



Consumer perception of different species and presentation forms of fish: An empirical analysis in Italy



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ABSTRACT

Fish consumption analysis involves public and commercial interests. Many studies have focused on this issue over the last few decades. Researchers rarely consider the heterogeneity of these products, while we believe there are at least five reasons why it should always be taken into account: (i) health factors; (ii) environmental drawbacks regarding the consumption of particular species; (iii) the importance of species and how the fish are presented to consumers; (iv) the perceived differences between species are of prime importance for marketing strategies; and finally (v) being able to identify different species helps prevent fraud. Through perceptual mapping we studied the perceived differences between European anchovies (*Engraulis encrasicolus*), European sardines (*Sardina pilchardus*) and mackerel (*Sgomer* spp.), wild-caught cod and sole, and farmed sea bream and sea bass. We checked for the influence of gender, age, education and residence in how consumers perceive seafood. We found that the gender, age and education of consumers do not usually affect their perception of blue fish as being cheap, flavorful and traditional, cod and sole as nutritional, and farmed sea bream and bass as natural. A slight difference was found in central/southern Italian residents, who perceive farmed sea bream and bass as cheap and flavorful. The results validate the idea that consumers recognize the different attributes of each species or type of fish for sale, but some issues remain unresolved and further studies are recommended.

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1. Introduction

The vast majority of scientific studies on fish consumption can be attributed to public interest in this issue, since it is considered as a significant source of important nutrients for the human diet (Friedman, 1996; Kinsella, 1986; Lloret, 2010; Venugopal & Shahid, 1996) and a source of income for many countries (FAO, 2012; Honkanen, Olsen, & Verplanken, 2005; Sen & Nielsen, 1996; Tietenberg & Lewis, 2006). This has been the driving force behind the literature on what determines fish consumption over the last two decades. However, among consumer analysts fish have been often treated as a group of homogeneous products (Dey et al., 2008). Despite the biological and product diversity between the species and the presentation forms for sale, which most consumers can recognize immediately (Pieniak, Verbeke, Vermier, Brunsø, & Olsen, 2007), we are not aware of any analysis that is explicitly aimed at estimating how consumers perceive the differences between species/types for sale.

We believe there are at least five reasons why these distinctions are useful: (i) there are various health and (ii) environmental drawbacks regarding the consumption of particular species related to the accumulation of contaminants (Domingo, Bocio, Falcó, & Llobet, 2007; Mozaffarian & Rimm, 2006; Verbeke, Sioen, Pieniak, Van Camp, & De Henauw, 2005) and stock depletion (Brunner, Jones, Friel, & Bartley, 2009; Le Gallic & Cox, 2006); (iii) according to the modern consumer theory (Lancaster, 1966), the utility of goods consumption is a function of the attributes that these goods possess, and species and types are unquestionably valuable determinants for consumer choice regarding fish consumption; (iv) the differences that consumers perceive in different fish products is of prime importance for marketing strategies (Grunert, Larsen, Madsen, & Baadsgaard, 1996); and (v) recognition of the different species is an important issue for public authorities with regard to fraud (Asensio & Montero, 2008; Baldauf & Jernudd, 1983; Gaviglio, Pirani, & Demartini, 2013; Jacquet & Pauly, 2008; Jernudd & Thau, 1984).

This paper presents a survey that was conducted on behalf of the Italian government, originally aimed at proposing a promotional framework to enhance the consumption of the so-called "blue fish" within the Country. This is a widespread definition commonly used to identify a large group of fish on the basis of their

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natural abundance in the Mediterranean Sea and appearance; they are small with a dorsal blue and ventral silver colour (Il Pesce, 2009). The most common species of this group are European anchovies (*Engraulis encrasicolus*), European sardines (*Sardina pilchardus*) and mackerel (*Sgomer* spp.) which, according to Istat's information, count for one third of the whole Italian wild-caught fish, but only command a low price (Cosmina et al., 2012) despite their healthiness (Lloret, 2010; Ruxton, Reed, Simpson, & Millington, 2004; Simopoulos, 1991).

In terms of marketing, the analysis was constructed so as to identify the differences in perception of different presentation forms of blue fish and other group of species (see next paragraphs). However its results contribute to the literature, because these differences demonstrate the distinction that consumers make between fish, suggesting the need for further studies.

The paper is organized into four sections. Section 2.1 reviews the literature on fish consumption, analyzing whether and how researchers distinguish between different types and species of fish in their analysis, while Section 2.2 describes the attributes that consumers recognize in seafood products. The methodologies and analysis are presented in Section 3, and the results and discussion in Section 4. Finally, the conclusion proposes some reflections on our analysis of fish consumption.

2. Fish perception and fish consumption

2.1. Points of view matter: simply fish or different fishes?

It is scientifically interesting that consumer analysts normally distinguish between poultry, pig and beef, but tend to present fish as a single commodity (Dey et al., 2008). As we argued in the introduction, there are some papers on fish consumption in terms of different types and species, which consider fish as a group of heterogeneous products. However, as we will go onto discuss, only very few of them aim to depict the differences between these products. In order to describe the importance of this phenomenon, we searched for papers where differences in types/species are considered. We focused on whether or not there was any sort of quantification of this heterogeneity. We found that researchers considered the following:

2.1.1. Species differentiation

Fish are distinguished on the basis of their biological characteristics. Biological properties are the most evident differences between fish. Important attributes for quality evaluation such as nutritional and sensory characteristics of the product depend on the species. Given the large amount of species for sale, they are firstly grouped into finfish and non-fish, such as crustaceans, shrimps (Dey, 2000; Dey et al., 2008) or by habitats into marine and freshwater finfish (Dey, 2000; Dey et al., 2008; Garcia, Dey, & Navarez, 2005). In these studies the different income and price elasticities found by the authors for different products reveal their heterogeneity. Finfish may also be classified by their nutritional characteristics into fat fish (mackerel and salmon) or lean fish (cod and haddock), suggesting particular types/species of fish may be preferred on the basis of health beliefs (Trondsen, Braaten, Lund, & Eggen, 2004; Trondsen, Scholdererb, Lundc, & Eggend, 2003) and availability in the market (Trondsen et al., 2003). A third differentiation lies among species commonly consumed in particular countries (Lawley, Birch, & Hamblin, 2012; Verbeke, Vanhonacker, Sioen, Van Camp, & De Henauw, 2007). Finally, Verbeke, Vermeir, and Brunsø (2007) classify fish as “common” or “exclusive” on the basis of the frequency of consumption and availability.

2.1.2. Process differentiation

Seafood can be purchased fresh or processed. Fresh fish differentiation consists essentially of different levels of cleaning and cutting, while processed fish present a wide range of products distinguishable on the basis of preservation and level of convenience. Despite the number of products for sale, we found four papers that consider such a distinction. They mention dried fish (Dey, 2000; Dey et al., 2008) or, generically, processed fish, which in one case is represented by convenient preparations such as cake, sticks and puddings (Trondsen et al., 2004), while in another case is represented by the typical forms of fish preservation, i.e. salting, drying and smoking (Verbeke, Vermeir, et al., 2007).

2.1.3. Origin differentiation

Since the introduction of farmed species for sale, fish can also be differentiated in terms of origin. Although few surveys consider this distinction, their results seem to confirm that it is an important feature for consumer perception. One experiment directly proved that farmed and caught Barramundi species have different sensory characteristics (Lawley et al., 2012). These differences, on the other hand, can be indirectly inferred by the correlation found between the level of consumption of farmed or caught fish and different health consumption habits (Trondsen et al., 2004), the level of a product's environmental sustainability perceived by consumers (Verbeke, Vanhonacker, et al., 2007), or, finally, from the different attitudes towards the products in different clusters (Gaviglio & Demartini, 2009).

2.2. Consumer perception of fish

According to cue utilization theory (Olson J. C., 1972), assessing the quality of products is carried out in terms of the identifying and defining the information cues that consumers use as indicators. Product information cues are traditionally classified as either intrinsic or extrinsic. Intrinsic cues are those inherent in the product, such as taste, smell or color, while extrinsic cues include any external features, such as price, brand or packaging. It is unclear which of the two classes predominates in consumer choices: some studies have highlighted the relevance of extrinsic cues (Han & Terpstra, 1988), while others have concluded that intrinsic cues are paramount (Szybillo & Jacoby, 1974).

Extrinsic cues are considered to be of a lower level, because they are not exclusively tied to the product. For example, each fish species will always taste the same, but its price differs from place to place and its country-of-origin can either be clearly shown or hidden (Asensio & Montero, 2008). This implies that consumers may even be fraudulently excluded from the assessment of one of these features because the seller decides not to make it visible. However, extrinsic cues seem to be more familiar to consumers (Lee & Lou, 2011). Lawley et al. (2012) reviewed the cues that have been used to analyze fish consumption – (a) intrinsic: taste, odour, texture and perceived freshness among the intrinsic cues; and (b) extrinsic: price, branding, context of consumption, method of production, certification of quality, country-of-origin, expert opinion, and nutritional information.

Olsen (2004) presents another interesting review on quality perception and fish consumption antecedents; through the framework of the Theory of Planned Behaviour (Ajzen, 1985). He divides the drivers and barriers of consumption into attitudes and preferences, subjective norms and perceived behavioural control. In attitudes and preferences, taste/distaste has been found to have a primary positive or negative attribute in consumer choice (Brunso, Verbeke, Olsen, & Jeppesen, 2009; Lawley et al., 2012; Leek, Maddock, & Foxall, 2000; Myrland, Trondsen, Johnston, & Lund, 2000; Olsen, 2004; Rødbotten, Lea, & Ueland, 2009; Trondsen et al., 2003; Verbeke & Vackier, 2005). In addition negative

experiences such as the presence of bones (Olsen, 2003; Verbeke & Vackier, 2005) and unpleasant smells (Brunso et al., 2009; Myrland et al., 2000; Nielsen, Hyldig, & Larsen, 2002; Olsen, 2001; Trondsen et al., 2003) are linked to the negative taste evaluation of fish. The quality of seafood seems entirely tied to its freshness, particularly as it has also been found that frozen fish is perceived as worse than fresh products (Olsen, 2004) and it is reasonable to argue that every process in some way affects the quality perception of fish.

There are also social factors that impact on food consumption. In the case of fish, these subjective factors derive primarily from its nutritional properties (Brunso et al., 2009; Juhl & Poulsen, 2000; Olsen, 2001, 2003; Trondsen et al., 2003; Verbeke, Sioen, Brunso, De Henauw, & Van Camp, 2007; Verbeke & Vackier, 2005; Verbeke, Vanhonacker, et al., 2007) which also support consumption in households with children (Myrland et al., 2000), and indirectly from the taste, because a family member's distaste of the product could be a barrier for fish purchase (Myrland et al., 2000; Olsen, 2003; Trondsen et al., 2003).

Perceived behavioral control refers to people's perceptions of their ability to perform a given behavior. Olsen (2004) mentioned four fish features that can be linked to this class: price, convenience, availability and knowledge. Although seafood is sometimes perceived as expensive (Brunso et al., 2009; Myrland et al., 2000; Nielsen et al., 2002) and some studies prove different price elasticities among different species and countries (Dey, 2000; Dey et al., 2008; Garcia et al., 2005), price cannot be definitely described as a barrier to purchase, because in some countries some fish species are cheap, as found by Leek et al. (2000) and Honkanen, Setälä and Eröla (1998).

Convenience concerns the time required for cooking, which could discourage some consumers from purchasing particular types (Brunso et al., 2009; Myrland et al., 2000; Trondsen et al., 2003), while it might make the purchase of ready-to-eat products more likely. Availability in the shops, which can be seen as a facet of convenience, represents a positive (Gempesaw, Bacon, Wessells, & Manalo, 1995; Trondsen et al., 2003) or unimportant attribute for fish consumption (Leek et al., 2000). Finally, knowledge, i.e. consumers' perception of their capacity to evaluate fish quality and preparation for consumption, is as an important variable in driving product choice, but has still not been fully investigated (Myrland et al., 2000; Olsen, 2004).

3. Materials and methods

3.1. Questionnaire and sample characteristics

A questionnaire was designed to collect information on the perception of different fish species and types and on their consumption frequency. The questionnaire was organized into three sections. In the first section we asked about family fish consumption: respondents reported the most consumed species in the family (see Section 4 for the list of species) and the frequency of consumption of fresh blue fish in a six-point rating scale from "almost never" to "2/3 times a week". The second section was dedicated to the collection of data on fish perception, and the third on demographic information. We designed the survey considering the evidence of our analysis of international reviews, the overall

needs of the public institution that funded the research, the characteristics of the Italian fish sector, and the experimental constraints. The two most sensitive issues were: (i) choosing the appropriate amount of products and attributes to be included in the questionnaire; and, (ii) setting the sampling plan and questionnaire collection method.

3.1.1. Fish species groups and choice of attributes

In order to understand consumers' perception of different fish products, the first issue was how to include fish heterogeneity in the questionnaire, without tiring the interviewees. The supply of Italian fish products is highly differentiated, with more than 650 different finfish and non-fish species for sale (Gaviglio et al., 2013) mostly sold in more than one form. This heterogeneity among fish products – which is typical all the markets for fish in developed countries may mean that the quantity of information requested can negatively influence the quality of the data collected from questionnaires (Heberlein & Baumgartner, 1978). In order to get round this problem, we grouped different fish species by common Italian cultural denominations, considering only different preparation forms between blue fish. Then we asked consumers to choose from a list of 24 attributes those they thought were most representative for each product.

Table 1 shows the fish groups used. Apart from blue fish (see Section 1), we divided the fish species into two groups: "white fish" and "farmed fish". The first group includes European hake (*Merluccius merluccius*), Atlantic cod (*Gadus morhua*) and common sole (*Solea solea*). Although these fish are very different in shape, in Italy this definition commonly identifies these species because of the color and nutritional properties of their flesh (ISMEA, 2004). Gilt-head sea bream (*Sparus aurata*) and European sea bass (*Dicentrarchus labrax*) are the two fish we presented to consumers as "farmed fish". This is because they are the two most important marine farmed finfish species produced in Italy (Bronzi et al., 2011). The preparation forms include fresh, canned, salted/smoked and ready-to-eat fish products.

The authors are aware that these groups do not perfectly guarantee that all interviewees reported their perceptions in terms of the same fish species/types in each group. For example, in terms of canned blue fish, one interviewee could have considered mackerel, while another anchovies, and there would be the same confusion between species pertaining to white fish and so on. However,

Table 2
Attributes used for analysis.

Code	Attributes	Code	Attributes
bon	Too many bones	hpr	Too expensive
che	Cheap	lon	Long preparation time
del	Delicate taste	mod	Modern
die	Dietetic	nat	Natural
dif	Difficult to digest	not	Not liked by everyone
dif	Difficult preparation	occ	Eaten on special occasions
dig	Easy to digest	sea	Flavor of the sea
eas	Easy to cook	sho	Short preparation time
fat	Fat	sme	Fishy smell
fla	Flavorful	tra	Traditional
fri	Eaten on Fridays	trb	I trust the brand
hea	Good for the health	trs	I trust the source

Table 1
Definition and codes of the fish groups used for the analysis.

Group name	Fresh	Canned	Salted Smoked	Ready-to-eat	Species
Blue fish	FBD	CBF	SBF	RBF	European anchovies (<i>Engraulis encrasicolus</i>), European sardines (<i>Sardina pilchardus</i>) and mackerel (<i>Sgomer</i> spp.)
White fish	WF	–	–	–	European hake (<i>Merluccius merluccius</i>), Atlantic cod (<i>Gadus morhua</i>) and sole (<i>Solea solea</i>)
Farmed fish	FF	–	–	–	Gilt-head seabream (<i>Sparus aurata</i>) and European seabass (<i>Dicentrarchus labrax</i>)

Table 3
Sample quotas used for the survey.

Area	Age range per region	Female			Male		
		Resident population		Quota	Resident population		Quota
		103	%		103	%	
Italy	Total	8173	1.00	640	8261	1.00	426
Inland Northern Italy	Lombardy	3105	0.38	244	3176	0.38	161
	18–25	352	0.11	28	371	0.12	19
	26–35	655	0.21	51	687	0.22	35
	36–45	819	0.26	64	871	0.27	44
	46–55	671	0.22	53	673	0.21	34
	56–65	607	0.02	48	575	0.18	29
	Emilia Romagna	1366	0.17	109	1376	0.17	73
	18–25	144	0.11	12	152	0.11	8
	26–35	290	0.21	23	299	0.22	16
	36–45	357	0.26	28	374	0.27	20
Coastal Northern Italy	46–55	301	0.22	24	298	0.22	16
	56–65	271	0.02	22	253	0.18	13
	Veneto	1558	0.19	122	1598	0.19	83
	18–25	182	0.12	14	191	0.12	10
	26–35	328	0.21	26	343	0.21	18
	36–45	410	0.26	32	433	0.27	22
	46–55	339	0.22	27	345	0.22	18
	56–65	297	0.19	23	286	0.18	15
	Friuli Venezia-Giulia	385	0.05	31	394	0.05	19
	18–25	40	0.11	3	43	0.11	2
Coastal Central/South Italy	26–35	74	0.19	6	80	0.02	4
	36–45	100	0.26	8	104	0.26	5
	46–55	85	0.22	7	86	0.22	4
	56–65	84	0.22	7	80	0.02	4
	Abruzzo	426	0.05	32	424	0.05	22
	18–25	56	0.13	4	60	0.14	3
	26–35	89	0.21	7	92	0.22	5
	36–45	106	0.25	8	105	0.25	5
	46–55	93	0.22	7	90	0.21	5
	56–65	80	0.19	6	77	0.18	4
	Puglia	1331	0.16	101	1293	0.16	68
	18–25	196	0.15	15	204	0.16	11
	26–35	292	0.22	22	291	0.22	15
	36–45	317	0.24	24	307	0.24	16
	46–55	279	0.21	21	261	0.02	14
	56–65	246	0.19	19	229	0.18	12

Table 4
Characteristics of the sample.

	Frequency No.	Percentage (%)
<i>Food purchasers</i>		
Other than me	436	40.9
Me	630	59.1
<i>Children in the household 0–12 years</i>		
No	827	77.6
Yes	239	22.4
<i>Children in the household 13–18 years</i>		
No	871	81.7
Yes	195	18.3
<i>Education</i>		
Elementary	31	2.9
Middle School	147	13.8
High school	426	40.0
University degree	462	43.3
<i>Household size (number)</i>		
1	62	5.8
2	208	19.5
3	287	26.9
4	355	33.3
5+	154	14.5

Table 5
Most consumed species and fresh blue fish consumption.

Fish species	Respondents	
	No.	Perc.
<i>Most consumed fish species</i>		
European anchovy, sardines, Atlantic markerel	95	8.9
Atlantic cod, European hake, sole	194	18.2
Sea bream, sea bass, European sea bass	213	20.0
Clams, mussels	82	7.7
Swordfish, tuna	201	18.9
Octopus, cuttlefish, squid	93	8.7
Trout, salmon	62	5.8
European lobster, prawn, lobster, European spiny lobster	62	5.8
No answer	64	6.0
<i>Total</i>	1066	100.0
<i>Fresh blue fish consumption frequency</i>		
Almost never	149	14.0
3/4 Times a year	202	18.9
Once a month	249	23.4
Once every two weeks	268	25.1
Once a week	168	15.8
2/3 Times a week	30	2.8
<i>Total</i>	1066	100.0

we chose this method because it considerably lowers the burden of the interviewees, given the large amount of information requested. In addition considering that the vast majority of fish consumption

literature reports far more extreme simplifications, we thus preferred the clarity of the questionnaire. Table 2 shows the set of attributes that consumers could pick from to describe different fish species/types, which were selected from an international and Italian literature review (see previous sections).

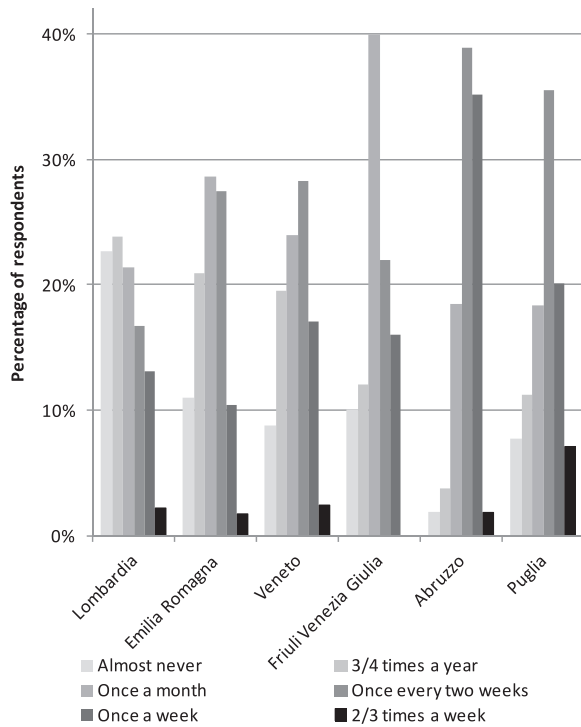


Fig. 1. Fresh blue fish consumption by Italian region.

3.1.2. Questionnaire and sample

Data were collected between March and June 2011 using an online questionnaire with 1066 respondents divided into different numbered classes using a quota sampling method. This involves identifying the starting population and establishing the

stratification characteristics that will be used to extract the sample. Quotas were defined on the basis of data from the official Italian registry of statistics (ISTAT, referenced from January 1, 2011 – www.demo.istat.it – see Table 3) stratified by residence, age and gender. A sample of Italian consumers was interviewed in six regional capitals, selected to provide indicators from both inland and coastal areas: Milan (Lombardy), Bologna (Emilia Romagna), Venice (Veneto), Trieste (Friuli-Venezia Giulia), Pescara (Abruzzo), and Bari (Puglia).

Sample characteristics are shown in Table 4 and consisted of individuals between the ages of 18 and 65. The sample was made up of 60% females, thus favoring the gender previously found to be more influential in family food purchases (Belch & Willis, 2002; Story, Neumark-Sztainer, & French, 2002). The families primarily consisted of 3–4 members (60.22% of the total) with children between the ages of 0–12 years, or between the ages of 13–18 years in about one third of cases. The average education level was quite high: 39.96% of the sample had a high school diploma, and 43.3% were university graduates (see Table 4). We are aware that such a sample's education profile does not respect Italian demographic statistics and consequently the information collected may not be generalizable to the whole population (Zhang, 2000). Furthermore, previous scientific evidence shows that education level can influence some aspects of fish perception (Verbeke et al., 2005) or consumer awareness of the importance of eating fish (Trondsen et al., 2003). However, the methodology we used has the potential to describe differences between the two groups, thus enabling the significance of this bias to be estimated.

3.2. Perceptual maps: visualizing consumer perceptions

In order to highlight the differences between fish species/types for sale we constructed a perceptual map of products. This is the

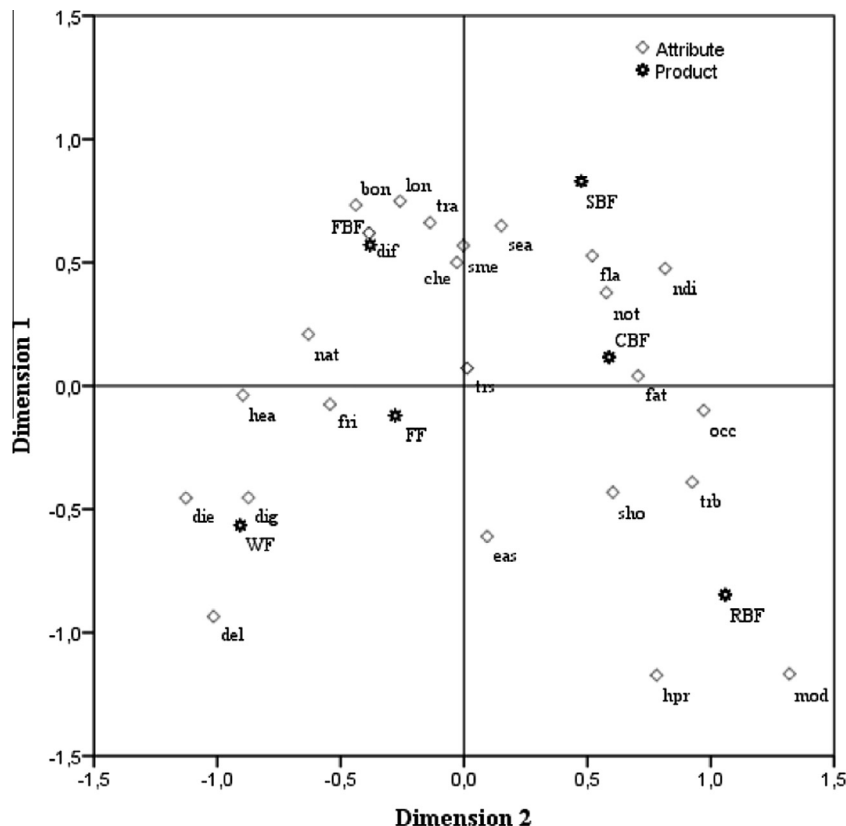


Fig. 2. Fish products perception maps. Note: total inertia = 0.846 – $\chi^2 = 7808.55$ – Sign. = 0.000.

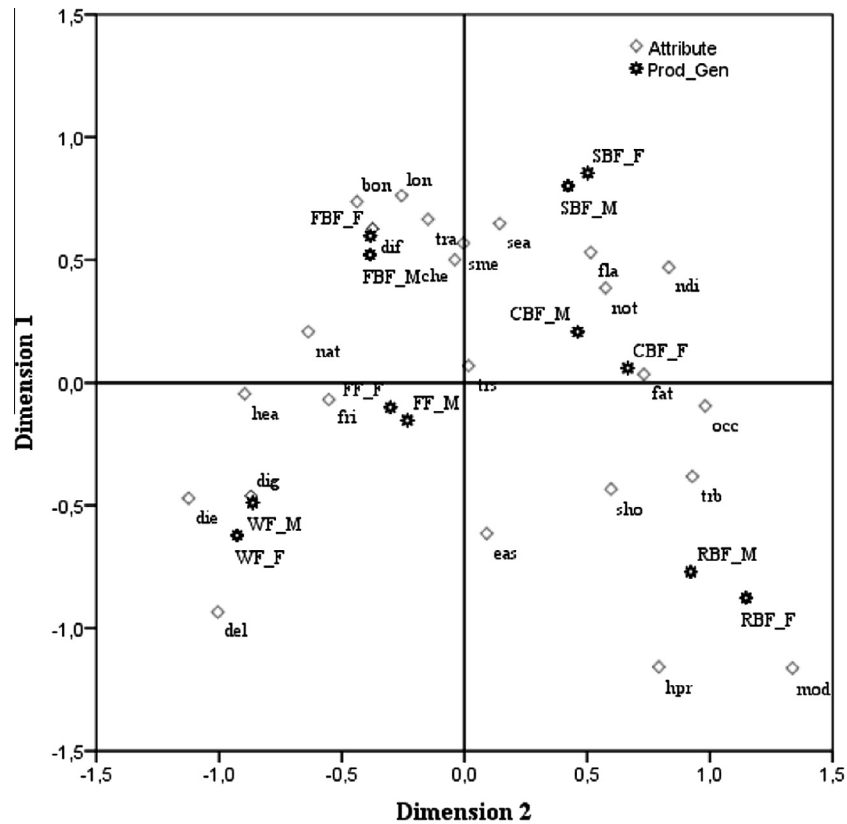


Fig. 3. Fish products perception maps by gender. Note: total inertia = 0.821 – $\chi^2 = 8111.46$ – Sign. = 0.000.

Table 6

Numerical results of figure 2 perceptual map.

Category	Mass	Inertia	I Dimension		II Dimension		Squared correlation		
			Coordinate	Contribution to dimension	Coordinate	Contribution to dimension	I Dimension	II Dimension	Quality
Products									
FBF – Fresh Blue Fish	.207	.046	–.381	.068	.571	.206	.291	.482	.773
WF – Fresh White Fish	.195	.096	–.907	.361	–.566	.191	.740	.213	.953
FF – Fresh Farmed Fish	.170	.015	–.279	.030	–.121	.008	.397	.055	.451
CBF – Canned Blue Fish	.155	.040	.588	.121	.116	.006	.591	.017	.608
SBF – Salted/Smoked Blue Fish	.135	.057	.475	.069	.829	.285	.238	.536	.774
RBF – Ready-to-Eat Blue Fish	.139	.105	1.059	.351	–.847	.305	.656	.310	.967
Attribute									
bon – Too many bones	.022	.010	–.439	.009	.733	.035	.182	.375	.557
che – Cheap	.066	.013	–.029	.000	.500	.050	.002	.402	.404
del – Delicate taste	.050	.041	–1.015	.117	–.935	.135	.557	.349	.907
die – Dietetic	.040	.026	–1.127	.115	–.455	.025	.861	.104	.965
dif – Difficult preparation	.011	.004	–.385	.004	.619	.013	.184	.351	.535
dig – Easy to digest	.045	.019	–.874	.077	–.454	.028	.811	.161	.972
eas – Easy to cook	.074	.010	.094	.001	–.611	.085	.030	.931	.960
fat – Fat	.026	.009	.705	.029	.040	.000	.610	.001	.612
fla – Flavorful	.067	.017	.520	.041	.527	.057	.464	.352	.815
fri – Eaten on Fridays	.015	.002	–.543	.010	–.075	.000	.967	.014	.981
hea – Good for health	.076	.029	–.896	.139	–.038	.000	.925	.001	.926
hpr – High price	.028	.023	.781	.038	–1.174	.117	.320	.534	.853
lon – Long preparation time	.015	.007	–.259	.002	.748	.026	.062	.383	.445
mod – Modern	.034	.044	1.319	.133	–1.169	.142	.599	.347	.946
nat – Natural	.056	.012	–.631	.050	.209	.007	.837	.068	.905
ndi – Difficult to digest	.016	.006	.815	.023	.475	.011	.750	.188	.938
not – Not liked by everyone	.071	.017	.577	.053	.377	.031	.619	.195	.814
occ – Eaten on special occasions	.025	.013	.972	.053	–.100	.001	.778	.006	.784
sea – Flavor of the sea	.059	.009	.151	.003	.649	.075	.066	.895	.960
sho – Short preparation time	.065	.018	.603	.054	–.432	.037	.570	.216	.786
sme – Fishy smell	.039	.005	–.003	.000	.568	.039	.000	.827	.827
tra – Too expensive	.055	.011	–.138	.002	.661	.073	.043	.738	.781
trb – I trust the brand	.024	.011	.925	.046	–.391	.011	.833	.110	.942
trs – I trust the source	.022	.001	.012	.000	.071	.000	.002	.057	.059

Note: respondents No. = 1066.

graphical output, also known as a bi-plot, of a group of data reduction techniques, which includes simple correspondence analysis, multiple correspondence analysis, preference mapping, multidimensional preference analysis, and multidimensional scaling (Kuhfeld, 2009). This can then be used to simplify the representation of the consumer perception of products for sale. Since the early 1990s this method has been applied in many research areas such as ecology, psychometry, sensory evaluation, health care, economics, medicine, text analysis, archaeology, and engineering (Beh, 2004). The advantages of simple correspondence analysis for consumer analyses are: (i) it is relatively easy to use in terms of data, software requirements and experimental design; (ii) researchers can choose products and cues arbitrarily; (iii) perceptual maps give an immediate representation of consumer perception based on recognized differences/similarities between products and attributes.

We applied a simple correspondence analysis with a symmetric normalization model (Beh, 2004; Hoffman & Franke, 1986; Lebart, Morineau, & Warwick, 1984) using the statistical software SPSS 17.0. This software is suitable for exploring relationships between items of two nominal variables, in our case corresponding to the different fish products and their descriptive attributes. Differences or similarities are derived from the position of points in a Cartesian plane: each product and attribute is uniquely identified by a pair of coordinates on the map. Interpreting the similarity and dissimilarity between points projected in bi-plots requires researchers to consider different parameters. Hoffman and Franke (1986) provide

a comprehensive discussion of the topic. In brief, the closer the points belonging to the same variable, the more they contribute in the same way in a bi-plot construction (i.e. the more similar they are). At the same time, we can (partly) qualitatively state that if one product is clearly surrounded by some attributes, while another product is surrounded by other attributes, each of the two products is “somehow” related to its surrounding attributes. Note that the classical notion of distance is not used to evaluate similarities/differences. Instead a simple correspondence analysis uses “relative positions”, because every bi-plot (i.e. the dimension of the plane) is derived from a unique original dataset and the rows and column profiles. In addition, some measure of the quality of the projection of the points is needed, as we show in the next section.

4. Results and discussion

4.1. The most consumed fish species and the consumption frequency of blue fish

Results showed that the most consumed species were sea bream and sea bass (20.0% of respondents), swordfish/tuna (18.9%) and cod/sole (18.2%) Well below the other three categories, 9.9% of families consume blue fish the most frequently (see Table 5); 8.7% and 7.7% of respondents stated that they consume cephalopod mollusks and bivalve mollusks the most, respectively; finally, 5.8% of the sample consume mostly trout or salmon, or lobsters.

Table 7
Numerical results of figure 3 perceptual map.

Category	Mass	Inertia	I Dimension		II Dimension		Squared correlation		
			Coordinate	Contribution to dimension	Coordinate	Contribution to dimension	I Dimension	II Dimension	Quality
Products									
FBF_F – Fresh Blue Fish*Female	.123	.030	–.384	.041	.597	.134	.268	.480	.748
WF_F – Fresh White Fish*Female	.121	.065	–.927	.233	–.622	.142	.709	.236	.945
FF_F – Fresh Farmed Fish*Female	.104	.009	–.302	.021	–.101	.003	.492	.041	.532
CBF_F – Canned Blue Fish*Female	.094	.028	.665	.093	.059	.001	.654	.004	.658
SBF_F – Salted/Smoked Blue Fish*Female	.081	.038	.502	.046	.854	.181	.239	.509	.748
RBF_F – Ready-to-Eat Blue Fish*Female	.086	.074	1.147	.254	–.877	.201	.675	.291	.967
FBF_M – Fresh Blue Fish*Male	.084	.019	–.385	.028	.521	.069	.295	.398	.692
WF_M – Fresh White Fish*Male	.074	.033	–.863	.124	–.490	.054	.746	.177	.923
FF_M – Fresh Farmed Fish*Male	.065	.008	–.232	.008	–.154	.005	.197	.064	.261
CBF_M – Canned Blue Fish*Male	.061	.015	.461	.029	.207	.008	.392	.058	.450
SBF_M – Salted/Smoked Blue Fish*Male	.054	.021	.422	.022	.802	.106	.207	.550	.757
RBF_M – Ready-to-Eat Blue Fish*Male	.053	.033	.922	.102	–.771	.096	.614	.317	.931
Attribute									
bon – Too many bones	.022	.012	–.438	.009	.737	.036	.160	.333	.493
che – Cheap	.066	.015	–.039	.000	.500	.050	.003	.372	.375
del – Delicate taste	.050	.041	–1.005	.114	–.935	.134	.547	.349	.895
die – Dietetic	.040	.027	–1.124	.114	–.471	.027	.847	.110	.957
dif – Difficult preparation	.011	.005	–.374	.003	.627	.013	.151	.313	.464
dig – Easy to digest	.045	.019	–.870	.076	–.462	.029	.801	.167	.968
eas – Easy to cook	.074	.011	.091	.001	–.615	.086	.025	.861	.887
fat – Fat	.026	.011	.731	.031	.033	.000	.569	.001	.570
fla – Flavorful	.067	.017	.514	.040	.530	.058	.454	.356	.810
fri – Eaten on Fridays	.015	.002	–.553	.010	–.069	.000	.867	.010	.877
hea – Good for health	.076	.030	–.895	.138	–.046	.000	.921	.002	.923
hpr – High price	.028	.024	.792	.039	–1.158	.113	.325	.512	.837
lon – Long preparation time	.015	.008	–.256	.002	.762	.027	.057	.370	.427
mod – Modern	.034	.045	1.337	.136	–1.163	.140	.602	.336	.937
nat – Natural	.056	.012	–.637	.051	.207	.007	.836	.065	.901
ndi – Difficult to digest	.016	.007	.833	.024	.469	.010	.674	.158	.831
not – Not liked by everyone	.071	.018	.575	.053	.386	.032	.594	.197	.791
occ – Eaten on special occasions	.025	.014	.981	.053	–.095	.001	.764	.005	.770
sea – Flavor of the sea	.059	.009	.143	.003	.648	.075	.059	.886	.944
sho – Short preparation time	.065	.019	.597	.052	–.434	.037	.544	.212	.756
sme – Fishy smell	.039	.005	–.004	.000	.568	.039	.000	.818	.818
tra – Too expensive	.055	.012	–.149	.003	.665	.074	.046	.677	.723
trb – I trust the brand	.024	.011	.929	.046	–.382	.011	.831	.104	.935
trs – I trust the source	.022	.001	.017	.000	.069	.000	.003	.039	.042

Note: respondents: Female No. = 640; Male No. = 426.

From these results, we obtained confirmation of Italian consumer habits and support for our analysis. As we expected, two of the three most consumed fish species represent the two groups used in the perceptual mapping. In addition, blue fish seem to suffer from a low demand; although almost 20% of the sample stated a “weekly” frequency of blue fish consumption, 25.1% eat blue fish every two weeks, while the rest of the respondents (56.3%) consume it from “almost never” to “once a month”. Although care must be taken, these results, together with the high supply volumes of blue fish, seem to account for its low price.

The analysis showed some differences in blue fish consumption by geography (Fig. 1), as shown with different fish species in previous studies (Rigatti Luchini & Mason, 1999; Trevisan & Mason, 2000). Generally, the frequency of consumption decreases from the north to south and from inland to coastal areas. In Lombardy and Emilia-Romagna (northern inland regions) we found a clear non-consumption habit for blue fish, while in Abruzzo and Puglia (central and southern regions) blue fish consumption increases and more than half of respondents consume blue at least once every two weeks. Veneto and Friuli Venezia-Giulia (northern coastal regions) show an intermediate distribution of consumption frequencies Fig. 2.

4.2. Perceptual mapping of different species and presentation forms of fish

We present five different perception maps derived from an analysis of the data (the original data are provided in the Appendix). The first one was constructed using the whole database, while the remaining four were constructed by grouping the sample according to gender, age, residence and education. Bi-plots and numerical outputs of the first map are presented, while the results from the partition follow with comments and a comparison with

the first one so as to emphasize the potential differences in perception due to demographic characteristics.

4.2.1. Whole sample map

Fig. 3 shows that fish products and attributes chosen by respondents to describe them. The first two dimensions account for 84.6% of the total inertia, ensuring a satisfactory representation of the primary information. Table 6 provides an interpretation for the map. The “contribution to dimension”, which sums to 1 for each set of products and attributes, refers to the importance of each point for the relative dimension definition. “The “squared correlation” and “quality” of a point, which is the sum of the squared correlation in the two dimensions and which can sum to a maximum of one, highlights how well the representation “fits” each point.

Fresh white fish and ready-to-eat blue fish contribute the most for the first principal axis. These products are still predominant for the second axis, whose other determinants include salted/smoked blue fish and fresh blue fish. The quality of projection shows very well fitted points for ready-to-eat blue fish (0.967) and fresh white fish (0.953), and quite a good fit for salted/smoked and fresh blue fish (0.774 and 0.774, respectively). Considering the attributes, the first notable finding is that most of them show a very good fit. Values of the contributions show that few attributes define the subspace. “Delicate taste”, “nutritional”, “good for health” and “modern” account for 50.4% of the first axis and “delicate taste”, “easy to cook”, “high price” and “modern” for 47.8% of the second axis; while “difficult preparation”, “fat”, “eaten on Fridays”, “long preparation time”, “flavor of the sea” and “I trust the source” are irrelevant for both dimensions.

Due to simple correspondence analysis formalities, care must be taken in assessing relations between products and attributes. The map and related table, would seem to reveal a relationship

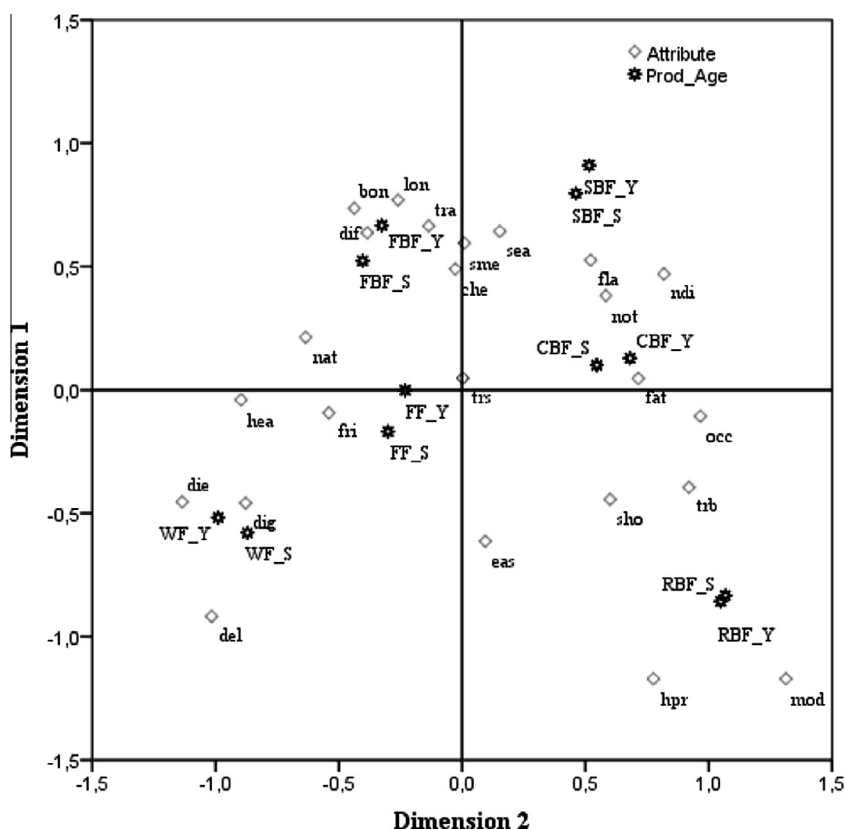


Fig. 4. Fish products perception maps by age. Note: total inertia = 0.823 – $\chi^2 = 8066.67$ – Sign. = 0.000.

between fresh blue fish (FBF) and the attributes “traditional” (tra) and “cheap” (che). These two are positives cues, however they both have at least one negative counterpart: the term “traditional”, as found by Guerrero et al. (2009), is linked to some dimensions (such as sensory, health, heritage and others) which may be optimal for a marketing campaign, but the value of these dimensions has still not been fully investigated in terms of the importance for purchase decisions. In addition, the low price of fresh blue fish has always been argued as the real strength of the product. However the literature on seafood consumption confirms that price elasticities vary depending on the product and socio-economic characteristics of the household. For instance, several studies (Dey et al., 2008; Myrland et al., 2000; Trondsen et al., 2003) have found that high-income consumers are less sensitive to high-price perception, however, Myrland et al. (2000) argued that high prices are a barrier for a “greater” consumption of seafood. This contributes to the belief that fresh blue fish would be more competitive if consumers believed they needed to eat more fish.

Unfortunately, consumers also refer to the presence of “too many bones” (bon), an already known reason for disliking blue fish (Olsen, 2003; Verbeke & Vackier, 2005), and a “long” (lon) and “difficult” (dif) preparation, which are two negative barriers for purchasing them, also found by other authors (Myrland et al., 2000; Olsen, 2004). The attributes tied to sensory characteristics offer different interpretations: fresh blue fish has an intense “fishy smell” (sme) and “flavor of the sea” (sea). A strong smell is a great barrier

for a certain population cluster (Brunso et al., 2009; Myrland et al., 2000; Nielsen et al., 2002; Olsen, 2001; Trondsen et al., 2003), which we therefore defined as negative. However the strong flavor, depending on the individual person, can be positive or negative (Cosmina et al., 2012).

Canned blue fish (CBF) is strictly tied to “fat” (fat) and “not liked by everyone” (not). There is no certainty as to whether consumers consider the fatty composition of canned blue fish as negative or positive. Cosmina et al. (2012) found that some males consume blue fish also because of its high content of polyunsaturated fatty acid. However, it is interesting that the “fat” point is closer to this product than to the others, suggesting that consumers perceive it to be “fatter” than other preparation forms, maybe referring to the unhealthy characteristic of the adjective “fat” when used for food (Povey, Conner, Sparks, James, & Shepherd, 1998). Not everyone likes the taste of canned blue fish, which is a strong barrier to the consumption of particular fish types (Myrland et al., 2000; Olsen, 2003; Trondsen et al., 2003). Especially in this case, Italian consumers seem to substitute canned blue fish with canned tuna, whose consumption increased to second place within European countries, following Spain, with 2.33 kg per capita per year (Hamilton, Lewis, McCoy, Havice, & Campling, 2011), suggesting that Italian consumers do not associate tuna with blue fish.

The position in the plane of salted/smoked blue fish is indicative of how it is perceived. Salted/smoked blue fish (SBF) is very close to the attributes “flavorful” (fla) and “flavor of the sea” (sea). SBF

Table 8

Numerical results of figure 4 perceptual map.

Category	Mass	Inertia	I Dimension		II Dimension		Squared correlation		
			Coordinate	Contribution to dimension	Coordinate	Contribution to dimension	Squared Correlation	Squared Correlation	Quality
Products									
FBF_Y – Fresh Blue Fish*Young	.065	.016	–.326	.016	.667	.088	.197	.610	.807
WF_Y – Fresh White Fish*Young	.061	.035	–.989	.135	–.518	.050	.760	.154	.914
FF_Y – Fresh Farmed Fish*Young	.053	.008	–.231	.006	–.002	.000	.153	.000	.153
CBF_Y – Canned Blue Fish*Young	.048	.017	.681	.050	.128	.002	.592	.016	.607
SBF_Y – Salted/Smoked Blue Fish*Young	.040	.021	.515	.024	.910	.102	.224	.518	.742
RBF_Y – Ready-to-Eat Blue Fish*Young	.045	.035	1.068	.115	–.834	.095	.652	.294	.946
FBF_S – Fresh Blue Fish*Senior	.142	.032	–.403	.052	.523	.118	.324	.404	.728
WF_S – Fresh White Fish*Senior	.133	.063	–.870	.227	–.580	.136	.715	.234	.949
FF_S – Fresh Farmed Fish*Senior	.117	.010	–.300	.024	–.169	.010	.480	.112	.592
CBF_S – Canned Blue Fish*Senior	.107	.025	.546	.072	.100	.003	.556	.014	.570
SBF_S – Salted/Smoked Blue Fish*Senior	.095	.037	.462	.046	.796	.183	.240	.527	.767
RBF_S – Ready-to-Eat Blue Fish*Senior	.094	.072	1.049	.233	–.858	.211	.641	.317	.957
Attribute									
bon – Too many bones	.022	.010	–.437	.009	.736	.036	.180	.377	.557
che – Cheap	.066	.013	–.027	.000	.490	.048	.002	.386	.388
del – Delicate taste	.050	.041	–1.016	.117	–.918	.129	.558	.337	.894
die – Dietetic	.040	.027	–1.135	.117	–.454	.025	.857	.101	.958
dif – Difficult preparation	.011	.005	–.385	.004	.637	.014	.160	.325	.485
dig – Easy to digest	.045	.019	–.878	.077	–.459	.029	.804	.162	.966
eas – Easy to cook	.074	.010	.094	.001	–.614	.085	.029	.906	.935
fat – Fat	.026	.010	.714	.030	.046	.000	.570	.002	.572
fla – Flavorful	.067	.018	.521	.041	.526	.057	.463	.349	.811
fri – Eaten on Fridays	.015	.003	–.541	.010	–.093	.000	.703	.015	.719
hea – Good for health	.076	.030	–.897	.138	–.040	.000	.920	.001	.921
hpr – High price	.028	.024	.776	.038	–1.171	.116	.313	.527	.840
lon – Long preparation time	.015	.008	–.260	.002	.770	.027	.058	.374	.431
mod – Modern	.034	.044	1.313	.132	–1.171	.142	.593	.349	.941
nat – Natural	.056	.012	–.634	.050	.214	.008	.797	.067	.864
ndi – Difficult to digest	.016	.007	.818	.024	.470	.010	.710	.173	.882
not – Not liked by everyone	.071	.018	.583	.054	.382	.031	.603	.192	.794
occ – Eaten on special occasions	.025	.014	.966	.052	–.107	.001	.730	.007	.737
sea – Flavor of the sea	.059	.009	.153	.003	.643	.074	.065	.856	.921
sho – Short preparation time	.065	.019	.600	.053	–.444	.039	.550	.223	.773
sme – Fishy smell	.039	.007	.009	.000	.595	.042	.000	.668	.669
tra – Too expensive	.055	.011	–.135	.002	.665	.074	.041	.734	.775
trb – I trust the brand	.024	.011	.920	.045	–.395	.011	.809	.111	.920
trs – I trust the source	.022	.001	.003	.000	.047	.000	.000	.012	.012

Note: young = 18–35 years old; senior = 36–65 years old; respondents: young No. = 357; senior No. = 708.

shares with fresh blue fish, the attributes “cheap” (che), “traditional” (tra), “fishy smell” (sme) and with canned blue fish, “not liked by everyone” (not). Low demand for these preparation forms indicates that low price and tradition do not guarantee that a product is attractive. For example, Italians have a strong preference for smoked salmon, which is neither traditional or cheap, showing that marked sensorial characteristics could represent a strong weakness in comparison with possible substitutes.

Ready-to-eat blue fish is the only group in the fourth Cartesian quadrant. It is associated with “modern” (mod) and “high prices” (hpr). Both features can be interpreted following [Trondsen et al. \(2003\)](#) whose findings suggest that new processed fish products represent a concrete opportunity to reach those consumers who normally do not purchase seafood due to its smell and long preparation time and the Italian ready-meal market, which is steadily growing in the fish sector ([Manuelli, 2011](#)). Thus, fried or marinated anchovies or fresh sauce, represents a real market opportunity for blue fish. The high price of ready-to-eat products still appears to be a great barrier to consumption, however [Cosmina et al. \(2012\)](#) reported that consumers would accept to pay more for blue fish in particular sales channels such as fast food and aperitif bars, suggesting a new positioning strategy for these products.

White fish (WF), i.e. fresh caught cod and sole, was associated with positive properties: consumers think they are “dietetic” (die), “easy to digest” (dig) and that they have a “delicate taste” (del). There appear to be no negative attributes linked to this product, which is actually one of the most commonly consumed by Italians. The “dietetic” cue, which means that white fish meets particular dietary needs, is particularly interesting in comparison with blue fish. The fatty acid composition of blue fish has been proved to have a beneficial effect on patients suffering from cardiovascular disease ([Kris-Etherton, Harris, & Appel, 2003](#)), however there is no clear diet-related attribute close to these products.

The perception of Italian consumers is in contrast with [Trondsen et al. \(2004\)](#), who found an increasing interest in fat fish (including mackerel) consumption among Norwegian consumers and a decreasing consumption of lean fish (a group including cod).

Farmed fish (FF), i.e. sea bream and sea bass, was categorized as “natural” (nat), typically “consumed on Fridays” (fri) and “healthy” (hea). Two of the three attributes, natural and healthy, represent positive attitudes in relation to the second main competitors of blue fish.

The fact that consumers perceive farmed sea bream and sea bass as “natural” is especially interesting, because it seems to clash with the breeding techniques used for this product. Care must be taken when considering the “healthy” cue. [Trondsen et al. \(2004\)](#) found a positive relationship between healthy habits, needs and seafood consumption, but also showed that there is no relationship between perceived health and total fish consumption, suggesting that beliefs do not definitely guarantee a purchase decision. The expression “consumed on Fridays”, which comes from the Christian tradition of eating fish on Fridays, could mean that for Italians this product is becoming a substitute for caught fish.

4.2.2. Perception and gender, age and education

The results of gender, age and education differentiation are presented in [Fig. 3](#) and [Table 7](#), [Fig. 4](#) and [Table 8](#), and [Fig. 5](#) and [Table 9](#), respectively. They will be discussed together because of the similarities between them and the results obtained from the analysis of the whole sample. The dimensions of the three perception maps are constructed using the same attributes as in the whole sample map, and few differences can be found considering product contributions. In terms of differentiation by education, fresh blue fish by highly educated people contributes considerably to the second dimension, but was not influential in the other maps. Given these similarities, the bi-plots are also very similar, though

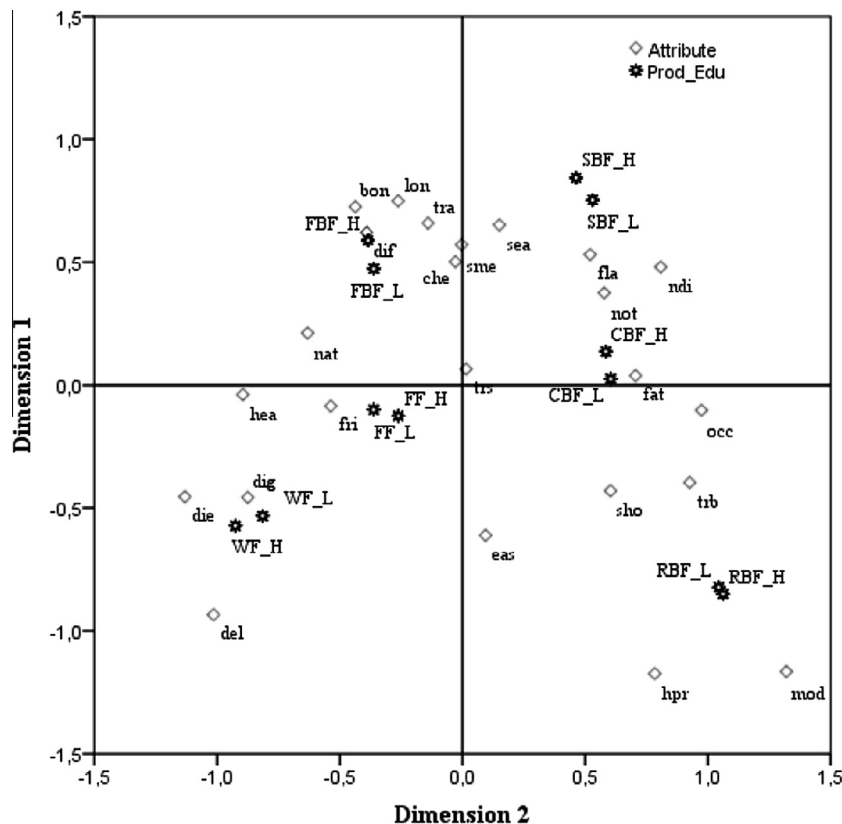


Fig. 5. Fish products perception maps by education. Note: total inertia = 0.831 – $\chi^2 = 7968.52$ – Sign. = 0.000.

their interpretation follows that of the whole sample. Particular focus is needed for the demographic differentiations. As can be seen from the figures, all product-by-demographic characteristics, are paired and, for example, the “fresh blue fish-male” (FBF_M) point is very close to the “fresh blue fish-female” (FBF_F) point in Fig. 3, which is the same feature for all pairs of points in all the maps considered. Although no inference tests can be provided by simple correspondence analysis, these results highlight that consumer perceptions of fish species and different presentation forms seem to be independent of gender, age and education.

4.2.3. Perception and residence

A slightly different perception pattern is obtained by dividing the sample by residence. Fig. 6 and Table 10 show the outputs of the analysis from the three areas of Italy covered by the survey: inland northern Italy (INL_N), coastal northern Italy (COA_N) and coastal central/southern Italy (COA_CS). Relevant product groups for dimension construction are white fish in the three areas (WF_INL_N, WF_COA_N and WF_COA_CS), ready-to-eat blue fish for coastal center/south of Italy residents (RBF_COA_CS) and canned blue fish for residents inland in the north of Italy (CBF_INL_N). Significant attributes include “delicate taste”, “dietetic”, “good for health” and “modern” for the first axis, and “delicate taste”, “easy to cook”, “high price” and “modern” for

the second axis. Apart from a few changes, most of the points representing fish species and the perception of presentation forms in the different partitions of the sample are still plotted in the same areas we found in the other analyses. Only the perception of fresh farmed fish of residents in coastal center/south of Italy (FF_COA_CS) clearly changed its position on the plane. In Fig. 6 this point is located quite close to the area of canned blue fish; note that farmed fish is linked to “cheap”, “fishy smell” and “flavor of the sea”. Fresh farmed fish is justifiably “cheap” for these consumers because of the high market supply due to the concentration of fish farms in these areas (Bronzi et al., 2011). Strong sensorial characteristics are difficult to interpret compared to the results for the other map, however they appear as a potential limitation for consumer choice as previously observed for fresh blue fish.

5. Conclusions

There are a few studies on consumer perception that specifically assess the heterogeneity of fish. This is a serious limitation in terms of the analysis of fish consumption. Our aim was thus to highlight differences between different species and preparation forms of fish for sale. We compared the different types of blue fish products with caught cod and sole (called white fish in the

Table 9
Numerical results of figure 6 perceptual map.

Category	Mass	Inertia	I Dimension		II Dimension		Squared correlation		
			Coordinate	Contribution to dimension	Coordinate	Contribution to dimension	I Dimension	II Dimension	Quality
Products									
FBF_L – Fresh Blue Fish*Low educated	.034	.008	–.361	.010	.473	.023	.254	.322	.576
WF_L – Fresh White Fish*Low educated	.032	.014	–.814	.048	–.533	.028	.669	.212	.881
FF_L – Fresh Farmed Fish*Low educated	.029	.003	–.362	.009	–.100	.001	.490	.028	.518
CBF_L – Canned Blue Fish*Low educated	.027	.007	.604	.022	.025	.000	.582	.001	.583
SBF_L – Salted/Smoked Blue Fish*Low educated	.022	.010	.531	.014	.753	.038	.280	.417	.697
RBF_L – Ready-to-Eat Blue Fish*Low educated	.023	.018	1.044	.057	–.824	.048	.633	.291	.924
FBF_H – Fresh Blue Fish*High educated	.173	.039	–.385	.058	.589	.183	.288	.499	.786
WF_H – Fresh White Fish*High educated	.162	.083	–.925	.313	–.573	.163	.739	.209	.948
FF_H – Fresh Farmed Fish*High educated	.140	.012	–.261	.022	–.126	.007	.342	.059	.401
CBF_H – Canned Blue Fish*High educated	.128	.034	.584	.099	.136	.007	.571	.023	.594
SBF_H – Salted/Smoked Blue Fish*High educated	.113	.048	.463	.055	.844	.247	.225	.551	.775
RBF_H – Ready-to-Eat Blue Fish*High educated	.116	.088	1.062	.294	–.850	.255	.656	.310	.966
Attribute									
bon – Too many bones	.022	.010	–.437	.009	.726	.035	.175	.357	.533
che – Cheap	.066	.014	–.029	.000	.502	.051	.002	.402	.403
del – Delicate taste	.050	.041	–1.014	.117	–.935	.134	.556	.349	.905
die – Dietetic	.040	.027	–1.131	.116	–.455	.025	.854	.102	.956
dif – Difficult preparation	.011	.004	–.390	.004	.621	.013	.173	.323	.497
dig – Easy to digest	.045	.019	–.875	.077	–.457	.028	.794	.160	.954
eas – Easy to cook	.074	.010	.094	.001	–.611	.085	.029	.897	.926
fat – Fat	.026	.010	.705	.029	.038	.000	.601	.001	.602
fla – Flavorful	.067	.018	.520	.041	.531	.058	.456	.351	.807
fri – Eaten on Fridays	.015	.004	–.537	.010	–.086	.000	.538	.010	.548
hea – Good for health	.076	.030	–.895	.138	–.039	.000	.920	.001	.922
hpr – High price	.028	.024	.784	.038	–1.174	.117	.320	.531	.852
lon – Long preparation time	.015	.007	–.262	.002	.749	.026	.063	.379	.441
mod – Modern	.034	.044	1.320	.133	–1.166	.141	.599	.345	.944
nat – Natural	.056	.012	–.631	.050	.212	.008	.822	.068	.890
ndi – Difficult to digest	.016	.007	.808	.023	.480	.011	.691	.180	.872
not – Not liked by everyone	.071	.017	.577	.053	.375	.030	.607	.189	.797
occ – Eaten on special occasions	.025	.013	.974	.053	–.102	.001	.771	.006	.777
sea – Flavor of the sea	.059	.009	.150	.003	.652	.076	.064	.887	.951
sho – Short preparation time	.065	.019	.603	.054	–.430	.037	.562	.211	.773
sme – Fishy smell	.039	.005	–.003	.000	.571	.039	.000	.799	.799
tra – Too expensive	.055	.011	–.140	.002	.659	.073	.044	.717	.761
trb – I trust the brand	.024	.011	.926	.046	–.397	.011	.803	.109	.912
trs – I trust the source	.022	.001	.015	.000	.065	.000	.003	.038	.041

Note: Low educated = Elementary and Middle school; High Educated = High school and University degree; Respondents: Low educated No. = 178; High Educated No. = 888.

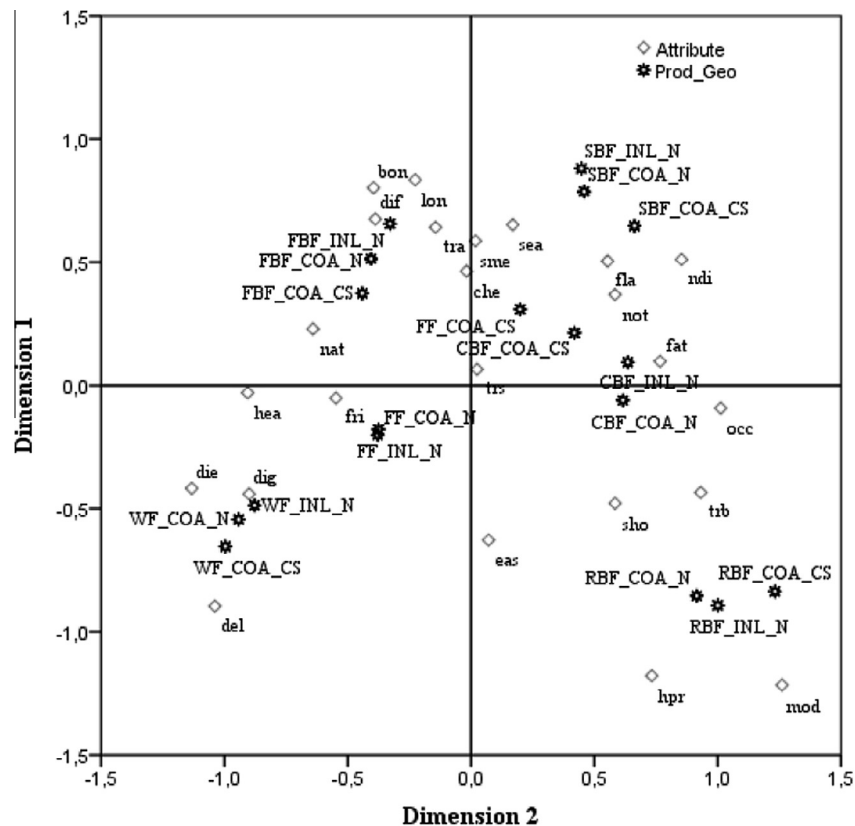


Fig. 6. Fish products perception maps by residence. Note: total inertia = 0.770 – $\chi^2 = 8837.64$ – Sign. = 0.000.

analysis) and farmed sea bream and sea bass (called farmed fish in the analysis) by applying a simple correspondence analysis over a sample of 1,066 respondents covering different regions of Italy. We obtained five different perceptual maps, on the whole sample or accounting for different perceptions of respondents in terms of gender, age, education and residence.

Some interesting findings emerged from the survey. Italian consumers clearly attach different attributes to the six products, which are well known as drivers for purchase choices. We believe that this can be considered as evidence of the translation of biological heterogeneity of fish into consumer seafood perception.

We would encourage researchers to give more consideration to this heterogeneity, and thus focus on fish species/type consumption analysis. Generally, we found that the traditional presentation forms of blue fish (i.e. fresh, canned and salted/smoked) are often associated with negative attributes or linked to sensory characteristics that could prevent its consumption, especially in the face of competing fish products associated with nutritional characteristics and delicate taste (white fish) or healthy and natural attributes (farmed fish). In addition, demographic differentiation surprisingly showed almost no differences across gender, age and education with regard to the perception of products considered. Only consumers' residence in central/southern coastal regions of Italy is relevant for farmed fish perception, probably because of the presence of fish farms in the area.

The general agreement across our results' confirms our hypothesis of a strong consumer differentiation among fish products, however data analysis highlights various shortcomings and possible remedies for further studies. Simple correspondence analysis is a multivariate descriptive method and its results do not allow for inference testing. This thus has a negative influence on the scientific relevance of the results, which is only partially mitigated by their clarity.

We believe that future studies should consider methods for hypothesis testing aimed at quantifying similarities and differences between the perception of seafood products and its determinants.

In addition, the interpretation of all the results is not straightforward. We noted that dimension 1 divides fresh fish (on the left of the origin) from transformed fish (on the right of the origin), while dimension 2 differentiates traditional presentation forms of blue fish, from its competitors and the new presentation form. However, the product variable ready-to-eat blue fish prevails over other objects in subspace definition, while some attribute profiles do not seem to be relevant for the analysis. This limitation could be partly removed by redefining these points as supplementary (Hoffman & Franke, 1986 – the analysis is not presented due to space constraints, but readers can use original data matrices in the Appendix to improve these results). Furthermore, some relevant relation between attributes and products, such as “fat” for canned blue fish, “dietetic” for white fish or “fishy smell” for farmed fish are not fully explained, thus we have just take them as a fact, leaving the issue partly unsolved. We would suggest however that the issue of the meaning of attributes in relation to consumer fish perception is a very interesting topic for future research.

In addition, considering that our work was intended to propose strategies for the Italian government to increase the consumption of blue fish, the data collected highlighted the probable reasons for its low consumption. This thus enables us to recommend some suggestions for a public advertising campaign and industry strategy for new product development and launches. Any public campaign aimed at relaunching blue fish onto the Italian market, should underline the optimal nutritional values of the entire blue fish group, showing that it is traditional and “made in Italy”, and explaining that it maintains its healthy features when prepared in particular ways. This will help to restore its positive image

Table 10

Numerical results of Fig. 5 perceptual map.

Category	Mass	Inertia	I Dimension		II Dimension		Squared correlation		
			Coordinate	Contribution to dimension	Coordinate	Contribution to dimension	Squared Correlation	Squared Correlation	Quality
Products									
FBF_INL_N – Fresh Blue Fish*Inland North	.120	.029	–.328	.029	.656	.156	.204	.604	.809
WF_INL_N – Fresh White Fish*Inland North	.114	.051	–.877	.195	–.487	.081	.767	.175	.942
FF_INL_N – Fresh Farmed Fish*Inland North	.099	.013	–.375	.031	–.178	.009	.480	.081	.561
CBF_INL_N – Canned Blue Fish*Inland North	.091	.027	.636	.082	.094	.002	.619	.010	.629
SBF_INL_N – Salted/Smoked Blue Fish*Inland North	.080	.040	.447	.035	.880	.185	.178	.510	.688
RBF_INL_N – Ready-to-Eat Blue Fish*Inland North	.081	.061	1.001	.181	–.893	.194	.596	.352	.948
FBF_COA_N – Fresh Blue Fish*Coastal North	.050	.012	–.406	.018	.514	.039	.305	.363	.668
WF_COA_N – Fresh White Fish*Coastal North	.045	.024	–.942	.089	–.544	.040	.755	.187	.941
FF_COA_N – Fresh Farmed Fish*Coastal North	.041	.005	–.379	.013	–.201	.005	.524	.109	.634
CBF_COA_N – Canned Blue Fish*Coastal North	.034	.010	.616	.029	–.061	.000	.564	.004	.568
SBF_COA_N – Salted/Smoked Blue Fish*Coastal North	.029	.013	.458	.014	.787	.054	.203	.444	.647
RBF_COA_N – Ready-to-Eat Blue Fish*Coastal North	.030	.020	.915	.057	–.855	.067	.572	.370	.941
FBF_COA_CS – Fresh Blue Fish*Coastal Center-South	.037	.010	–.441	.016	.374	.015	.312	.165	.477
WF_COA_CS – Fresh White Fish*Coastal Center-South	.036	.025	–.996	.080	–.654	.046	.641	.204	.845
FF_COA_CS – Fresh Farmed Fish*Coastal Center-South	.029	.009	.199	.003	.309	.008	.060	.106	.166
CBF_COA_CS – Canned Blue Fish*Coastal Center-South	.030	.009	.419	.012	.213	.004	.253	.049	.301
SBF_COA_CS – Salted/Smoked Blue Fish*Coastal Center-South	.027	.014	.663	.026	.647	.034	.378	.267	.646
RBF_COA_CS – Ready-to-Eat Blue Fish*Coastal Center-South	.027	.033	1.232	.093	–.837	.058	.573	.196	.768
Attribute									
bon – Too many bones	.022	.012	–.395	.007	.802	.042	.129	.393	.521
che – Cheap	.066	.018	–.018	.000	.464	.043	.001	.257	.257
del – Delicate taste	.050	.043	–1.039	.121	–.896	.122	.572	.315	.887
die – Dietetic	.040	.027	–1.132	.115	–.418	.021	.854	.086	.940
dif – Difficult preparation	.011	.006	–.388	.004	.676	.015	.128	.289	.417
dig – Easy to digest	.045	.021	–.899	.080	–.441	.026	.758	.135	.893
eas – Easy to cook	.074	.011	.071	.001	–.628	.088	.016	.890	.905
fat – Fat	.026	.014	.766	.034	.098	.001	.502	.006	.508
fla – Flavorful	.067	.021	.554	.046	.504	.051	.438	.269	.707
fri – Eaten on Fridays	.015	.003	–.548	.010	–.052	.000	.728	.005	.733
hea – Good for health	.076	.031	–.905	.140	–.030	.000	.921	.001	.921
hpr – High price	.028	.024	.733	.033	–1.178	.116	.281	.538	.819
lon – Long preparation time	.015	.010	–.227	.002	.835	.032	.036	.360	.395
mod – Modern	.034	.044	1.261	.120	–1.217	.151	.546	.377	.923
nat – Natural	.056	.013	–.641	.051	.229	.009	.762	.072	.834
ndi – Difficult to digest	.016	.008	.854	.025	.511	.012	.619	.164	.783
not – Not liked by everyone	.071	.019	.584	.054	.369	.029	.583	.172	.755
occ – Eaten on special occasions	.025	.018	1.012	.056	–.092	.001	.614	.004	.617
sea – Flavor of the sea	.059	.010	.169	.004	.652	.075	.075	.831	.906
sho – Short preparation time	.065	.020	.584	.050	–.479	.045	.499	.248	.748
sme – Fishy smell	.039	.006	.018	.000	.587	.041	.001	.802	.803
tra – Too expensive	.055	.013	–.144	.003	.642	.068	.041	.601	.641
trb – I trust the brand	.024	.013	.931	.046	–.435	.013	.710	.115	.824
trs – I trust the source	.022	.001	.024	.000	.065	.000	.004	.021	.025

Note: respondents: Inland Northern Italy No. = 588; Coastal Northern Italy No. = 255; Coastal Central/South Italy No. = 223.

and gain the attractiveness that it has lost in favor of wild caught cod and sole and farmed sea bass.

With regard to the seafood industry, we identified two possible levers. Blue fish makes consumers think of an unpleasant strong smell, which is naturally connected to the rapid degradation of the flesh due to its small size. The fish industry could enhance the quality of blue fish by improving logistics and the transformation technologies of the product. At the same time, we suggest marketing new ready-to-eat blue fish products, preventing issues of smell and perceived long preparation times, encouraging non-consumers to purchase them. It could be argued that the ready-to-eat blue fish will actually be more expensive, thus dissuading consumption. However, as discussed, scientific evidence suggests that only low-income buyers are sensitive to the price of fish and new consumption trends show a high potential for convenience foods. Unfortunately, our results do not identify clear targets for such new products, although high-income and young consumers seem to be the best cluster to aim an advertising campaign at, but further studies are needed to estimate whether this cluster would accept them. Considering the strengths and weaknesses of blue fish, we

suggest highlighting the differences between this “un-smelly and easy” food and the traditional fresh and processed blue fish.

However, a final issue needs underlining. We found differences in fish perception based on fish species and presentation forms, but we could not identify patterns based on socio-demographic characteristics. Thus the real question is: does consumer perceptions of different fish species/types predominate over socio-demographic differences? We believe that the regularity we found is very interesting for fish consumption analysis and its confirmation could have important consequences for both private and public fishery sectors. We have discussed the potential of this outcome in terms of marketing strategies, however we would like to stress that it would also be an excellent starting point in designing tools to combat fraud.

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Appendix A. Perceptual maps data matrix Codes legend*Codes. legend*

Products.

Code	Attributes	Code	Attributes
FBF	Fresh blue fish	CBF	Canned blue fish
WF	Fresh white fish	SBF	Salted/smoked blue fish
FF	Fresh farmed fish	RBF	Ready-to-eat blue fish

Attributes.

Code	Attributes	Code	Attributes
bon	Too many bones	hpr	Too expensive
che	Cheap	lon	Long preparation time
del	Delicate taste	mod	Modern
die	Dietetic	nat	Natural
dif	Difficult to digest	not	Not liked by everyone
dif	Difficult preparation	occ	Eaten on special occasions
dig	Easy to digest	sea	Flavor of the sea
eas	Easy to cook	sho	Short preparation time
fat	Fat	sme	Fishy smell
fla	Flavorful	tra	Traditional
fri	Eaten on Fridays	trb	I trust the brand
hea	Good for the health	trs	I trust the source

Demographic variables.

Code	Attributes	Code	Attributes
<i>Gender</i>			
_F	Female	_M	Male
<i>Age</i>			
_Y	Young: 18–35 years old	_S	Senior: 36–65 years old
<i>Education</i>			
_L	Low educated: maximum Middle School	_H	High educated: at least High School
<i>Residence</i>			
_INL_N	Inland North	_COA_N	Coastal North
_COA_CS	Coastal Center/South		

Whole sample data.

Attribute	bon	che	del	die	dif	dig	eas	fat	fla	fri	hea	hpr	lon	mod	nat	ndi	not	occ	sea	sho	sme	tra	trb	trs
<i>Product</i>																								
FBF	196	497	94	199	73	185	228	65	247	80	540	28	77	18	386	52	276	39	376	166	224	305	48	106
WF	46	152	553	418	36	387	407	21	99	96	549	99	49	29	347	8	124	31	116	229	112	227	30	75
FF	125	220	293	165	65	238	251	118	206	71	362	106	89	128	188	39	174	73	179	128	151	146	78	103
CBF	25	319	72	39	4	78	263	179	386	32	92	54	7	154	129	89	262	82	211	383	103	184	142	87
SBF	62	143	14	33	52	35	105	78	355	30	71	50	99	41	121	90	412	144	270	144	194	293	60	55
RBF	15	108	72	23	10	47	367	105	173	23	52	268	9	369	40	62	293	168	124	371	71	40	157	59

Gender partition data.

Attribute	bon	che	del	die	dif	dig	eas	fat	fla	fri	hea	hpr	lon	mod	nat	ndi	not	occ	sea	sho	sme	tra	trb	trs
<i>Product</i>																								
FBF_F	142	281	58	119	51	101	127	42	143	45	324	22	54	9	231	36	192	21	220	89	136	161	24	57
WF_F	32	86	335	277	20	246	281	10	54	57	349	55	25	14	216	4	75	18	70	163	68	122	14	41
FF_F	79	115	172	101	40	148	176	67	123	40	232	65	53	61	127	28	115	42	114	84	97	93	46	58
CBF_F	17	169	39	23	4	45	164	120	231	15	55	33	3	112	68	68	168	49	124	239	64	95	88	54
SBF_F	44	75	9	16	39	21	54	60	211	17	40	29	67	29	69	60	258	91	155	75	121	164	38	31
RBF_F	7	62	42	11	6	26	225	81	107	8	23	177	4	233	18	41	181	117	73	225	43	19	101	37
FBF_M	54	216	36	80	22	84	101	23	104	35	216	6	23	9	155	16	84	18	156	77	88	144	24	49
WF_M	14	66	218	141	16	141	126	11	45	39	200	44	24	15	131	4	49	13	46	66	44	105	16	34
FF_M	46	105	121	64	25	90	75	51	83	31	130	41	36	67	61	11	59	31	65	44	54	53	32	45
CBF_M	8	150	33	16	0	33	99	59	155	17	37	21	4	42	61	21	94	33	87	144	39	89	54	33
SBF_M	18	68	5	17	13	14	51	18	144	13	31	21	32	12	52	30	154	53	115	69	73	129	22	24
RBF_M	8	46	30	12	4	21	142	24	66	15	29	91	5	136	22	21	112	51	51	146	28	21	56	22

Age partition data.

Attribute	bon	che	del	die	dif	dig	eas	fat	fla	fri	hea	hpr	lon	mod	nat	ndi	not	occ	sea	sho	sme	tra	trb	trs
<i>Product</i>																								
FBF_Y	65	151	31	53	25	46	67	22	90	22	155	9	25	4	130	12	97	18	120	46	84	108	13	24
WF_Y	18	41	181	147	16	122	120	5	32	18	170	27	23	7	129	3	40	10	26	60	44	72	8	19
FF_Y	41	63	98	42	28	62	64	50	70	18	103	37	38	40	61	14	56	20	53	21	66	49	30	22
CBF_Y	6	101	19	8	0	20	95	69	120	6	25	14	0	48	32	33	101	24	56	118	45	50	41	19
SBF_Y	17	44	3	7	11	8	35	18	104	6	21	11	29	11	23	28	141	36	88	47	77	87	14	16
RBF_Y	6	37	21	8	3	14	122	37	51	4	15	79	2	128	18	27	104	41	38	125	22	14	47	15
FBF_S	131	346	63	146	48	139	161	43	157	58	385	19	52	14	256	40	179	21	256	120	140	197	35	82
WF_S	28	111	372	271	20	265	287	16	67	78	379	72	26	22	218	5	84	21	90	169	68	155	22	56
FF_S	84	157	195	123	37	176	187	68	136	53	259	69	51	88	127	25	118	53	126	107	85	97	48	81
CBF_S	19	218	53	31	4	58	168	110	266	26	67	40	7	106	97	56	161	58	155	265	58	134	101	68
SBF_S	45	99	11	26	41	27	70	60	251	24	50	39	70	30	98	62	271	108	182	97	117	206	46	39
RBF_S	9	71	51	15	7	33	245	68	122	19	37	189	7	241	22	35	189	127	86	246	49	26	110	44

Education partition data.

Attribute	bon	che	del	die	dif	dig	eas	fat	fla	fri	hea	hpr	lon	mod	nat	ndi	not	occ	sea	sho	sme	tra	trb	trs
<i>Product</i>																								
FBF_L	41	78	16	28	10	32	42	8	31	22	90	10	12	2	52	9	48	8	55	35	35	45	8	23
WF_L	10	27	92	58	1	50	62	2	22	26	97	20	7	6	60	1	29	8	19	39	19	30	5	14
FF_L	22	33	53	36	9	35	38	19	28	20	68	15	16	19	36	12	36	11	28	21	23	29	14	16
CBF_L	3	48	15	7	0	16	41	35	59	8	17	11	1	31	23	16	52	16	29	55	11	38	33	18
SBF_L	9	19	1	5	5	4	19	16	55	10	12	8	13	6	19	10	74	28	42	25	27	49	13	9
RBF_L	1	16	16	4	1	8	48	19	25	7	9	46	0	64	11	14	56	31	21	59	8	11	22	11
FBF_H	155	419	78	171	63	153	186	57	216	58	450	18	65	16	334	43	228	31	321	131	189	260	40	83
WF_H	36	125	461	360	35	337	345	19	77	70	452	79	42	23	287	7	95	23	97	190	93	197	25	61
FF_H	103	187	240	129	56	203	213	99	178	51	294	91	73	109	152	27	138	62	151	107	128	117	64	87
CBF_H	22	271	57	32	4	62	222	144	327	24	75	43	6	123	106	73	210	66	182	328	92	146	109	69
SBF_H	53	124	13	28	47	31	86	62	300	20	59	42	86	35	102	80	338	116	228	119	167	244	47	46
RBF_H	14	92	56	19	9	39	319	86	148	16	43	222	9	305	29	48	237	137	103	312	63	29	135	48

Residence partition data.

Attribute	bon	che	del	die	dif	dig	eas	fat	fla	fri	hea	hpr	lon	mod	nat	ndi	not	occ	sea	sho	sme	tra	trb	trs
<i>Product</i>																								
FBF_INL_N	137	263	54	112	48	89	117	45	157	45	301	13	58	7	221	30	187	25	221	90	138	179	31	57
WF_INL_N	32	93	311	237	28	228	231	12	50	64	307	59	30	13	194	7	94	18	67	137	76	132	24	34
FF_INL_N	70	137	197	105	40	150	133	45	98	45	224	67	53	79	118	11	114	38	85	68	88	84	52	61
CBF_INL_N	15	147	46	20	2	43	165	120	252	19	49	31	5	88	58	57	162	50	118	213	66	119	82	53
SBF_INL_N	47	54	10	20	35	22	56	50	190	19	37	36	78	22	75	56	249	81	163	60	125	185	30	34
RBF_INL_N	11	63	48	13	5	26	224	60	107	12	30	150	5	229	25	36	165	71	80	229	42	24	81	29
FBF_COA_N	39	126	16	45	21	65	57	12	60	21	133	11	14	7	96	11	57	7	89	42	53	74	8	20
WF_COA_N	10	35	124	87	7	107	89	5	21	25	127	24	13	12	86	0	24	10	22	45	22	58	3	21
FF_COA_N	28	41	64	39	16	71	85	21	46	18	100	25	16	30	48	5	29	12	44	41	31	50	14	19
CBF_COA_N	5	74	15	10	1	22	58	36	76	8	20	15	2	40	16	16	53	14	41	96	19	42	38	19
SBF_COA_N	8	21	3	8	17	9	23	19	61	8	20	10	13	7	29	24	94	32	61	31	38	74	13	10
RBF_COA_N	2	22	18	9	4	16	77	28	45	7	17	61	2	78	6	17	53	29	25	78	15	13	25	15
FBF_COA_CS	20	108	24	42	4	31	54	8	30	14	106	4	5	4	69	11	32	7	66	34	33	52	9	29
WF_COA_CS	4	24	118	94	1	52	87	4	28	7	115	16	6	4	67	1	6	3	27	47	14	37	3	20
FF_COA_CS	27	42	32	21	9	17	33	52	62	8	38	14	20	19	22	23	31	23	50	19	32	12	12	23
CBF_COA_CS	5	98	11	9	1	13	40	23	58	5	23	8	0	26	55	16	47	18	52	74	18	23	22	15
SBF_COA_CS	7	68	1	5	0	4	26	9	104	3	14	4	8	12	17	10	69	31	46	53	31	34	17	11
RBF_COA_CS	2	23	6	1	1	5	66	17	21	4	5	57	2	62	9	9	75	68	19	64	14	3	51	15

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