et al., 2012; Van Herpen & Van Trijp, 2011).

1.1. Heuristic elements

As mentioned, there are elements or terms that may provoke the activation of cognitive heuristics. In the case of food products, several indicators may be considered: colours, images and alphanumeric clues. All these indicators are easily learned in childhood using experience-based knowledge (Strough, Karns, & Schlosnagle, 2011). Colours are widely used to classify products or services (i.e., underground lines and level of danger) and are frequently used in nutritional food labelling, such as traffic light logos developed in the United Kingdom by the Food Standards Agency (Becker et al., 2015; Méjean, Macouillard, Péneau, Hercberg, & Castetbon, 2013). Furthermore, they have a symbolic meaning, making the product easily recognized (Ares et al., 2011; Díaz Rojo, Morant, & Westall Pixton, 2006; Hine, 1995; Vidales Giovannetti, 1995). Images are simple elements widely used in the touristic and gastronomic sectors but not so frequently in food choice. For example, hotels use the star system to reduce consumer information asymmetry (Martin-Fuentes, 2016). Images improve recall and recovery of information, they are pleasant, and they enhance comprehension when

[3] With the exception of wine (Hamlin, 2010).

[4] Directive 2002/4/CE, January 30, 2002, on the registration of establishments of laying hens.

endowed with a clear meaning (analogy with the product) (i.e., McQuarrie & Mick, 2003; Schlosser, 2006; Schmitt, Tavassoli, & Millard, 1993). In the nutritional context, Feunekes, Gortemaker, Willems, Lion, and van den Kommer (2008), defend the simplicity and the use of grades (different number of smileys or stars), arguing that consumers need less time to evaluate them than with another complex indicator. Finally, an alphanumeric classification is internationally used to construct rankings. Thus, we propose that this is easily understood by consumers and constitutes a simple way of establishing grades or quality levels in an FCS. These classifications involve a succession of letters (A, B, C…), numbers (1, 2, 3…) or combinations of both (A1, A2, B1…). Examples of products using this classification are home appliances or eggs in the food context.

Finally, we also propose that the quantity of information (number of words or information given) may act as a heuristic. In this context, an antagonism effect may arise; that is, it could be perceived to be easy to learn fewer terms, but if they are not clearly different, they could be confusing. Furthermore, using too many terms could result in information overload, hindering perception (Dunbar, 2010; Hall & Osses, 2013).

Taking into account all these considerations, Marano-Marcolini and Torres-Ruiz (2017) developed a model that allows for a comparison of different FCS alternatives from the point of view of utility or adequacy for the consumer. The model can be used to perform simulations of different FCSs in order to study which type of stimuli are better remembered and recognized by consumers.

1.2. The Marano-Marcolini & Torres-Ruiz Model (2017)

In this study, we test a model (see Fig. 1) that assumes a number of principles: (1) The basic function of an FCS is to be a reference for the purchasing process, enabling consumers to choose their wanted product in full awareness of that product's characteristics and differences compared to other products. (2) An FCS is composed of a set of *categories* or descriptors (symbolic or alphanumerical terms used to identify products quickly) and a block of *information* associated with each descriptor that makes it possible to acquire clear and specific knowledge of the characteristics of the products associated with each category. (3) One system will be better than another if the consumers have a greater knowledge of its categories and of the information associated with them. (4) The aspects or dimensions that should be taken into account when studying the level of knowledge of a system are (a) knowing that different categories/types/grades of food and their names exist, (b) knowing or ranking the categories according to their quality and (c) knowing the basic and main characteristics of each category, particularly those related to purchasing decisions (best uses, chemical composition, nutritional properties, etc.). (5) The analysis of the acquired level of knowledge can be thought of as a learning problem and as processing and retrieving information from memory (explicit memories).(6) Among the most commonly used explicit measures are the tasks of recalling and recognition, widely used in the literature (Ahn & La Ferle, 2008; Hartmann, Apaolaza, & Alija, 2013; Jin, Suh, & Donavan, 2008; Leigh, Zinkhan, & Swaminathan, 2006; Lerman & Garbarino, 2002; Lowrey, Shrum, & Dubitsky, 2003).

In sum, this study's objectives are as follows:

1. To analyse which elements (colours, ordinal numbers or images) are more suitable for establishing a FCS for products with different grades of quality, from the point of view of utility for the consumer.
2. To study whether to use many or few terms in the descriptors of the categories.

2. Method

2.1. Participants

A total of 720 consumers participated in the study. The profile of the target population involved people with ages ranging from 20 to 65 years accustomed to the purchase of food. They were from different locations -geographical zones- in Spain, although the main producing provinces were excluded to avoid a knowledge effect. The sample was derived from a panel of consumers contacted by a market research company. Level quotas for academic qualifications, gender and age were established (see Table 1).In each treatment, gender was divided

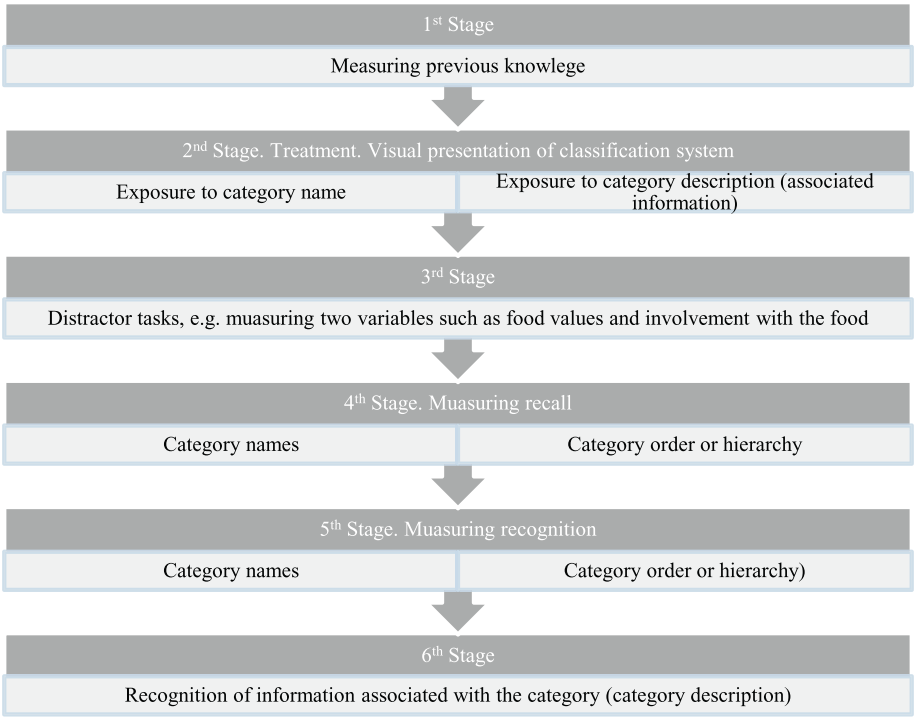

Fig. 1. Stages of experimental study. Source: adapted from Marano-Marcolini and Torres-Ruiz (2017).

Table 1
Sampling data sheet.

Universe	Regular food buyers (age 20–65) living in non-producing areas.	
Type of interview	Online survey with experimental treatment.	
Sample size	720 acceptable cases.	
Type of sampling	Restricted randomized, with randomized treatment by individual	
Quotas	Age	50% 20–40/50% 41–65
	Gender	50% Women/50% Men
	Level of education	50% with university studies/50% without

down the middle balanced into men and women; half the sample was divided into people between 20 and 40 years of age and the other half into people from 41 to 65 years of age; and level of education was also divided into people with and without university studies.

2.2. Experimental design

We conducted an experimental study in which six experimental conditions were designed. These constitute a 3 × 2 between-subjects factorial design combining three types of visual signs (colours, ordinal numbers and evocative images) and two types of categories depending on their length (short description and long description). Each treatment was applied to 120 randomly selected participants within the total number of panellists. Table 1 shows a diagram of the six experimental conditions.

In synthesis, the factorial design obtained, which resulted from the combination of different dimensions, was balanced in all the experimental conditions, and furthermore, the sample composition is similar in each experimental condition, according to the variables level of education, age and gender.

2.3. Food classification system design

Food classification systems used in each condition were designed for three different products: olive oils, Iberian hams and orange juices. These products present different qualities/types and typically induce confusion among consumers. To guide the design of the proposed FCS, a preliminary study was conducted. It consisted of 14 in-depth interviews with academics and professionals working on expertise areas of the three products tested; furthermore, the legal regulations[5] referring to the three products were taken into consideration to design the content of the categories and the information associated with each FCS, and finally, for the specific case of olive oil, the study by Marano-Marcolini et al. (2015) was also considered.

Each of the FCSs designed had three different grades or quality categories. For the design of the FCSs with short categories, only the name of the category of the product was used, leaving all the weight of the differentiation to the signs and definitions of the categories. For the long categories, clear terms were used, that is, terms with no negative connotations and that symbolized objective quality properties of the product (see Appendix A: Table A1 for the description of the design of the proposed systems).

In the design of the FCSs with numbers, ordinal numbers (1st, 2nd and 3rd) from the highest to lowest quality category were used. In the case of the images, images evocative of the product were used (one, two or three images). The higher the quality of the category was, the greater the number of images. For the case of olive oil, three olives were used for the highest quality oils, two olives for the intermediate quality, and one olive for the lower quality ones. For Iberian hams, this image was an acorn (given that the best quality of these products is for acorn-based food, which is also a key determinant of their quality), in this case, two acorns (higher quality), one acorn (intermediate quality) and no acorn (lower quality). In the third category of quality, this means that this product comes from an animal that was not fed with acorns. In the case of orange juice, the images chosen were three, two and one oranges.

Finally, in the FCSs with colours, the three primary colours were chosen: blue, red and yellow, from highest to lowest quality of the product category. Using primary colours avoids possible natural continuity biases that could lead to hierarchy inferences (for example, orange would be between yellow and red). However, the main problem of colours is that there is no natural universal hierarchy and, thus, meaning can vary between cultures. In this case, we conducted a pilot study with 100 interviewees responding to the colour they would give to three similar products of high, medium and low quality. The results showed a high preference for blue, followed by yellow and red, although between these two, colours the differences were not so pronounced.

2.4. Procedure

Each participant in the experimental study was exposed to one of the six experimental conditions, including three FCSs (one for each product).

The six experimental conditions were included of an online questionnaire that appeared on a computer screen, preventing participants from going back. First, several questions on socio-demographics and other variables of interest were followed by the experimental treatment in which participants were exposed for 1 min to one of the six experimental conditions for the three products, for each system and product. After the treatment, some distractor tasks were included that could interfere with information retention and could attenuate passive and repetitive thinking (Harris & Pashler, 2005; León et al., 2010; Papageorgiou & Siegle, 2003). Subsequently, measurements were made of recall and recognition. The open question referring to recall consisted of asking the interviewee what categories they remembered seeing, with no recovery aids. Thus, the variable ranges from (none) to three (all). On successive screens, they were asked about their recall of the quality hierarchy. In the questions referring to recognition, the recovery aid provided was the stimulus itself. Finally, they were asked about their recognition of the associated information. In this case, the information on the description for the three categories was divided into eight blocks of information, randomly ordered. The participants had to decide what block or information they recognized as belonging to the above mentioned categories. If an information block was correctly associated to a category, the variable had a value of 1. Consequently, the variable fluctuated between 0 and 8. To avoid order effects, exposure was counterbalanced so that one-third of the participants received the sequence of exposure to the classifications first with oil (sequence: oil-ham-juice), another third with ham (sequence: ham-juice-oil) and the remainder with juice (sequence: juice-oil-ham), which resulted in (3 × 6) 18 different combinations.

Appendix A provides example of what participants saw on the screen.

3. Results

To address the objectives, the influence of each type of visual sign (colours, images and ordinal numbers) and category length (short and long) were analysed along with the interactions on six dependent variables relating to memory: recall and recognition of the categories (RCC/RGC), recall and recognition of the quality order (RCO/RGO), and the information associated with each FCS (right answers-IR and wrong answers-IW). Therefore, a multivariate analysis of variance (MANOVA) was performed. The results of the final model demonstrate that, at a global level, significant influences exist, both in relation to the

[5] In the case of olive oils, the names and definitions provided for in Regulation 29/2012, of the Commission, of January 13, 2012 have been taken into account. For orange juices, the names and definitions provided for in Royal Decree 781/2013 October 11 and for Iberian hams the names and definitions provided in Royal Decree 4/2014, of January 10 have been considered.

Table 2
Experimental conditions.

Treatment X1	Treatment X2
Short-Images	Short-Numbers
Treatment X3	Treatment X4
Short-Colours	Long-Images
Treatment X5	Treatment X6
Long-Numbers	Long-Colours

Table 3
MANOVA. Synthesis of the main effects and interactions.

Effects		F	*p*	Partial Eta squared
Length	Pillai's Trace	53.299	*0.000*	0.129
	Wilk's Lambda	53.299	*0.000*	0.129
	Hotelling's Trace	53.299	*0.000*	0.129
	Roy's largest Root	53.299	*0.000*	0.129
Type of sign	Pillai's Trace	17.604	*0.000*	0.047
	Wilk's Lambda	17.911	*0.000*	0.047
	Hotelling's Trace	18.217	*0.000*	0.048
	Roy's largest Root	33.673	*0.000*	0.086
Length*type of sign	Pillai's Trace	5.557	*0.000*	0.015
	Wilk's Lambda	5.572	*0.000*	0.015
	Hotelling's Trace	5.587	*0.000*	0.015
	Roy's largest Root	9.206	*0.000*	0.025

Note. Type of sign: colours, ordinal numbers or evocative images; length (short – long).

main effects and the interactions included in the model (Table 2).

Contrasts among hypotheses using analysis of variance (ANOVA) show that, at a global level, there are differences in the results of the memory process among the levels of all the independent variables of the model and their interactions. Nonetheless, the importance or magnitude of these differences clearly varies, with category length being the variable presenting the greatest explanatory power. Likewise, it should be noted that the main effects have greater explanatory power than the interactions, with some of these being almost insignificant for three of six dependent variables (Table 3).

In general, category length yielded a significant main effect on 5 of 6 dependent variables, as did the type of visual sign employed. The interaction between both variables only affected the recall of the categories and both types of recognition (Table 3).

Of note is that the number of errors in the associated information (IW) has no significant effect on the two variables of interest (length and type of sign), and it can therefore be concluded that the treatments considered do not generate, or even reduce, the inherent potential confusion (or the erroneous information associated with each category). However, they do have an effect on the remaining memory results, that is, on those of a positive nature.

The estimation of the marginal means enables us to study in greater depth the nature and magnitude of these relationships. Thus, considering the information presented in Table 4 and in Figs. 2, 3, 4 and 5, the use of short lengths has a greater effect on RCC and RCO (recall variables) than the use of long categories. However, long categories have higher mean scores in recognition (RGC and RGO). Moreover, despite a lower grade, their scores are also higher in the information correctly associated with each category (IR). The inclusion of more words seems to increase the likelihood that consumers use some of them as clues to recognize the categories and their order of quality, whereas in the activity of pure recollection, without help, simplicity prevails. On the other hand, the use of colours in the FCS seems to have a significantly higher effect in the recall processes (RCC and RCO) and associated information (IR), whereas the use of images seems more effective in the recognition processes (RGC and RGO). Finally, it should be noted that the use of ordinal numbers is not the most effective option for any of the dependent variables considered, being clearly lower in the recognition activity (Table 5).

Table 4
ANOVA. Effect of visual signs and category length on each indicator of the results of the memory process.

Origin	Dependent variable	F	*p*	Partial Eta squared
Length	RCC	165.437	*0.000*	0.071
	RCO	16.076	*0.000*	0.007
	RGC	29.625	*0.000*	0.014
	RGO	87.762	*0.000*	0.039
	IR	25.238	*0.000*	0.012
	IW	2.210	0.137	0.001
Type of sign	RCC	4.222	*0.015*	0.004
	RCO	4.825	*0.008*	0.004
	RGC	73.075	*0.000*	0.063
	RGO	56.146	*0.000*	0.049
	IR	7.994	*0.000*	0.007
	IW	1.199	0.302	0.001
Length*type of sign	RCC	10.762	*0.000*	0.010
	RCO	1.456	0.233	0.001
	RGC	15.299	*0.000*	0.014
	RGO	7.179	*0.001*	0.007
	IR	0.337	0.714	0.000
	IW	0.135	0.873	0.000

Note. Type of sign: colours, ordinal numbers or evocative images; length (short – long).RCC = Recall of categories; RCO = Recall of order of quality; RGC = Recognition of categories; RGO = Recognition of order of quality; IR = Information right answers; IW = Information wrong answers.

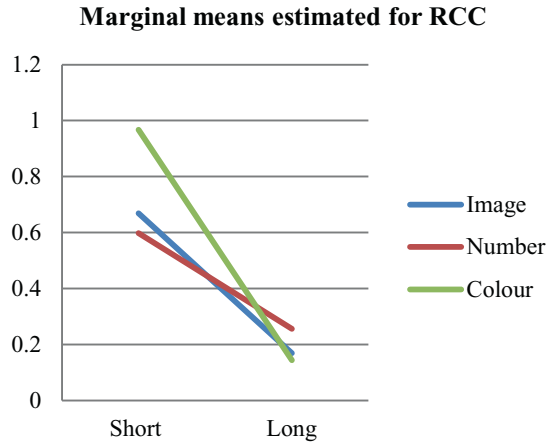

Fig. 2. Marginal means estimated for recall categories.

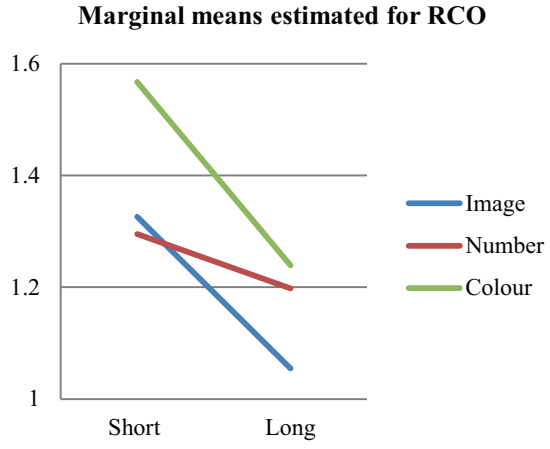

Fig. 3. Marginal means estimated for recall order.

The analysis of the interaction of the two obtained variables does not change the general recommendations obtained by analysing only the main effects. Thus, in Figs. 2 and 3, the greater influence of the use

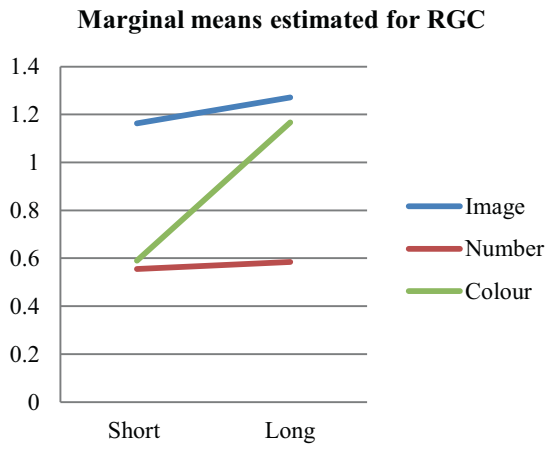

Fig. 4. Marginal means estimated for recognition categories.

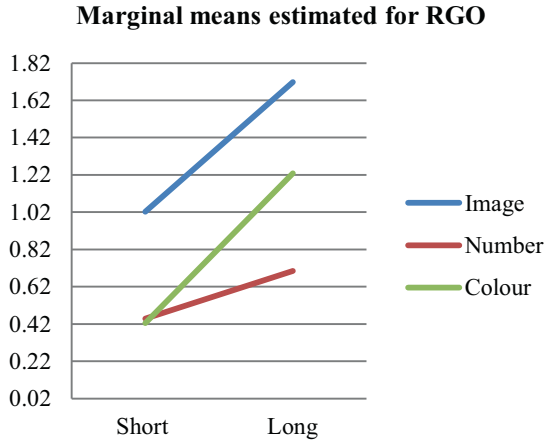

Fig. 5. Marginal means estimated for recognition order.

of colour on the recall of short categories (RCC) can clearly be seen, which is at least as effective as signs and numbers in the long ones. On the other hand, the superiority of the use of images is significant in recognition (RGC and RGO), both in the use of short and long categories (Figs. 3 and 4).

Fig. 6 presents a summary of the results graphically.

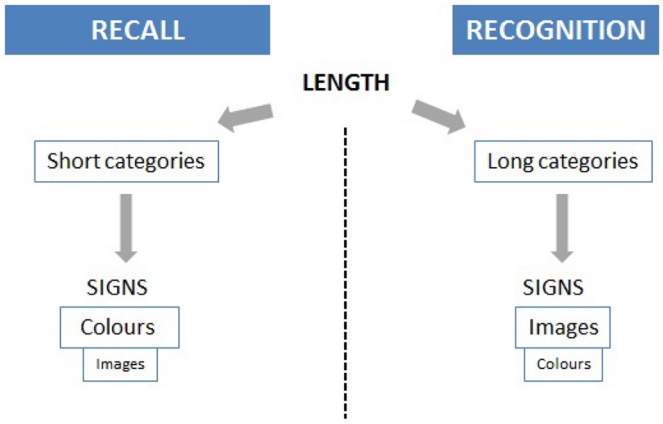

Fig. 6. Summary of the effect of using different signs and lengths.

4. Discussion

The present paper focused on FCS problems. Although the main function of these systems is to help the consumer (to inform, clarify and facilitate choice and purchase), they often seem to have the opposite effect as a result of a deficient approach or of vested interests in the design. In this sense, consumers are often confused or unaware of the types of products, their characteristics or associated qualities, among other factors. Thus, the principal objective of this study was to test an FCS and to propose guidelines for the design of an efficient FCS so as not to confuse consumers even further but rather facilitate their memorization of the basic characteristics of the food products they consume. Given that food products are purchased in an environment with a low level of involvement, an overload of information and heuristic processing, the present paper proposes two modes of action in the design of these systems: length of the categories and a series of visual signs acting as heuristics. The main results allow us to conclude, first, that consumers are sensitive to the type of heuristic sign used, as shown by the differences found in those analysed in this study. In this sense, even at the level of simplicity and ease of learning of those used, there are clear differences between them. The effectiveness of images and colours in memorization activities is confirmed. According to the results, colours and images positively influence recall and recognition activities, respectively. Previous studies, such as Siegrist, Leins-Hess, and Keller (2015), proved that colours reduce the time needed to process information. On the other hand, Vasiljevic, Pechey, and Marteau

Table 5
Estimated Marginal Means (Length/Type of sign/Length*Type of sign).

Dependent variable	Length	Type of sign			Mean (Std. Error)
		Image	Number	Colour	
RCC	Short	0.669 (0.053)	0.598 (0.053)	0.967 (0.053)	0.745 (0.031)
	Long	0.169 (0.053)	0.256 (0.053)	0.144 (0.053)	0.190 (0.031)
	Mean (Std. Error)	0.419 (0.038)	0.427 (0.037)	0.556 (0.037)	
RCO	Short	1.326 (0.071)	1.295 (0.070)	1.567 (0.071)	1.396 (0.041)
	Long	1.055 (0.071)	1.198 (0.071)	1.239 (0.071)	1.164 (0.041)
	Mean (Std. Error)	1.191 (0.050)	1.247 (0.050)	1.403 (0.050)	
RGC	Short	1.163 (0.054)	0.555 (0.053)	0.590 (0.053)	0.769 (0.031)
	Long	1.271 (0.054)	0.584 (0.053)	1.167 (0.054)	1.007 (0.031)
	Mean (Std. Error)	1.217 (0.038)	0.569 (0.038)	0.878 (0.038)	
RGO	Short	1.022 (0.077)	0.448 (0.076)	0.424 (0.076)	0.632 (0.044)
	Long	1.718 (0.077)	0.705 (0.076)	1.228 (0.077)	1.217 (0.044)
	Mean (Std. Error)	1.370 (0.054)	0.577 (0.054)	0.826 (0.054)	
IR	Short	4.028 (0.128)	4.568 (0.126)	4.523 (0.127)	4.373 (0.073)
	Long	4.652 (0.127)	4.983 (0.127)	5.050 (0.128)	4.895 (0.073)
	Mean (Std. Error)	4.340 (0.090)	4.776 (0.090)	4.787 (0.090)	

Note. RCC = Recall of categories; RCO = Recall of order of quality; RGC = Recognition of categories; RGO = Recognition of order of quality; IR = Information right answers.

(2015) prove that images, such as emoticons, produce an effect superior to colours in the perception of taste. However, the previous literature that analyses the effect of heuristic signs is generally focused on nutritional labelling. To the best of our knowledge, this is the first study that examines the influence of heuristic elements in the design of FCSs. Regarding the use of ordinal numbers to categorize, this approach does not turn out to be effective in any of the memory tasks. Perhaps this may be because the order in their use has been arbitrary in many previous cases, as low numbers mean the best in some classifications and the worst in others (Gunasti & Ross, 2010), which can generate confusion in the consumer. As for the length of the categories, it seems almost obvious that the short categories will be better remembered than the long ones because of the different learning effort (Shu & Carlson, 2014). However, it is striking that our results regarding recognition are better in the case of long categories. This can be produced by the association of long arguments with more persuasive characteristics of the text, acting as heuristics. Thus, making arguments longer when the probability of elaboration is low (such as the context in question) has more impact[6] on the consumer and makes them recognize arguments better. In other words, a low involvement increases the probability of following heuristics, and therefore, long arguments are preferred because they are perceived as more persuasive.

The choice of a FCS, oriented to the consumer, is hampered by different mental processes in consumers. That is, the most appropriate process to facilitate one of them is not the same used to facilitate another. In general, the results obtained from the analyses highlight the fact that the decisions taken in the design of the FCS analysed have different impacts on the recall and recognition activities. It is therefore logical that, in relation to FCSs, recall and recognition constitute two different activities, which is in line with previous literature (Anderson & Bower, 1972; Kintsch, 1970), as they are considered to constitute different procedures. Given that the former is more associated with processes of learning and processing information related to communication and the latter with heuristic processes, as occurs with self-service shopping, the general orientation in the design of FCSs will depend on whether priority is given to one dimension or the other.Considering that most shopping is currently done in self-service supermarkets (Karmarkar, 2004), one can assume that in the event of conflict between these two dimensions, priority should be given to design decisions that facilitate recognition of the product, as this is closer to the current reality of how people buy. The results of the present research (giving primacy to the dimension of recognition over that of recall) suggest using long categories with images for the development of effective FCSs.

4.1. Limitations and future research

Two limitations, however, should be taken into account. First, it is possible to combine images and colours, given that each one apparently presents differential advantages (Fig. 7) (for example, a classification system for different olive oils composed of olive images changing in colour depending on the quality of the category).

Nonetheless, as this combination has not been tested in the present paper, it should be addressed with due caution and subjected to further investigation. To provide positive results, this research could be considered as a basis for a food classification system in which the same colours are always used, with images that vary according to the type of product. Second, with regard to using long categories in the recognition process, it should be noted that to avoid confusion, apart from considering the amount of arguments, care should be taken with the quality or robustness thereof.

However, the identification of a set of evocative signs that facilitate both tasks (recall and recognition) can be an important step in the development of a FCS. Additionally, in the search for a FCS for products with different grades of quality, more tests would be necessary to create and test other systems. Also of interest would be carrying out tests in different cultural contexts. Additionally, the same result with more product categories would strengthen our conclusions.

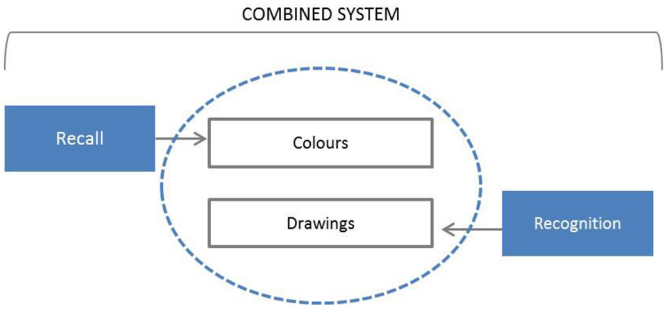

Fig. 7. Combined system of images and colours suggested.

4.2. Implications for practice

FCS should not only serve to establish the technical or regulatory specifications of the agri-food industry, but to facilitate the consumer's purchase process. Ignorance and confusion have important effects on the market, favouring companies that offer lower quality products, making it difficult for consumers to have clear reference prices based on quality. Thus, the practical implications of this study are clear. First, it is important to highlight the need to analyse and to study the most appropriate heuristics to change or implement a new FCS. In this sense, a protocol or standard model of general application for products with different degrees of quality should be implemented in the agro-food regulations of different countries, easy to apply, to ensure that FCS are easily understood by consumers. In this context, to avoid confusion and extra effort of consumer learning, the ideal would be that the FCS was a general as possible to represent quality hierarchy. Hence, this is the main empirical contribution of this study. Among the possible heuristic signs to use, our results suggest that research should focus on the colour and the gradual use of evocative signs of each product in terms of quality.

5. Conclusions

Including heuristic elements in food classification systems influences the storage capacity of these systems. This is important because these systems often confuse the consumer, who is unable to differentiate which product within the same category has more quality. These elements can help to memorize the name of the product/s as well as the associated information and the hierarchy of quality between products of the same category. The differences come from the type of memorization activity. For recall activities, the use of colours and short categories (with few words) is more effective, and for recognition activities, it is more efficient to use images that evoke the product and long categories (with more words). Our findings highlight the potential of heuristic elements in the design of FCSs oriented to the consumer and provide important implications for policymakers.

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[6] According to Petty and Cacioppo (1984); Moya (2007).

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Appendix A. Appendix

Table A1
Examples of some FCS designs and experimental conditions.

Treatment X1 (Short/Images)	
Olive oils	
Category	Description of the category.
Olive oil 	Maximum quality oil obtained from pure olive juice and only with mechanical procedures that conserve all the flavour, aroma and properties of the natural fruit.
Olive oil 	Oil obtained from pure olive juice and only with mechanical procedures that conserve all the flavour, aroma and properties of the natural fruit.
Olive oil 	Oil obtained from a mixture of oils subjected to chemical rectification treatment and oils obtained from pure olive juice.
Iberian hams	
Category	Description of the category
Iberian ham 	Ham from a 100% genetically pure animal, slaughtered immediately after exclusive consumption of acorns, grass and other natural resources of the *dehesa*, with no supplementary feed.
Iberian ham 	Ham from an animal that genetically corresponds by at least 50% to the Iberian pig breed, slaughtered immediately after exclusive consumption of acorns, grass and other natural resources of the *dehesa*, with no supplementary feed.
Iberian ham	Ham from an animal that genetically corresponds by at least 50% to the Iberian pig breed and fed with feed fundamentally made up of cereals and legumes, managed under intensive farming systems.
Orange juices	
Category	Description of the category
Orange juice 	100% juice from fresh, healthy and ripe oranges, conserved by means of refrigerating or freezing and possessing the colour, aroma and flavour characteristic of this fruit. No added sugars.
Orange juice	Product obtained exclusively from orange juice that has previously been dehydrated and subsequently reconstituted with drinking water. Contains the aroma, pulp and cells of the orange. No sugars or

(continued on next page)

Table A1 *(continued)*

	additives.
Orange juice 	Product obtained by means of water, sugars and additives added to the orange pulp, with a 50% minimum orange content.
Treatment X2 (Short/Numbers)	
Olive oils	
Category	Description of the category
Olive oil 1	Maximum quality oil obtained from pure olive juice and only with mechanical procedures that conserve all the flavour, aroma and properties of the natural fruit.
Olive oil 2	Oil obtained from pure olive juice and only with mechanical procedures that conserve all the flavour, aroma and properties of the natural fruit.
Olive oil 3	Oil obtained from a mixture of oils subjected to chemical rectification treatment and oils obtained from pure olive juice.
Iberian hams	
Category	Description of the category
Iberian ham 1	Ham from a 100% genetically pure animal, slaughtered immediately after exclusive consumption of acorns, grass and other natural resources of the *dehesa*, with no supplementary feed.
Iberian ham 2	Ham from an animal that genetically corresponds by at least 50% to the Iberian pig breed, slaughtered immediately after exclusive consumption of acorns, grass and other natural resources of the *dehesa*, with no supplementary feed.
Iberian ham 3	Ham from an animal that genetically corresponds by at least 50% to the Iberian pig breed and fed with feed fundamentally made up of cereals and legumes, managed under intensive farming systems.
Orange juices	
Category	Description of the category
Orange juice 1	100% juice from fresh, healthy and ripe oranges, conserved by means of refrigerating or freezing and possessing the colour, aroma and flavour characteristic of this fruit. No added sugars.
Orange juice 2	Product obtained exclusively from orange juice that has previously been dehydrated and subsequently reconstituted with drinking water. Contains the aroma, pulp and cells of the orange. No sugars or

(continued on next page)

Table A1 *(continued)*

	additives.
Orange juice 3	Product obtained by means of water, sugars and additives added to the orange pulp, with a 50% minimum orange content.
Treatment X6 (Long/Colours)	
Olive oils	
Category	Description of the category
Top quality natural juice olive oil 🔵	Maximum quality oil obtained from pure olive juice and only with mechanical procedures that conserve all the flavour, aroma and properties of the natural fruit.
Natural juice olive oil 🔴	Oil obtained from pure olive juice and only with mechanical procedures that conserve all the flavour, aroma and properties of the natural fruit.
Natural juice olive oil mixed with rectified olive oils 🟡	Oil obtained from a mixture of oils subjected to chemical rectification treatment and oils obtained from pure olive juice.
Iberian hams	
Category	Description of the category
100% Iberian acorn-fed ham 🔵	Ham from a 100% genetically pure animal, slaughtered immediately after exclusive consumption of acorns, grass and other natural resources of the *dehesa*, with no supplementary feed.
Acorn-fed ham with a minimum of 50% Iberian blood 🔴	Ham from an animal that genetically corresponds by at least 50% to the Iberian pig breed, slaughtered immediately after exclusive consumption of acorns, grass and other natural resources of the *dehesa*, with no supplementary feed.
Fodder-fed ham with a minimum of 50% Iberian blood 🟡	Ham from an animal that genetically corresponds by at least 50% to the Iberian pig breed and fed with feed fundamentally made up of cereals and legumes, managed under intensive farming systems.
Orange juices	
Category	Description of the category
100% natural orange juice 🔵	100% juice from fresh, healthy and ripe oranges, conserved by means of refrigerating or freezing and possessing the colour, aroma and flavour characteristic of this fruit. No added sugars.
100% natural rehydrated orange juice 🔴	Product obtained exclusively from orange juice that has previously been dehydrated and subsequently reconstituted with drinking water. Contains the aroma, pulp and cells of the orange. No sugars or additives.
Orange juice reconstituted with additions 🟡	Product obtained by means of water, sugars and additives added to the orange pulp, with a 50% minimum orange content.

(continued on next page)

Table A2
Adaptation of the screen shots shown in the experimental procedure during the recall stage.

Recall
Screen 1
Of the type of **olive oils/Iberian hams/orange juices** we have presented to you, which ones do you recall? Please specify any symbol or drawing.
Screen 2
Within these, which one was the highest quality?
I do not recall any
Screen 3
Which was the second highest quality?
I do not recall any
Screen 4
And the third?
I do not recall any

Table A3
Adaptation of the screenshots shown in the experimental procedure during the recognition phase of the associated information (example for Iberian hams).

Recognition (Iberian hams)		
Screen 2		
The following is a list of classifications of Iberian cured hams. Of the categories of this product that you recall (maximum of three), please click on the one you believe to be of the highest quality, then on the second highest and finally on the third highest. *Remember that you can deselect your answers, clicking again on an option you had already chosen.*		
100% Iberian acorn-fed ham ●	Iberian acorn-fed ham ▬	
Iberian ham ●	Iberian ham 2	1 ▬
Iberian ham 🌰🌰	Fodder-fed ham with a minimum of 50% Iberian blood	2 ▬
Iberian ham	Fodder-fed ham with a minimum of 50% Iberian blood ●	3 ▬
Iberian ham ●	Iberian-pastured fodder-fed ham ▬	
100% Iberian acorn-fed ham	Iberian ham 1	
Iberian ham 3	Acorn-fed ham with a minimum of 50% Iberian blood	
100% Iberian acorn-fed ham 🌰🌰	Acorn-fed ham with a minimum of 50% Iberian blood 🌰	
Fodder-fed ham with a minimum of 50% Iberian blood 3	Acorn-fed ham with a minimum of 50% Iberian blood 2	
Acorn-fed ham with a minimum of 50% Iberian blood ●	Iberian ham ●	
100% Iberian acorn-fed ham 1	100% Iberian acorn-fed ham ▬	
Iberian ham 🌰		

Table A4
Adaptation of the screenshots shown in the experimental procedure during the recognition phase of the associated information (example treatment ×1/olive oils).

Associated Information (olive oils)	
Screen 1	
In the following categories of olive oil, mark with an X the information you remember seeing in each of them. Please note that there can be several correct phrases (more than one associated phrase) and that there can be repeated information among each type of oil.	
Olive oil 	o Maximum quality oil o Subjected to chemical rectification treatment o Only with mechanical procedures o Exclusively contains refined olive oils and virgin olive oils o Conserves all the flavour, aroma and properties of the natural fruit o Obtained from pure olive juice o Subjected to refining treatment o Obtained from a mixture of oils
Olive oil 	o Subjected to refining treatment o Conserves all the flavour, aroma and properties of the natural fruit o Exclusively contains refined olive oils and virgin olive oils o Maximum quality oil o Only with mechanical procedures o Obtained from pure olive juice o Subjected to chemical rectification treatment o Obtained from a mixture of oils
Olive oil 	o Exclusively contains refined olive oils and virgin olive oils o Obtained from pure olive juice o Obtained from a mixture of oils o Maximum quality oil o Only with mechanical procedures o Subjected to refining treatment o Conserves all the flavour, aroma and properties of the natural fruit o Subjected to chemical rectification treatment

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