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Understanding consumers' perceptions of aquaculture and its products in Gran Canaria island: Does the influence of positive or negative wording matter?

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ABSTRACT

Many investigations have looked to understand consumers' perceptions of aquaculture and its products, with Likert scales being the most popular instrument employed. In some of them, negatively and positively worded survey items are mixed looking to reduce potential acquiescence bias. Nevertheless, several studies found that this solution could be problematic because reverse recoded negatively worded statements might not exactly measure the same as their positively worded counterparts. This study aims to examine the impact of positive and negative wording on surveys that analyze the consumers' perceptions of aquaculture and its products. The results revealed that if the goal is to understand how well consumers perceive aquaculture and its products, using negative statements on Likert scale instruments is not appropriate because it increases respondents' negative perception, and the information appears to be less reliable and with more variability than that obtained with positively worded statements. In addition, our study reveals interesting insights on how to improve consumers' perceptions of aquaculture and its products for the segment of the population formed by young adults and highly educated residents.

1. Introduction

Aquaculture is probably one of the fastest-growing food production industries in the last decade, and since 2014 has overtaken wild-catch production as a source of seafood (FAO, 2018). Aquaculture's rapid growth is a consequence of the big development of intensive aquaculture production, which has raised questions and criticism about its environmental impacts (Diana, 2009) and the potential adverse economic or social effects (Brugère et al., 2019). All this has happened in a global context where consumers are more aware of environmental issues and demand safer products (Bacher, 2015). Moreover, despite the bulk of global aquaculture production being related to Asia, there is still a stronger opposition in the western world, where modern aquaculture is considered a relatively new industry that competes with well-established activities such as fishing (Bacher, 2015). In addition, several studies have shown that consumers usually prefer wild fish over farmed fish (Cantillo et al., 2020), even though the study of Claret et al. (2016) found that in a blind tasting, consumers preferred farmed fish over wild fish, but when they realized the origin (wild or farmed) their preferences were again aligned with wild fish. Thus, people's beliefs and perceptions might impact their product choices. Considering this, and the negative perception that some consumers have over aquaculture products, it is important to better understand how the survey design could affect the consumers' perception of aquaculture's image.

The research on aquaculture perceptions has been mainly focused on the attitudes of consumers towards aquaculture products, opinions of the general public on the aquaculture industry and the perceptions of aquaculture key stakeholder groups (Bacher, 2015). Many of these studies have used Likert scales to measure the level of importance/agreement for certain characteristics or statements for aquaculture's image and its products. From these, it can be observed that some investigations have mixed negatively and positively worded survey items (e.g. Murray and D'Anna (2015)), looking to decrease the potential acquiescence bias, which is the tendency to agree with questionnaire statements or items irrespective of the content (Chyung et al., 2018). Acquiescent responses might lead to biased results because they confuse the attitudes and behaviours studied with the general tendency to agree (Kuru and Pasek, 2016). In addition, acquiescence bias can result in exaggerated positive correlations between items that are similarly keyed and deflated negative correlations between items that are oppositely

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keyed (Kam and Meyer, 2015).

However, several investigations have found that mixing negatively and positively worded survey items can be problematic, as the negatively worded items, which are usually reverse recoded, might not measure exactly the same concept as the positively worded statement counterparts (Chyung et al., 2018). In addition, negatively worded items may appear as separate factors (method effect) or might be misunderstood by some respondents, causing erroneous data. Eddy (2021) found that some respondents commented that the negative wording of some questions was confusing.

Despite the previous issues, to our knowledge, the effects of using a mix of positively and negatively worded statements have not been evaluated in the context of aquaculture perceptions. Following this, the objectives of this investigation are twofold: (1) to understand the influence of positive and negative wording on the analysis of consumers' acceptance of aquaculture and its products and (2) to provide new insights that can be used by some stakeholders such as retailers and fish farm‘s managers on how to improve the acceptability of aquaculture and its products for consumers in the island of Gran Canaria.

The remainder of the paper presents the literature review (section 2), the data and methodology used (section 3), the results (section 4), the discussion (section 5), and the conclusions (section 6).

2. Literature review

2.1. Consumers' perceptions of aquaculture and its products

Many studies have focused on understanding the perceptions of the public view of aquaculture. These studies for the general aquaculture perceptions have been assessed in different countries such as Germany and Israel (Freeman et al., 2012), Sweden (Thomas et al., 2018), Ireland and Norway (Hynes et al., 2018), Spain (Ruiz-Chico et al., 2020a, 2020b), the US (Robertson et al., 2002), New Zealand (Shafer et al., 2010), Australia (Mazur and Curtis, 2008), and in five European countries simultaneously -France, Germany, Italy, Spain, and the United Kingdom- (López-Mas et al., 2021). Others have focused on the public perceptions of different specific types of aquaculture such as shellfish aquaculture in Canada (Murray and D'Anna, 2015), salmon farming in Scotland (Whitmarsh and Palmieri, 2011; Whitmarsh and Wattage, 2006), salmon, shellfish and seaweed farming in Canada (Flaherty et al., 2019), and integrated multi-trophic aquaculture (IMTA) in Canada (Barrington et al., 2010) and in five countries simultaneously -Ireland, Israel, Italy, Norway and the UK- (Alexander et al., 2016).

The literature describes that aquaculture represents both benefits and disadvantages for the public. Concerning the benefits, some studies have highlighted the economic benefits of aquaculture at the local level (Alexander et al., 2016; Flaherty et al., 2019; Mazur and Curtis, 2008; Murray and D'Anna, 2015; Ruiz-Chico et al., 2020a, 2020b; Shafer et al., 2010), which also translate into job opportunities that had been appreciated in previous investigations (Alexander et al., 2016; Flaherty et al., 2019; Hynes et al., 2018; Katranidis et al., 2003; Murray and D'Anna, 2015). In fact, Hynes et al. (2018) found that the Norwegian and Irish public had the highest accordance with the idea that fish farming creates opportunities for local employment in coastal areas. Also, Katranidis et al. (2003), in the context of two Greek islands found that local society put greater importance on jobs created by the farms than those resulting from tourism. In addition, the locals considered farms as an important element of their prosperity and a driving force in the development of their islands. Moreover, an investigation in Israel found that respondents who have a higher concern for employment security, tend to be more supportive of aquaculture (Freeman et al., 2012).

Other benefits of aquaculture in comparison to fisheries are related to cheaper prices and superior availability throughout the year (Alexander et al., 2016; López-Mas et al., 2021; Ruiz-Chico et al., 2020a, 2020b). Similarly, another benefit of aquaculture highlighted in the studies is the contribution to the local food supply of the places where the farms are located (Flaherty et al., 2019; Katranidis et al., 2003; Ruiz-Chico et al., 2020a, 2020b). However, previous studies found that while those people living close to marine farms agreed that sea farms can have a positive economic impact on nearby communities, they were most sensitive to marine farm development and were less positive about evaluating marine farms (Katranidis et al., 2003; Shafer et al., 2010). Also, a previous investigation found that consumers considered aquaculture products to be superior in terms of control (López-Mas et al., 2021).

In the same line, the public considers that another benefit of aquaculture is that it might prevent overfishing (Alexander et al., 2016). Similarly, in a study conducted in five countries (Ireland, Israel, Italy, Norway and the UK), more than 50% of the respondents rated aquaculture as having health and nutrition benefits or major benefits (Alexander et al., 2016). However, this result cannot be generalized as, in other investigations, consumers have considered that fisheries products are healthier than aquaculture products (Ruiz-Chico et al., 2020a, 2020b).

Concerning the negative aspects highlighted by the public in the literature, the most relevant is the environmental concern. For example, Mazur and Curtis (2008) found that in Australia, the majority of the public rated environmental impacts as the most important aquaculture issue. Similarly, Alexander et al. (2016) obtained the same results in five different countries in which the highest negative impact of aquaculture was related to pollution. In Canada, the public had negative environmental perceptions of shellfish aquaculture, because they considered it harmful to the ecology of the beach and the ocean bottom, and they also perceive negatively the issues of industry's growth and debris generated (Murray and D'Anna, 2015). Similarly, in Israel, there was a negative link between environmental concern and aquaculture support, because Israelis have focused their environmental concerns on cage effluent and marine pollution (Freeman et al., 2012). In another study, in Scotland, Whitmarsh and Palmieri (2011) found that increased concern for salmon farming's environmental performance is linked to a lower likelihood of salmon purchase. Although, on the other hand, Whitmarsh and Wattage (2006) found that Scottish consumers were willing to pay premiums for salmon produced in an environmentally friendly way. In Canada, Flaherty et al. (2019) found that the highest negative impression of salmon farming was related to being harmful to wild stocks, followed closely by the use of chemicals/antibiotics, waste accumulation on the ocean floor and, sea lice generated by salmon farms. In Spain, it was found that the public considered wild-caught fishing more environmentally friendly than farmed fish (Ruiz-Chico et al., 2020a, 2020b).

Nevertheless, one positive environmental aspect of aquaculture was found in Germany, where environmental concern was positively correlated to the support of marine aquaculture because Germans have a high concern about the depletion of wild stocks (Freeman et al., 2012). Also, Spaniards seem to be less concerned about the environmental effects of farmed fish than those of wild fish (Honkanen and Ottar Olsen, 2009).

Other disadvantages of aquaculture products against wild-caught products discussed by the public are relative to the comparatively low quality (López-Mas et al., 2021; Ruiz-Chico et al., 2020a, 2020b). This is in line with the study of Hynes et al. (2018), which found that the majority of Norwegian and Irish consumers agreed that fish farming prioritizes quantity over quality. Also, López-Mas et al. (2021) found that European consumers thought farmed fish were less fresh and with higher antibiotic concentrations than wild fish. Some studies also found that farmed fish are considered unnatural and unhealthy due to the abuse or misuse of feeds and chemicals (Ruiz-Chico et al., 2020a, 2020b). Moreover, Thomas et al. (2018), analysing the Swedish west coast, found that the public considered aquaculture to have a high risk to leak chemicals into the environment.

Other disadvantages of the aquaculture industry for consumers according to the literature are related to the adverse effects on traditional fishing (Ruiz-Chico et al., 2020b) and concerns about animal welfare (Alexander et al., 2016; Kupsala et al., 2013).

Moreover, although it is well known that tourism competes with aquaculture in some locations (Bacher, 2015), a study has found that, in Germany and Israel, the support for tourism is positively correlated with the support for marine aquaculture (Freeman et al., 2012). Similarly, in Scotland, Nimmo et al. (2011) found that the impact of aquaculture on tourism was attached by the public to its effect on the landscape stand-out. However, a different study indicated that the public considered a relatively low visual impact of aquaculture, with almost 40% of respondents indicating little or no visual impact (Alexander et al., 2016); while another study showed divided opinions on this aspect (Murray and D'Anna, 2015). Furthermore, another study found that the public considers that aquaculture farms do not restrict their swimming potential (Katranidis et al., 2003). However, New Zealand residents considered that marine farms would limit public access (Shafer et al., 2010).

2.2. The influence of negatively worded statements (reverse coded items) in Likert-scales

Reversed-coded items are those in which the scores of respondents must be reflected at the midpoint of the rating scale to ensure that all the items in a multi-item scale have the same directional relationship to the underlying construct of interest (Weijters et al., 2013). Some literature highlights that the integration of reversed items in questionnaires has significant advantages. One of the main reasons why positively and negatively worded items are both included in structured survey questionnaires is to possibly reduce the potential response bias, such as acquiescence bias (Chyung et al., 2018; Suárez-Álvarez et al., 2018). Also, reversed items are suggested to disrupt no substantive response and to allow the detection and control of aberrant response behaviour when it happens (Podsakoff et al., 2003; Weijters et al., 2013). In addition, reversed items can enhance the validity of the scale by extending the belief sample on which responses are based, and as a result, ensure more complete coverage of the domain of content of the construct and an enhanced prediction of other constructs (Tourangeau et al., 2000).

Nevertheless, there is also significant empirical evidence that reverse-coded items may have several undesirable consequences. First, reversed items often have lower item-total correlations in comparison to regular items, which leads to less reliability (Weijters and Baumgartner, 2012). In addition, models including reversed items are usually poorer in terms of fitness, and reversed items often have smaller factor loadings (Weijters and Baumgartner, 2012). Sometimes reversed items can even distort the factor structure and conduct to the erroneous specification of several substantive factors based on groups of items that differ in their coding direction (Weijters and Baumgartner, 2012).

Many studies have shown that using a mix of positively and negatively worded items in the same questionnaire is not appropriate (Chyung et al., 2018; Podsakoff et al., 2003). Chyung et al. (2018) examined the literature on including positively and negatively worded items in structured surveys, in order to address specifically if this is a good option to reduce the potential acquiescence bias. The authors found that a disadvantage of mixing negatively and positively worded items is that the negatively worded items must be reversed to be combined with the rest of the data, nevertheless, it presupposes that being in accordance with a positive statement is the same to disagree with its negative wording counterpart, which is not always the right thing to take for granted. Also, the authors found that careless interviewees may misunderstand written statements and provide responses that are not an accurate reflection of their views. Similarly, the authors contended that negative wording of items may promote method effect, showing an unexplained variance because constructs are measured using more than one method, which might happen when positive wording and negative wording are loaded onto separate factors. Finally, the authors concluded that it is better not to mix positive and negative elements because this can threaten the validity and reliability of the survey instrument. Furthermore, if the mixing is done, the authors suggest using strategies such as avoiding double negatives in the statements, alerting respondents of negatively worded items, reporting the results of the negatively worded items separately, or others.

Moreover, Suárez-Álvarez et al. (2018) evaluated the responses of participants to positive, reversed and combined forms of a self-efficacy test. The authors found that if both positive and negative (reversed) elements are used in the same test, their reliability will worsen, and secondary sources of variance will compromise the unidimensionality of the test. The authors also found that the cognitive process used in regular and reversed objects by respondents is not the same. Also, when combining both positive and negative (reversed) elements, the variance of the scores decreases and the means differ significantly in tests in which all items are formulated only positively or negatively. The reversed form had the highest scores, followed by the combined and then the regular. In line with this, a previous study agreed that respondents tend to disagree more with reversed items than agree with regular items (Solís Salazar, 2015).

Likewise, Weems et al. (2003) in a study conducted in the US using a Likert response scale with items positively and negatively (later reversed) worded found that positive and negative wording scores were not consistent, suggesting that “strongly disagreeing” with a positively worded statement is not the same as “strongly agreeing” to its negative counterpart. Thus, the authors contended that the differences in the results suggest that respondents are either not reading carefully the negatively worded items or they are processing them differently from those positively worded. In a similar study in the US, Weems et al. (2006) studied the role of reading ability in the responses to some negatively worded items, finding that the items that were positively worded had higher means than those negatively worded. Similarly, the authors contended that respondents may not carefully read or process negatively worded statements as well as positively worded statements.

An additional concern of mixing positive and negative worded statements is that negative formulations can lead to a method factor (method effect) irrelevant to the constructs that are being measured (Chyung et al., 2018). Ibrahim (2001) analysed data of students in Oman including one negatively worded amongst 21 different items. The author obtained two factors from the data, the first with 19 positively worded items and the second with one positively worded item and the negatively worded item. For this second factor, the author interpreted that both items were probably loaded on the same factor because of ambiguity, implying a method effect, because all positive wording items were loaded to one factor (except one) while the negative wording item was loaded to another separate factor.

Similar findings were obtained by Greenberger et al. (2003) in the US using three different versions of a questionnaire measuring self-image. The original version (5 positive items and 5 negative items) emerged as a two-factor model measuring both positive and negative self-image; the revised version (all positive items) emerged as a one-factor model measuring only positive self-image; and lastly, a new revised version (all negative items) emerged as a one-factor model measuring only negative self-image. Given this, the authors concluded that the original two-factor structure was developed by the mixing of items, which demonstrates a risk to construct validity when both types of items are mixed.

Solís Salazar (2015) analysed social well-being in Spain, using three different types of surveys with Likert scales: (1) only positive items, (2) eight positive and seven negated positive items, and (3) seven positive, three negated positive and five polar opposite items. The findings showed that the positively worded items had higher scores than their negative counterparts. Moreover, the authors found that the scores of the positively worded (e.g., honest) were more similar to the reversed values of the negated positive ones (e.g., not honest) than the reversed values of the polar opposites (e.g., dishonest).

Moreover, Schriesheim et al. (1991) designed a survey with four different forms of items: regular, negated regular, polar opposite and negated polar opposite, which was applied in the US to college students. Their results showed that the regular and negated regular forms were

more reliable than the rest. This is in line with cognitive information processing theory, which indicates that people usually store information concerning the presence or absence of positive attributes, such as clear or not clear, rather than negative attributes, such as unclear; and as a result, it may be difficult for respondents to obtain information based on negative attributes (Chyung et al., 2018).

Negative statements, particularly double negative statements, also need additional cognitive resources and often cause misunderstanding amongst respondents (Chyung et al., 2018). Johnson et al. (2004) found in a Likert-scale survey applied in the US that irrespective of the positive or negative wording used, a unidimensional factor structure was obtained, however, inner consistency decreased with negatively worded items. Also, double negatively worded items not only further reduced internal consistency but also had a negative effect on the factor structure, suggesting that interviewees were confused by the presence of two negatives. As a consequence, positively worded items are recommended by the authors, but in case negatively worded items are used, double negatives should be avoided.

On the other hand, some researchers still support the use of negative wordings in surveys, if they are carefully used (Weijters and Baumgartner, 2012). Weijters et al. (2009) contend that whereas reversed items may improve the reliability and lead to simpler factor structures, these desirable psychometric internal properties can simply signal a repetition of mechanic responses without thought to items that are minor and redundant variations of the same basic question. In addition, items with the same coding direction have their own systemic method biases, such as bias towards the direction of the wording, and when reversed items are absent, the method variance becomes undetectable, as it is confused with the content variance (Weijters and Baumgartner, 2012). Lastly, the items can be reversed in various ways, and even if certain reversals are prone to error, such as negated items, this does not imply the removal of all reversed items (Weijters and Baumgartner, 2012).

Particularly, Weijters and Baumgartner (2012) warn to avoid the use of the word “not” to negate regular statements, because it might lead respondents to retrieve information that is not necessary for processing the statements and may complicate their judgement process. Also, some complex forms of negation may confuse respondents and must be evaded to reduce cognitive load and errors in the judgement, and instead use polar opposites, which offers a more robust process of information retrieval (Weijters and Baumgartner, 2012).

In general, the debate seems to lean towards not mixing positive and negative wording items in survey instruments, however, there are still many divided opinions. Up until now, there have been no previous studies assessing this issue in the context of aquaculture preferences.

3. Data and methodology

3.1. Data collection

The data used in this research were obtained from surveys conducted online during April and June of 2020 using the Google forms platform in the context of an investigation assessing the preference for seabream and seabass products for adult consumers living in Gran Canaria, Spain and who were responsible for buying food at their homes. Wright (2005) contends that online surveys show advantages such as the possibility to access individuals who would be difficult to reach through other channels, as well as saving time and costs for researchers. In our particular case, the main reason for applying the surveys online was due to the Covid lockdown period that took place in Spain during the start of the Covid-19 pandemic, which impeded the face-to-face interviews.

Despite this, it is important to notice that the use of online surveys might bring sampling issues, such as low knowledge of the characteristics of the online population and the impossibility to track the non-response rate, as well as self-selection bias that is the main cause for the impossibility to generalize the results, considering that some people are more likely than others to respond to an invitation to participate in an online survey (Wright, 2005). Thus, online respondents could not adequately represent a population due to their age, gender, level of education, and other variables, and even when the exact characteristics of a sample are known to the researcher, respondents can easily misrepresent their identity or their true feelings regarding the survey's content (Wright, 2005). These issues should be taken into account when analysing the results obtained from the data of the survey.

The survey was distributed by email to the population of the island's leading public university, the University of Las Palmas de Gran Canaria, as a way to distribute the questionnaire amongst consumers on the island. In April 2020, the questionnaire was first e-mailed, and the community was reminded of the questionnaire two weeks later by a second e-mail. In the emails, it was clarified that the survey could and should be shared with other individuals outside the university, as the idea was to reach different consumer segments of the islands. Interested respondents were first asked to confirm they were island residents, that they were in charge of the home purchase of food and that they were seabream/seabass consumers. The questionnaire could only be continued by those who met these criteria (351 respondents in total).

The core of the investigation is based on a particular section of the survey, in which respondents were asked to rate their level of agreement for 16 statements related to the image of aquaculture and its products on a scale from 1 (completely disagree) to 5 (completely agree). These statements included information about consumers' opinions about aspects such as pesticides and fish illnesses, pollution, crowded conditions of fish, cleanliness and healthiness of the environment, the naturalness of the fish farming process, comparisons with other types of farming and fisheries, the affordability of farmed fish, sustainability, the diet of the fish and the social and economic benefits.

Moreover, to understand the influence of positive and negative wording, two different survey blocks were distributed: one with the statements written in a positive way towards aquaculture, and the other one with the same statements but written in a negative perspective towards aquaculture. For example, a statement was written like this in each survey: (1) aquaculture farming is a natural process and (2) aquaculture farming is not a natural process. In the end, 167 respondents answered the negatively worded survey block and 184 the positively worded survey block.

3.1.1. Ways of wording survey statements

When examining the dichotomous categories of positive and negative survey items more closely, it can be concluded that there are different ways of wording survey statements. In general, they depend on three aspects: the descriptor (positive or negative), the absence or presence of the negation (not) and the absence or presence of a reference comparison.

For example, a descriptor with a positive meaning is “important”, while its negative counterpart is “unimportant”. Similarly, the descriptor might be accompanied by the inclusion of a negated word (not), thus following the same example, there are two extra options for each description: important vs. not important and unimportant vs. not unimportant. Finally, these four forms can also include or not a reference comparison. Thus, it is possible to form 8 different ways of wording survey statements (see Table 1). It is important to notice, that the comparison can describe a better or worst situation than the reference used, but we will just consider its presence or absence.

Considering the previous, we constructed the different statements for the two blocks treated according to a negative or positive image sense of aquaculture, respectively. The first block (negative image sense) included 16 statements or attributes, from which half of the statements included a negative descriptor. The other half have positive descriptors but included either a negation (not) or a comparison that turned the meaning of the statement against aquaculture. Similarly, the second block (positive image sense) included 16 statements, from which 13 included a positive descriptor. The remaining three statements with

Table 1
Eight ways of wording survey statements.

Number	Type of wording	Characteristics			Example
		Description	Negation (not)	Reference Comparison	
1	Un-compared positively worded	Positive	Absent	Absent	Fish farming is a natural process
2	Compared positively worded	Positive	Absent	Present	Fish coming from aquaculture are raised in a cleaner and healthier environment than fish from fisheries
3	Un-compared negatively worded	Positive	Present	Absent	Fish farming does not contribute to the fish mass sustainability
4	Unclear compared positively worded	Positive	Present	Present	Wild-caught fish are not better than farmed fish for living in a natural habitat
5	Un-compared negatively worded	Negative	Absent	Absent	Fish farms create an excessive pollution damage
6	Compared negatively worded	Negative	Absent	Present	Fish coming from aquaculture are exposed to more amounts of pesticides and diseases than fish from fisheries
7	Un-compared double negatively worded	Negative	Present	Absent	The fish that come from the aquaculture do not contribute to the fish mass unsustainability*
8	Compared double negatively worded	Negative	Present	Present	Fish coming from aquaculture do not have the same problems that other types of farming (processed food, chemicals in diets, bad live conditions for animals)

Source: Own elaboration.
* This type of wording has not been included in the questionnaire.

negative descriptors included a negation (not), comparison or a limiting adjective such as "low" that changed the meaning of the statement in favour of aquaculture. Moreover, in both cases, the majority of the statements had the negation (not) absent (14 statements for the first block and 13 statements for the second block). Also, the same attributes in each block had 8 statements that did not include a reference comparison while the other 8 did.

In terms of the types of wording (please refer to Table 1), for the first block (negative image sense), most of the statements were worded according to types [5] Un-compared negatively worded and [2] Compared positively worded (37.5% each). The remaining statements were associated with types [6] Compared negatively worded and [3] Un-compared negatively worded (12.5% each). For the cases in which the descriptor was positive, the meaning was changed to negative towards aquaculture using a comparative (type 2) or negation (type 3). Moreover, for the case of the second block (positive image sense), most of the statements were worded according to types [1] Un-compared positively worded (43.75%) and [2] Compared positively worded (25%). The remaining statements were worded according to types [4] Unclear compared positively worded (12.5%), [5] Un-compared negatively worded (6.25%), [6] Compared negatively worded (6.25%) and [8] Compared double negatively worded (6.25%). For the cases in which the descriptors were negative, the meaning was changed to positive towards aquaculture using a negation (not), comparison or a limiting adjective such as "low". Table 2 shows the aquaculture image attributes included in the survey according to the block and type of wording used.

3.2. Data analysis methods

Two stages of analysis have been taken to evaluate the data in this research: a combination of fuzzy logic and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and fuzzy clustering. Fuzzy clustering allows segmenting the market in a more realistic multidimensional way, with consumers not being forced to belong to one cluster (Zhang et al., 2013), especially considering that it is not always right to assume that consumers are part of only one cluster when the market is segmented (Li et al., 2013). Indeed, consumer information can be lost if only one cluster is used by consumers (Chaturvedi et al., 1997; Chiang, 2011; Li et al., 2013). Thus, using fuzzy clustering can help to reduce information loss.

3.2.1. Fuzzy-hybrid multi-criteria decision making

For the analysis of the data, we used a methodology using a hybrid approach based on Fuzzy Set Theory (FST) and TOPSIS (Techniques for order preference by similarity of the ideal solution). Fuzzy methods can capture the essence of human ambiguity judgement when respondents deal with multidimensional attributes (Chang, 1996). Moreover, TOPSIS techniques are known as appropriate tools for handling various decision-making processes, and they are particularly useful when respondents make choices with multiple attributes, as these techniques prioritize and rank the items for easy managerial interpretation, which leads to the appropriate policy and strategy implementation. We established synthetic indicators to measure the consumers' acceptance of aquaculture and its products, considering three different treatments (mixing positive and negative statements -treatment 1-, just negative statements -treatment 2- and just positive statements -treatment 3-) and with respect to different segments, in which the sample was divided according to frequencies of consumption for diverse seafood products, their residence, their preferred species, preference for aquaculture products, origin preference, place of buying, education level, gender, household composition and age.

The responses to the acceptance level expressed by the respondents are based on a Likert scale of five points (Totally disagree [1]; Disagree [2]; Neither disagree nor agree [3]; Agree [4]; Totally agree [5]). Like the other qualitative semantic scales used for social sciences, Likert scales provide uncertain and vague information not suitable for quantitative analysis. This is why FST is a good alternative to other conventional methods to cope with such information (D'Urso et al., 2016; Martín et al., 2020). Table 3 shows the transformation of the raw dataset into triangular fuzzy numbers as a good alternative for handling this vague information. The TFNs (Triangular Fuzzy Numbers) are three parameters (a_1, a_2, a_3). The most probable value is a_2 and the minimum and maximum values are a_1 and a_3, respectively. This way, the first step of the methodology is to transform the answers into TFNs based on the default values in Table 3. These default values are chosen based on the authors' criteria, therefore it is crucial to note that it is also possible to employ other forms of representations that take into consideration more symmetric TFNs, such as the scale used by Lin (2010), in which the range for the whole set of the 5-point Likert scale is always 20. In our case, we assume that the information is more blurred in the overlapping areas of the extreme values, as previously considered by Cantillo et al. (2021) and Martín and Román (2017).

In the second step, we calculate the mean TFNs for each segment of analysis, which include various segmentation variables v (e.g., Living municipality, education level, etc.) and some categories s that correspond to each of them (e.g., Las Palmas de Gran Canaria or Another

Table 2
Aquaculture image attributes.

Statement	Block 1 (Negative image sense)	Type of wording	Block 2 (Positive image sense)	Type of wording
Img1	Fish coming from aquaculture are exposed to more amounts of pesticides and diseases than fish from fisheries	(6) Compared negatively worded	Fish coming from aquaculture are exposed to fewer amounts of pesticides and diseases than fish from fisheries	(6) Compared negatively worded
Img2	Fish farms create an excessive pollution damage	(5) Un-compared negatively worded	Fish farms create low pollution damage	(5) Un-compared negatively worded
Img3	The crowded conditions of fish farms are bad for fish	(5) Un-compared negatively worded	The crowded conditions of fish farms are good for fish	(1) Un-compared positively worded
Img4	Fish coming from aquaculture are raised in a less clean and less healthy environment than fish from fisheries	(2) Compared positively worded	Fish coming from aquaculture are raised in a cleaner and healthier environment than fish from fisheries	(2) Compared positively worded
Img5	Fish coming from aquaculture have the same problems as other types of farming (processed food, chemicals in diets, bad live conditions for animals)	(6) Compared negatively worded	Fish coming from aquaculture do not have the same problems as other types of farming (processed food, chemicals in diets, bad live conditions for animals)	(8) Compared double negatively worded
Img6	Fish farming is an unnatural process	(5) Un-compared negatively worded	Fish farming is a natural process	(1) Un-compared positively worded
Img7	Fish coming from aquaculture are inconsistent and unaffordable	(5) Un-compared negatively worded	Fish coming from aquaculture are consistent and affordable	(1) Un-compared positively worded
Img8	Fish coming from the aquaculture are an unhealthy food option	(5) Un-compared negatively worded	Fish coming from the aquaculture are a healthy food option	(1) Un-compared positively worded
Img9	Fish farming does not contribute to the fish mass sustainability	(3) Un-compared negatively worded	Fish farming contributes to the fish mass sustainability	(1) Un-compared positively worded
Img10	The controlled diet of fish coming from aquaculture is not good	(3) Un-compared negatively worded	The controlled diet of fish coming from aquaculture is good	(1) Un-compared positively worded
Img11	The social and economic benefits of fish farming are inferior to the environmental and health costs	(2) Compared positively worded	The social and economic benefits of fish farming are superior to the environmental and health costs	(2) Compared positively worded
Img12	Fish coming from aquaculture have less flavour than fish from fisheries	(2) Compared positively worded	Fish coming from aquaculture have more flavour than fish from fisheries	(2) Compared positively worded
Img13	Fish coming from aquaculture have less quality than fish from fisheries	(2) Compared positively worded	Fish coming from aquaculture have more quality than fish from fisheries	(2) Compared positively worded
Img14	Wild-caught fish are better than farmed fish because they live in a natural habitat	(2) Compared positively worded	Wild-caught fish are not better than farmed fish for living in a natural habitat	(4) Unclear compared positively worded
Img15	Wild-caught fish have a natural diet, which is better for them in comparison with farmed fish.	(2) Compared positively worded	Wild-caught fish have a natural diet, which is not good for them in comparison with farmed fish.	(4) Unclear compared positively worded
Img16	The visual impact of fish farming in the sea is negative	(5) Un-compared negatively worded	The visual impact of fish farming in the sea is negligible	(1) Un-compared positively worded

Source: Own elaboration.

Table 3
Triangular fuzzy numbers. Default values of linguistic terms.

Linguistic terms	Fuzzy Numbers (a,b,c)
Totally disagree	(0,0,30)
Disagree	(20,30,40)
Neither disagree nor agree	(30,50,70)
Agree	(60,70,80)
Totally agree	(70,100,100)

Source: Own elaboration.

municipality for the living municipality). Also, the mean TFNs are estimated separately according to the attribute q (Img1, Img2, etc.). Following this, the mean TFN ($\widetilde{A}$) for a category s that is part of the segmentation variable v and related to an attribute q, can be estimated as the mean of the TFN responses of the individuals 1 to n that are part of that particular segment of analysis. This can be seen in eq. 1.

$$\widetilde{A} = (a_1^{s,v,q}, a_2^{s,v,q}, a_3^{s,v,q}) = \left(\frac{\sum_{i=1}^{n} a_1^{s,v,q}}{n}, \frac{\sum_{i=1}^{n} a_2^{s,v,q}}{n}, \frac{\sum_{i=1}^{n} a_3^{s,v,q}}{n} \right) \quad (1)$$

where s:1, …,s; v:1, …,v and q:1, …,q.

After that, in the third step, we perform a defuzzification process to transform the elements of the TFN information matrixes into crisp values (CVs), which represent precise values measuring something objectively in opposition to fuzzy numbers and that goes on a scale from 0 to 100. These CVs for simplicity and objectivity could be calculated according to eq. 2 (Chen, 1996).

$$CV_{s,v,q} = \frac{a_{s,v,q} + 2 \times b_{s,v,q} + c_{s,v,q}}{4} \quad (2)$$

where s:1, …,s; v:1, …,v and q:1, …,q.

The next step (fourth step) is characterized by determining the ideal (CV_q^+) and negative-ideal (CV_q^-) solutions per each attribute q, as the maximum and minimum CVs of all the segments of analysis, as shown in eq. 3. The ideal solution maximizes the level of acceptance of each particular attribute q, whereas the negative ideal solution minimizes it.

$$\begin{aligned} &CV_q = \{CV_{1,1,q}, \ldots, CV_{s,v,q}\} \\ &\text{where } CV_q^+ \\ &= \max_q (CV_q) \text{ and } CV_q^- \\ &= \min_q (CV_q) \end{aligned} \quad (3)$$

where s:1, …,s; v:1, …,v and q:1, …,q.

The fifth step consists of calculating the Euclidean distances of each category s of the segment of analysis v with respect to the ideal solutions, as shown in Eq. 4.

$$d_{s,v}^{+} = \sqrt{\sum_{q=1}^{q}\left(CV_{q}^{+} - CV_{s,v,q}\right)^{2}} \quad \text{and} \quad d_{s,v}^{-} = \sqrt{\sum_{q=1}^{q}\left(CV_{s,v,q} - CV_{q}^{-}\right)^{2}} \tag{4}$$

where s:1, …,s; v:1, …,v and q:1, …,q.

The estimation by each segment of analysis of synthetic indicators (SIs) is the sixth step of the method and is executed using Eq. 5, which simultaneously characterizes the distance between ideal and negative ideal solutions. SIs represent the level of acceptance for aquaculture and its products, which implies that a value closer to 1 indicates that the image towards aquaculture is positive, whereas values closer to 0 indicate the opposite.

$$SI_{s,v} = \frac{d_{s,v}^{-}}{d_{s,v}^{+} + d_{s,v}^{-}} \tag{5}$$

where s:1, …,s and v:1, …,v.

3.2.2. Fuzzy clustering

For each treatment, a fuzzy clustering method is applied with a three-cluster solution [(Pro-Aquaculture (positive aquaculture image), Intermediate (intermediate aquaculture image) and Anti-Aquaculture (negative aquaculture image)] to segment the consumers accurately. The fuzzy clustering method extends other non-overlapping (hard) and overlapping algorithms, allowing respondents to belong to multiple clusters. The method provides a membership function that assigns a probability that each respondent has to belong to each of the clusters (D'Urso et al., 2015). This is an extension of the well-known k-means partitioning method in which the membership function is unique for the single cluster to which each respondent is obliged to belong to.

Below are the fundamentals of the hybrid cluster algorithm. The method is an extension of Leisch's Bagged Cluster algorithm (Leisch, 1999). D'Urso et al. (2013, 2015, 2016) can be referred to interested readers for further details. The adopted C-means algorithm for fuzzy data can be expressed as follows:

$$\begin{aligned} min: \sum_{i=1}^{n}\sum_{c=1}^{C} u_{ic}^{m} d_{F}^{2}\left(\widetilde{x}_{i}, \widetilde{p}_{c}\right) &= \sum_{i=1}^{n}\sum_{c=1}^{C} u_{ic}^{m}\left[w_{2}^{2}\left\|a_{2}^{i} - p_{2}^{c}\right\|^{2} + w_{1}^{2}\left(\left\|a_{1}^{i} - p_{1}^{c}\right\|^{2}\right.\right. \\ &\left.\left. + \left\|a_{3}^{i} - p_{3}^{c}\right\|^{2}\right)\right] s.t.\ m \\ &> 1, u_{ic} \geq 0, \sum_{c=1}^{C} u_{ic}^{m} = 1, w_{1} \geq w_{2} \geq 0, w_{1} + w_{2} \\ &= 1 \end{aligned} \tag{6}$$

Where $d_{F}^{2}\left(\widetilde{x}_{i}, \widetilde{p}_{c}\right)$ indicated the squared fuzzy distance between the ith respondent and the profile of the cth cluster; the $\widetilde{x}_{i} = \left\{\widetilde{x}_{iq} = \left(a_{1iq}, a_{2iq}, a_{3iq}\right) : q = 1 \ldots Q\right\}$ indicated the TFN vector for the ith respondent obtained from the observation of the Q attributes, which are 16 in the current study; $\widetilde{p}_{c} = \left\{\widetilde{p}_{cq} = \left(p_{1cq}, p_{2cq}, p_{3cq}\right) : q = 1 \ldots Q\right\}$ indicates the fuzzy profile of the cth cluster; $\left\|a_{2}^{i} - p_{2}^{c}\right\|^{2}$ is the squared Euclidean distances between the centres of the TFN vectors of the ith respondent and profile of the cth cluster; $\left\|a_{1}^{i} - p_{1}^{c}\right\|^{2}$ and $\left\|a_{3}^{i} - p_{3}^{c}\right\|^{2}$ are respectively the squared Euclidean distances between the left and right extreme components of the TFN vectors of the ith respondent and profile of the cth cluster; $w_{1} \geq w_{2} \geq 0$are appropriate weights for the centre and extreme components according to the fuzzy distance considered; $m > 1$ is a weighted exponent which controls the fuzziness of the partition obtained; $u_{ic} \geq 0$ gives the membership degree of the ith respondent in the cth cluster.

We have preferred to use a fuzzy clustering method over other more conventional methods such as the k-means partitioning method, which is likely to be the most popular method in marketing, for a number of reasons. First, the identification of the cluster size is unimportant. Second, the clustering solution does not depend on statistical properties between the with-in cluster distance that measures the similarity degree between the respondents of each cluster that has a determinant influence on developing an adequate marketing strategy. And third, the three-fuzzy solution also alleviates the existing dependency on the characteristics of the dataset in regard to the cluster outcome solution. The discussion on cluster validation and cluster profiles is not examined in this paper and can be consulted by interested readers in D'Urso et al. (2013, 2015, 2016).

4. Results

4.1. Descriptive statistics

In terms of the total sample, most respondents were women (60.7%), single (47.9%) and between the ages of 18 and 35 years (47%). Most of the respondents said their income was around the national average (70.4%) and are well-qualified in terms of education, as over 81% of them had at least a university major degree. In addition, public sector employees accounted for 39% of the total respondents and students 36%. Moreover, there seem to be slight differences between the two samples by block, with respondents of block 1 (negative image sense) accounting for a higher number of younger and single respondents, while there seem to be no important differences according to gender and income. Moreover, although in both databases there is a high number of highly educated respondents, for block 2 (positive image sense) there is a higher proportion of respondents with at least a university major degree, whereas there is a higher proportion of students on the sample of block 1. Nevertheless, despite the small differences, there are similar tendencies in the sample features in both blocks, with the majority of respondents being highly educated and relatively young adults between 18 and 35 years old.

Moreover, in the total sample, 81.2% of respondents consume seafood at home at least once every week, and over 52.7% consume seafood at least once a month outside the house. Also, the consumption pattern for seabream and seabass products indicates that 59,5% of respondents consume these products at least once a month. Similar figures are observed if the samples are divided by blocks. In addition, the most common and frequently consumed species is tuna, followed by hake, seabream, salmon and seabass. Lastly, respondents show a preference to buy their fish products in supermarkets and markets. The full sample statistics of the 351 interviewees could be found in the appendix (see Tables A1 and A2).

Furthermore, in the appendix, Table A3 shows the frequencies of the responses for the different statements. Results indicate that for almost all the attributes, most respondents evidenced a neutral position towards aquaculture, mostly not disagreeing nor agreeing with each statement. Only statement 6 “Fish farming is a natural process” leaned more towards disagreeing. Meanwhile, the attribute that showed the highest level of agreement was related to statement 9 “Fish farming contributes to the fish mass sustainability”. Also, attribute 11 “The social and economic benefits of fish farming are superior to the environmental and health costs” was selected as the one with the higher neutral opinion amongst respondents.

Fig. 1 shows the mean of the responses for each attribute and survey block. For this case, the information of block 1 (Negative image sense)

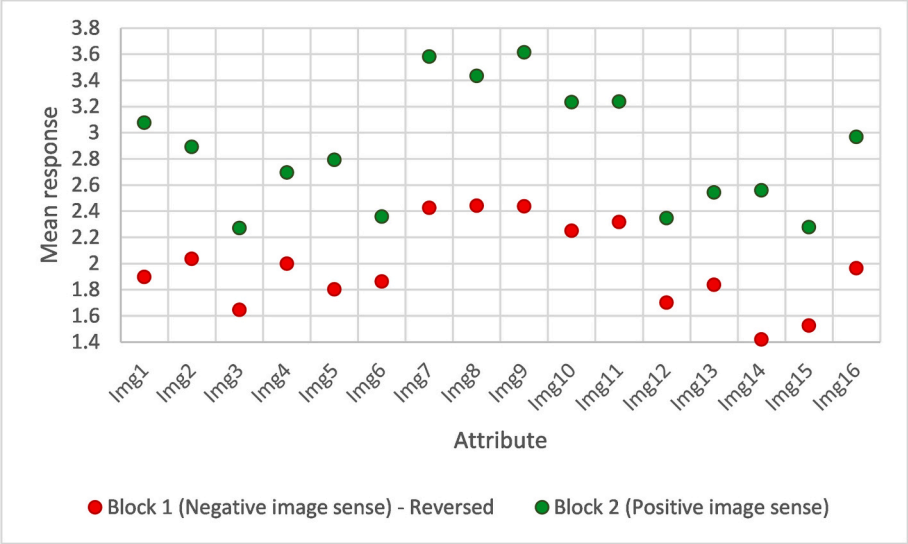

Fig. 1. Mean responses of the attributes per block.

was reversed to be compared with block 2. It can be observed that for all attributes, the reversed information of block 1 is lower in magnitude than that of block 2. This indicates that when consumers are presented with negative information about aquaculture, there is a higher rejection of aquaculture, as a result, when reversed, the information shows less agreement with aquaculture, in comparison to when the information is presented positively. In other words, when the information is negatively presented, the rejection of aquaculture is higher.

Additionally, Fig. 2 shows the variance of the responses for each attribute and survey block. It can be observed that in most cases, the variance of the attributes is higher when negative information is used. This suggests less reliability of the data when negative statements are included, considering that the variability of the responses increases, suggesting that it is not appropriate to include negative statements on Likert-scale instruments assessing the acceptance of aquaculture and its products.

The only exceptions to the previous, occur with attributes 1, 2, 3, 4 and 5. For the cases of attributes 1, 2 and 5, the reason behind this difference might be because these are the only 3 cases in which the positive wording is used with a negative descriptor. For the case of attribute 3, the start with the negative aspect of "crowded conditions", despite using a negative descriptor, might have confused respondents, reflecting on the variability. Finally, although there is no explanation for attribute 4 having a higher variance when worded positive in comparison to when worded negative, the difference in the variance is almost negligible for this particular case.

4.2. *Fuzzy-hybrid multi-criteria decision making*

Once we have implemented the first three steps of the Hybrid Fuzzy TOPSIS methodology, we obtained the mean CVs per segment of analysis and treatment. After that, in the fourth step. we calculated the ideal and the negative ideal solutions. These results are shown respectively in Tables 6, 7 and 8 for treatment 1 (mixing positive and negative information), treatment 2 (negative information reversed) and treatment 3 (positive information). Ideal and negative ideal solutions show the analysis segment that has given the best and worst importance to the attributes of each treatment, whereas the percentage of variation measures the heterogeneity of the opinions.

The results indicate that the levels of agreement for the attributes are

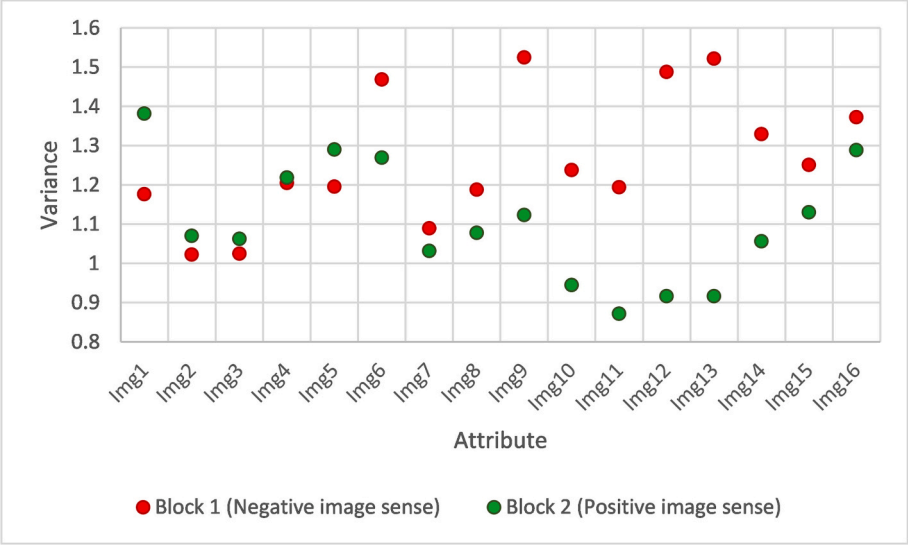

Fig. 2. Variances of the attributes per block.

heterogeneous with variations between ideal and negative ideal solutions. For treatment 1, the variation of the ideal and negative ideal solutions goes from 72% to 634%, while for treatment 2 and treatment 3, it goes from 187% to 983% and from 90% to 983%, respectively.

The highest heterogeneity for treatments 1 and 3 was obtained from attribute 5 "Fish coming from aquaculture do not have the same problems that other types of farming (processed food, chemicals on diets, bad live conditions for animals)". This might be due to respondents comparing aquaculture with other types of farming, without specifying the type of farming. As a result, each respondent might have responded to it according to a different scenario. On the other hand, the highest heterogeneity for treatment 2 was related to attribute 4 "Fish coming from aquaculture are raised in a less clean and less healthy environment than fish from fisheries". Again, the highest heterogeneity might be due to the comparison, in which various respondents might have different perceptions of the environment of fisheries. Moreover, other attributes that experienced a high variation and also presented a comparison were attributes 4 and 14 for treatment 2; and 12 and 14 for treatment 3. Lastly, there was also a high variation for attributes 2 "Fish farms create an excessive pollution damage" and 16 "The visual impact of fish farming in the sea is negative" in treatment 2, where the words "excessive" and "negative" might have been judged different by respondents. The full results of the obtained positive and negative ideal solutions for the different treatments can be found in the appendix, in Tables A4, A5 and A6.

Table 4 shows the aquaculture image SIs for each segment of analysis and treatment. As previously stated, SIs represent the level of acceptance for aquaculture and its products, with a value closer to 1 indicating that the image towards aquaculture is positive and a value closer to 0, the opposite. In the results, we found some similarities between the three treatments, such as a better acceptance of aquaculture and its products for the respondents belonging to the following segments: consider salmon as one of their favourite species, prefer farmed fish over wild fish, prefer products of EU origin, do not consider that the information accompanying the products is clear and buy their products in supermarkets. However, there are some cases where there are similarities between the two treatments, but a different tendency from the other one. For example, treatments 1 and 2 indicate a better acceptance of aquaculture products for those who are male, married and can identify if the fish is wild or farmed, while there are no clear tendencies for these aspects for treatment 3. Also, treatments 1 and 2 show a higher acceptance of aquaculture for those who are between the ages of 36 and 65, while for treatment 3 there is higher acceptance for those between 25 and 66 years old. Likewise, for treatments 1 and 3, there is a better acceptance of aquaculture for those with 2 or more children, while for treatment 2 it is related to those with just one child. Also, there is a better acceptance of aquaculture for those that earn lower than the national average, while there is no clear tendency for this type of segment according to treatment 2.

Moreover, regarding the lower acceptance of aquaculture, the three treatments agreed on a lower acceptance for those who prefer wild fish over farmed fish and buy their products at food markets. But similarly, as with the higher acceptance, there are differences. On one hand, there is a lower acceptance for those who are not interested in the origin preference according to treatments 1 and 2, while there are no clear tendencies for treatment 3. In addition, treatments 1 and 2 show a lower acceptance of aquaculture for those who live in a household of 4 or more, while treatment 3 identified the lower acceptance for those who live alone or with just one companion. In the same way, treatments 1 and 3 identified a lower frequency of consumption for respondents who do not read the information accompanying the seafood products, have a very low educational level and are part of the generation between 26 and 35 years of age; whereas according to treatment 2, there is a lower consumption for those who consider that some of the information accompanying the seafood products is clear and easy, have a technical degree and are younger than 25 years old. Also, it is important to add,

Table 4
Aquaculture image synthetic index.

Segmentation variables	Categories	Aquaculture image synthetic indexes		
		Treatment 1 (Complete sample)	Treatment 2 (Only negative statements)	Treatment 3 (Only positive statements)
Total		0.6031	0.6112	0.4804
Living municipality	Las Palmas de Gran Canaria	0.5832	0.6330	0.4881
	Another municipality	0.6070	0.6112	0.4766
Frequency of consumption of fish at home	Every day (Home)	0.1638	0.6330	0.1909
	2–3 times a week (Home)	0.5984	0.5870	0.4878
	Once a week (Home)	0.6155	0.6281	0.4891
	2–3 times per month (Home)	0.5768	0.5475	0.5048
	Once per month (Home)	0.7224	0.7938	0.4296
	Sometimes per year (Home)	0.5742	0.5771	0.4873
	Almost never (Home)	0.3858	0.3013	0.3795
Frequency of consumption of fish away from home	2–3 times a week (A-H)	0.6926	0.6435	0.5822
	Once a week (A-H)	0.5627	0.5127	0.4957
	2–3 times per month (A-H)	0.6633	0.6846	0.5024
	Once per month (A-H)	0.5478	0.5973	0.4069
	Sometimes per year (A-H)	0.6299	0.6477	0.4931
	Almost never (A-H)	0.5691	0.5297	0.5046
Species more consumed	Tuna	0.6121	0.6430	0.4548
	Seabream	0.5136	0.6009	0.3895
	Hake	0.5728	0.5771	0.4731
	Salmon	0.6817	0.7243	0.5067
	Other species	0.6067	0.5439	0.5387
Frequency of consumption of fresh fish at home	2–3 times a week (Fresh)	0.5413	0.5189	0.4669
	Once a week (Fresh)	0.6231	0.6414	0.4910
	2–3 times per month (Fresh)	0.6383	0.6562	0.4753
	Once per month (Fresh)	0.6202	0.6221	0.4862
	Sometimes per year (Fresh)	0.5397	0.5620	0.4500
	Almost never (Fresh)	0.5727	0.4922	0.5089
Frequency of consumption of frozen fish at home	Every day (Frozen)	0.5556	0.6330	0.4735
	2–3 times a week (Frozen)	0.6990	0.6837	0.5498
	Once a week (Frozen)	0.5893	0.5770	0.4893
	2–3 times per month (Frozen)	0.6546	0.6723	0.4943
	Once per month (Frozen)	0.5867	0.6518	0.4084
	Sometimes per year (Frozen)	0.4606	0.5562	0.3521
	Almost never (Frozen)	0.5580	0.5179	0.5024
Frequency of consumption of processed fish at home	Every day (Other)	0.7148	0.6055	0.6566
	2–3 times a week (Other)	0.6116	0.6763	0.4605
	Once a week (Other)	0.6434	0.7010	0.4451
	2–3 times per month (Other)	0.5878	0.6069	0.4621

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Table 4 (*continued*)

Segmentation variables	Categories	Aquaculture image synthetic indexes		
		Treatment 1 (Complete sample)	Treatment 2 (Only negative statements)	Treatment 3 (Only positive statements)
	Once per month (Other)	0.6274	0.6321	0.4959
	Sometimes per year (Other)	0.5786	0.5828	0.4760
	Almost never (Other)	0.5738	0.5068	0.5258
Frequency of consumption of canned fish at home	Every day (Canned)	0.4986	0.3894	0.4764
	2–3 times a week (Canned)	0.6248	0.6437	0.4859
	Once a week (Canned)	0.5642	0.5892	0.4370
	2–3 times per month (Canned)	0.5891	0.5877	0.4792
	Once per month (Canned)	0.7343	0.7075	0.5890
	Sometimes per year (Canned)	0.5586	0.5347	0.4697
	Almost never (Canned)	0.5383	0.3013	0.5051
Frequency of consumption of shellfish at home	2–3 times a week (Shellfish)	0.4056	0.2054	0.4204
	Once a week (Shellfish)	0.6077	0.6248	0.4661
	2–3 times per month (Shellfish)	0.6404	0.6310	0.5201
	Once per month (Shellfish)	0.5951	0.6339	0.4444
	Sometimes per year (Shellfish)	0.5776	0.6190	0.4259
	Almost never (Shellfish)	0.6087	0.5286	0.5477
Frequency of consumption of seabream and seabass	2–3 times a week (Seabream + Seabass)	0.2494	0.3066	0.2585
	Once a week (Seabream + Seabass)	0.6516	0.7147	0.4904
	2–3 times per month (Seabream + Seabass)	0.6657	0.6466	0.5374
	Once per month (Seabream + Seabass)	0.6304	0.6070	0.5222
	Sometimes per year (Seabream + Seabass)	0.5803	0.6117	0.4465
	Almost never (Seabream + Seabass)	0.5215	0.5034	0.4552
Identification of origin when buying seabream and seabass	I cannot identify fresh or aquaculture Seabream and Seabass	0.5806	0.5851	0.4692
	I am not interested in identifying whether the fish is wild or farmed	0.6014	0.5915	0.4984
		0.6373	0.6615	0.4828
	I can identify if the fish is wild or farmed			
Wild vs farmed preference	I prefer wild fish over farmed fish	0.5463	0.5601	0.4402
	I am indifferent between wild or farmed fish	0.6037	0.6170	0.4789
	I prefer farmed fish over wild fish	0.7813	0.8038	0.5996
Origin preference	Not interested	0.4579	0.3964	0.4762
	Do not know	0.5657	0.5892	0.4495
	EU preference	0.7490	0.7359	0.5420
	Local preference	0.6047	0.6123	0.4819
Information accompanying the products	Clear and easy	0.6090	0.6056	0.4998
	Almost clear and easy	0.6445	0.6371	0.5195
	Some information is clear and easy	0.5714	0.5368	0.5063
	It is not clear at all	0.7242	0.6908	0.6443
	I do not read any information	0.5644	0.6462	0.3961
Places to buy fish	Food Markets	0.5422	0.5680	0.4211
	Fish section in supermarkets	0.6251	0.5946	0.5273
	Supermarkets	0.6135	0.6395	0.4778
	Other	0.5103	0.5982	0.3881
Frequency of reading labels on seabream and seabass products	Always	0.6011	0.5700	0.5115
	Frequently	0.5991	0.6435	0.4556
	Sometimes	0.6738	0.6539	0.5464
	Occasionally	0.5755	0.5564	0.4849
	Never	0.5708	0.6330	0.4164
Knowledge about skeletal anomalies	Skeletal anomalies (N)	0.5928	0.5976	0.4741
	Skeletal anomalies (Y)	0.6181	0.6331	0.4887
Observation of skeletal anomalies in the past	Observed SA (N)	0.6333	0.6569	0.4923
	Observed SA (IDN)	0.5808	0.5857	0.4667
	Observed SA (Y)	0.5724	0.5556	0.4893
Gender	Female	0.5948	0.5923	0.4858
	Male	0.6153	0.6401	0.4726
Education level	Primary	0.3125	0.4524	0.2551
	Secondary	0.5180	0.4871	0.5446
	Technical degree	0.4330	0.3893	0.4080
	University degree	0.6513	0.6439	0.5230
	Master/PhD	0.6109	0.6590	0.4606
Marital status	Married	0.6080	0.6309	0.4740
	Single	0.5812	0.5853	0.4744
	Other	0.6462	0.6560	0.5084
Household composition	Living alone	0.6381	0.7402	0.4317
	1 companion	0.5761	0.6096	0.4446
	2 companions	0.6327	0.6013	0.5265
	3 companions	0.6143	0.6553	0.4627
	4 or more companions	0.5460	0.5209	0.4863
Children at home	No children	0.6018	0.6044	0.4844
	1 child	0.6009	0.6916	0.3755
	2 or more children	0.6557	0.6330	0.5385
Salary		0.6243	0.6155	0.5049

(*continued on next page*)

Table 4 (*continued*)

Segmentation variables	Categories	Aquaculture image synthetic indexes		
		Treatment 1 (Complete sample)	Treatment 2 (Only negative statements)	Treatment 3 (Only positive statements)
	Lower than the national average			
	About the national average	0.5565	0.5773	0.4485
	Greater than the national average	0.5477	0.6188	0.4125
Age	Age. ≤25	0.4957	0.4205	0.5450
	Age. 26–35	0.5841	0.6191	0.4288
	Age. 36–45	0.6496	0.6590	0.4939
	Age. 46–55	0.6241	0.6667	0.4759
	Age. 56–65	0.6299	0.6705	0.4836
	Age. ≥ 66	0.5976	0.5220	0.5228

that none of the treatments identified clear tendencies for the segments related to the living municipality and the frequencies of consumption.

Moreover, Table 5 shows the results for the Spearman correlation coefficients of AISI (Aquaculture image synthetic index). The results indicate a strong positive correlation between treatments 1 and 2, and a moderate positive correlation between treatments 1 and 3. These two correlations are expected, considering that treatment 1 included the data of treatments 2 and 3. However, it is interesting to notice that there is a very weak non-significant correlation between treatments 2 and 3, exhibiting that negative statements when reversed do not measure the same as positive statements.

4.3. Fuzzy-clusters

The three representative profiles of each cluster for the three treatments are presented in Table 6. Data are presented as Likert scale answers instead of using fuzzy conversion. The table displays a vector of 16 values in the range 1 to 5. The cluster names are (1) Pro-Aquaculture; (2) Anti-Aquaculture; and (3) Intermediate. According to the fuzzy clusters, for all treatments, it can be said that the profile of an extreme Pro-Aquaculture consumer is characterized by a consumer who perceives all the attributes at the maximum or second-maximum values. In this cluster, the values are the same for treatments 1 and 2, however, there are differences with treatment 3 in some cases, in which attributes 1, 2, 3, 5 and 16 have a relatively lower agreement in comparison to the other treatments, and attributes 4 and 11 have a relatively higher agreement in comparison to the other treatments. Meanwhile, in all treatments, extreme Anti-Aquaculture consumers are characterized for perceiving all statements on the scale as having the lowest value. Finally, the third cluster is a group of respondents who agree with aquaculture at intermediate levels. The values are only the same in the treatments for attributes 1 and 9, and for the rest, there are differences amongst the values assigned to the Intermediate cluster.

Given the previous, we observe more similarities with the different treatments for the extreme clusters (Pro-Aquaculture and Anti-Aquaculture). However, this is not the case for the Intermediate cluster, in which there are considerable differences depending on the

Table 5
Spearman correlation coefficients of AISI (Aquaculture image synthetic index).

	Treatment 1	Treatment 2	Treatment 3
Treatment 1		0.792***	0.563***
Treatment 2	0.792***		0.096
Treatment 3	0.563***	0.096	

Computed correlation used spearman-method with listwise-deletion.

Table 6
Aquaculture image cluster profiles.

Statement	Treatment 1 (Complete sample)			Treatment 2 (Only negative statements)			Treatment 3 (Only positive statements)		
	P	A	I	P	A	I	P	A	I
Img1	5	1	3	5	1	3	4	1	3
Img2	5	1	1	5	1	2	4	1	4
Img3	5	1	1	5	1	4	4	1	2
Img4	4	1	3	4	1	3	5	1	2
Img5	5	1	3	5	1	4	4	1	4
Img6	5	1	2	5	1	1	5	1	2
Img7	4	1	4	4	1	3	4	1	4
Img8	4	1	4	4	1	5	4	1	4
Img9	4	1	4	4	1	4	4	1	4
Img10	4	1	3	4	1	4	4	1	4
Img11	4	1	4	4	1	3	5	1	3
Img12	5	1	3	5	1	2	5	1	2
Img13	5	1	3	5	1	2	5	1	2
Img14	5	1	3	5	1	2	5	1	2
Img15	5	1	2	5	1	4	5	1	2
Img16	5	1	4	5	1	1	4	1	3

P: Pro-Aquaculture, A: Anti-Aquaculture, I: Intermediate.

treatment. Thus, it can be concluded that the choice of treatment used has the largest impact on the identification of the Intermediate cluster.

Ternary plots were also drawn up to improve the understanding of respondents' distribution amongst the three clusters for treatments 2 (Fig. 3) and 3 (Fig. 4). The ternary plots represent graphically the distribution of respondents by the weights of their membership functions for each cluster. In other words, the graph gives us an overview of the distribution of respondents across the three clusters.

For both treatments 2 (negative information) and 3 (positive information), it can be observed that there is an important group of respondents belonging to the intermediate cluster. However, in treatment 3, there is a considerably higher number of respondents situated in the small triangle of the right vertex where is situated the imaginary pure intermediate representative. This triangle is characterized because the complementarity probability is split between the other two clusters: “pro-aquaculture” and “anti-aquaculture”. Moreover, for both treatments 2 and 3, there is a similar number of respondents in the small triangle of the left vertex, where those pure Pro-Aquaculture respondents are situated. Meanwhile, judging from the number of respondents located in the top small triangle, it looks like there are more anti-aquaculture respondents in treatment 3 in comparison to treatment 2 which, in principle, seems to be quite counterintuitive. Moreover, in both treatments, it looks like respondents are laying in the line that joins the intermediate cluster with both the Pro-Aquaculture and Anti-Aquaculture clusters, but there seems to be more quantity of respondents for treatment 3 in both cases (in-between Pro-Aquaculture and Intermediate, and Anti-Aquaculture and Intermediate). Given the previous, it can be concluded, that treatment 3 offers a distribution of respondents leaning more clearly towards the intermediate cluster, in comparison to treatment 2.

5. Discussion

5.1. Mixing positive and negative statements or not on Likert-scale instruments analysing the acceptance of aquaculture and its products

We found that when the mean responses of block 1 (Negative image sense) were reversed to be compared with block 2, we obtained that for all attributes, the reversed information of block 1 was lower in magnitude than the information of block 2. This shows that if negative information is provided to respondents, aquaculture is rejected more highly, and the consequence is that if reversed, the respondent becomes less in agreement with aquaculture compared to when the information is positive. In other words, the negative perception of respondents towards

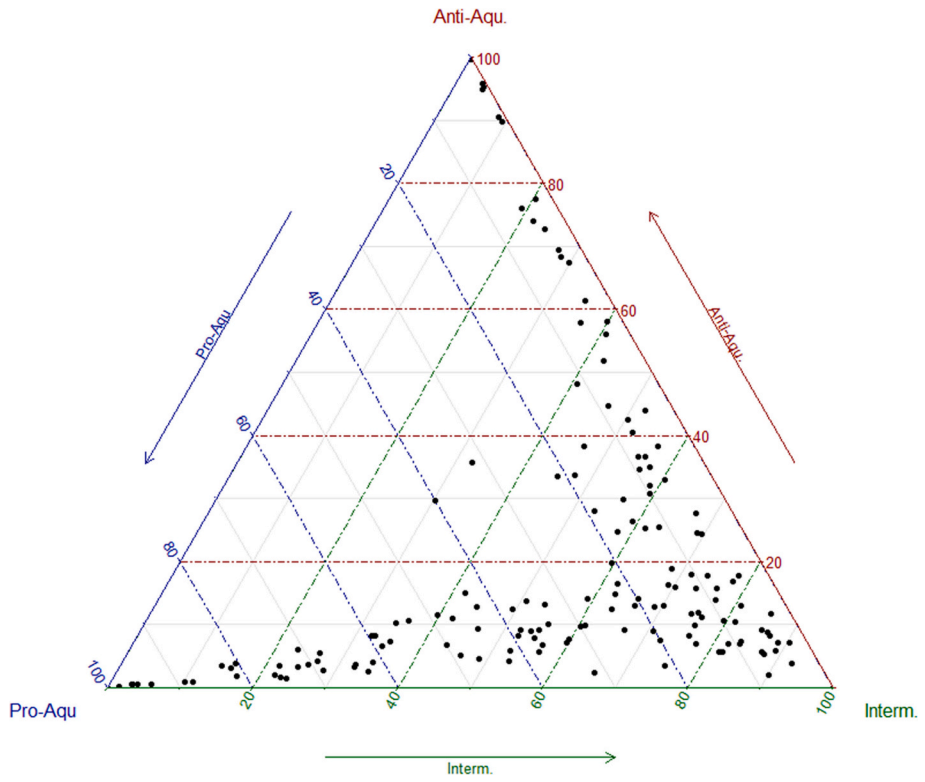

Fig. 3. Aquaculture image ternary graphs. Fuzzy hybrid segmentation – Treatment 2 (negative information).

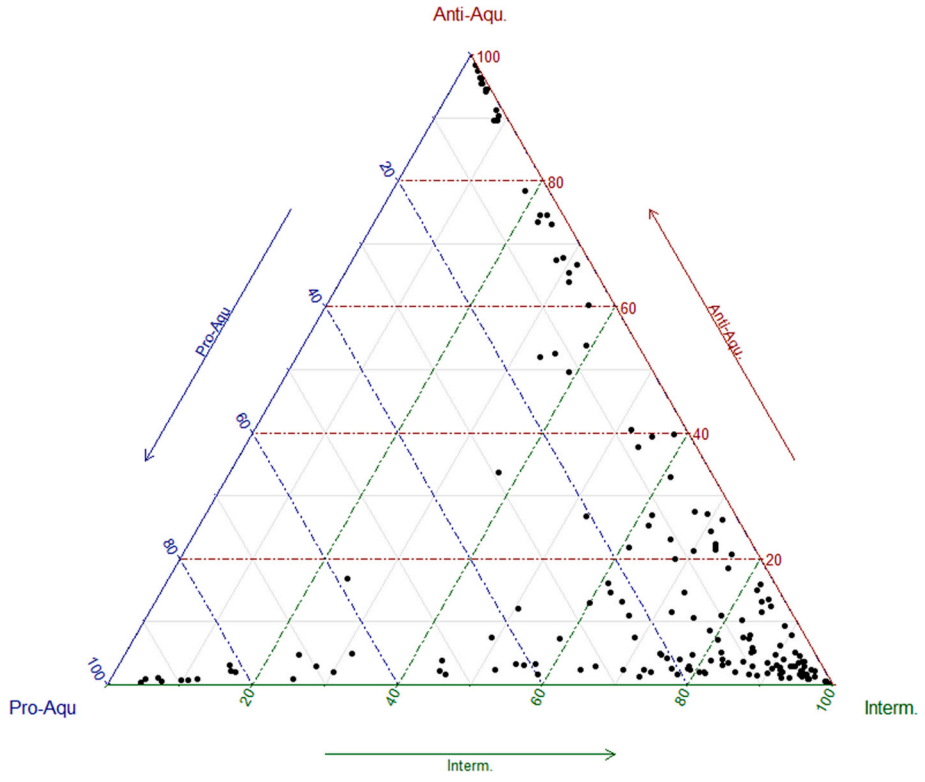

Fig. 4. Aquaculture image ternary graphs. Fuzzy hybrid segmentation – Treatment 3 (positive information).

aquaculture is higher if the information is negatively presented, which is an effect that will considerably affect the results. Thus, it can be concluded that it is not appropriate to include negative statements on Likert-scale instruments when researchers assess the acceptance of aquaculture and its products. These results line up with the investigation of Solís Salazar (2015) and Suárez-Álvarez et al. (2018), who found significant differences in mean values whether the test items were regular, reversed or combined, finding that respondents tend to disagree

more with reversed items than agree with regular items.

In addition, for the variances, we have seen that, in most cases, when negative information is used, the variance of the attributes is higher, suggesting that data are less reliable when negative statements are included because the response variability increases. Similarly, we found that when the information of negative statements is reversed for statistical analysis, the reliability and validity of the data get compromised and the variability in the responses increases. The data with positive statements, on the other hand, retained their validity and reliability. This might be due to consumers understanding better positively worded statements, while those negatively worded might be confusing. This also indicates that it is not the same to ask questions in a positively worded manner as to ask them in a negatively worded manner. This result is in line with Suárez-Álvarez et al. (2018), which contended that the cognitive process used by respondents when asked about regular and reversed objects is not the same. In general, the differences in the mean responses and the variances of the treatments are the main causes of the variability in the Synthetic indicators obtained with the Hybrid Fuzzy TOPSIS methodology.

Moreover, regarding the finding that there is a very weak non-significant correlation between treatments 2 and 3, it can be concluded that negative statements when reversed do not measure the same as positive statements. This could be explained by taking into account that the use of positive statements seems to measure how positive or well the perception of aquaculture and its products is, while negative statements lean more towards understanding how bad or negative is that perception. Given this, when the negative statements are reversed, they still measure how far from negative is the perception of aquaculture and its products, which is considerably different to understanding how positive is that perception. As a result, we can conclude that using positive statements would be more appropriate if the objective is to understand how positive the perception of consumers of aquaculture is, while the use of negative statements would be recommended to assess how bad is the perception of aquaculture and its products. In addition, our results show that it is not appropriate to mix both positive and negative statements to understand the acceptance of aquaculture and its products, and to deal with acquiescence bias, it should be better to use different types of positive wording statements, but always using positive image statements towards aquaculture.

5.2. Discussion of results from treatment 3

The results of treatment 3 (positive information), which is the most reliable based on what was previously discussed, provide key insights for improving the acceptance of aquaculture and its products. However, results should be analysed with caution, given that the sample used was obtained using an online survey, and although 96% of the Canarian households account for internet access (Canary Islands Telecommunications and Information Society Observatory, 2021), our sample does not seem to be representative of the whole island. Although there are no statistics on the population associated with consumers of seabream and seabass in Gran Canaria, we would expect that the sample will not differ from the complete population of the island.

We found that, according to the Spanish National Institute of Statistics (2016), the population of Gran Canaria for inhabitants above 15 years old, is dominated by people above 55 years old (31.5%), followed by those between the ages of 25 and 34, and 35 and 44, in which each group accounts for around 20% of the population. In addition, the population of the province of Las Palmas (which includes the island of Gran Canaria) is represented by a population of just around 22.6% of inhabitants accounting for at least a university degree, while the majority of the population has an educational level of high school with Laboral insertion (around 50.8%) (Spanish National Institute of Statistics, 2016).

Given this, it is clear that our sample does not represent well the population of the whole island, as our sample is mainly formed by groups ages between 18 and 35, and between 46 and 55, and highly educated respondents with at least a university degree. As a result, our results on the perception of aquaculture and its products are more representative of a relatively younger and highly educated sector, but which is also worth studying. Moreover, the results could also be used by researchers, academics, and institutions to guide future research.

Following the results obtained, according to the crisp values, the three most valued items are as follows: fish farming contributes to fish mass sustainability (55.37), fish coming from aquaculture are consistent and affordable (54.99) and fish coming from aquaculture are a healthy food option (52.83). As a result, in the approach of younger and highly educated consumers, marketing campaigns towards the consumption of aquaculture products in Gran Canaria should highlight the healthiness of the products, consistency and affordability, as well as sustainability features. Moreover, concerning the sustainability of the products, several investigations have found that consumers are willing to pay for sustainable products incorporating ecolabels (Cantillo et al., 2020). Thus, the existence of more sustainable aquaculture products in the market might enhance the acceptability of aquaculture, especially if the contribution to fish mass sustainability is highlighted.

In addition, one of the important features of aquaculture products is their affordability. Studies have demonstrated that there is a lower frequency of consumption of fishery and aquaculture products if they have a relatively higher price or cost. In consequence, the fact that aquaculture products are perceived as affordable might be a positive aspect to highlight for promoting a higher frequency of consumption and a higher acceptance. However, other studies have associated the lower cost of aquaculture products in comparison to products of fisheries, as a sign of lower quality (Altintzoglou et al., 2010; Claret et al., 2014; Vanhonacker et al., 2011), thus, the highlighting of the lower price should be accompanied with a declaration and demonstration of quality.

Lastly, regarding the healthiness of fish and seafood products, these products are usually seen as healthy because of many benefits such as their high levels of omega-3 fatty acids, protein and low-fat content (Arvanitoyannis et al., 2004; Birch and Lawley, 2012; Brunsø et al., 2009; Hall and Amberg, 2013; Stefani et al., 2012; Verbeke et al., 2007). In addition, some studies show that consumers are willing to pay extras for products that highlight benefits such as heart function (Banovic et al., 2019; Lim et al., 2018) and brain function (Banovic et al., 2019) improvement. As a result, producers should focus on producing aquaculture products that contribute to improving customers' health and satisfaction with them, translating into a higher acceptance of aquaculture products.

On the other hand, the three least valued items for aquaculture image are related to: fish farming is a natural process (38.41), the crowded conditions of fish farms are good for fish (40.01) and wild-caught fish have a natural diet, which is not good for them in comparison with farmed fish. (40.38). Interestingly, the three least valued items are related to fish conditions and this result can be considered strategically to improve the aquaculture image. Therefore, it is required that producers adopt practices that are perceived as more animal friendly to customers. To cope with this, organic production methods might be a good alternative to enhance the preference of younger and highly educated consumers for aquaculture products (Ankamah-Yeboah et al., 2019; Mauracher et al., 2013; Olesen et al., 2006, 2010; Stefani et al., 2012).

The results of treatment 3 indicate that there is a better acceptance of aquaculture and its products for the respondents belonging to the following segments: prefer farmed fish over wild fish, prefer products of EU origin, consider that the information accompanying the products is unclear, consider salmon as one of their favourite species, earn lower than the national average, live with 2 or more children at home, buy their products in supermarkets, and are part of the youngest (below 25 years) and oldest generation (above 66 years). On the contrary, there is a lower acceptance of aquaculture and its products for respondents

belonging to the following segments: consider seabream as one of their favourite species, prefer wild fish over farmed fish, do not read the information accompanying the seafood products, buy their products at food markets, have a very low educational level, live in a small household, earn more than the national average, and are part of the generation between 26 and 35 years of age. Stakeholders of the aquaculture industry should look for solutions to increase the acceptance of aquaculture for these segments. Moreover, there were no clear tendencies for attributes such as the living municipality, the frequencies of consumption, gender, and marital status.

According to the fuzzy clusters, it can be said that the profile of an extreme Pro-Aquaculture consumer is characterized by a consumer who perceives all the attributes at the maximum or second-maximum values. Meanwhile, extreme Anti-Aquaculture consumers are characterized for perceiving all statements on the scale at the lowest value. The intermediate cluster is characterized by (1) seven low-valued attributes with a value of 2, (2) three intermediate valued attributes with a value of 3, and (3) six high-valued attributes showing values of 4. Moreover, in treatment 3, the average probability of belonging to the "Pro-Aquaculture" consumer segment is 37.26%, for the "Anti-Aquaculture" consumer segment is 35.88%, and for the "Intermediate" consumer segment is 41.63%. Considering the previous, the biggest impact can be obtained if stakeholders look to address the issues that were related to the lowest score (2) for the intermediate cluster. These are the attributes "The crowded conditions of fish farms are good for fish", "Fish coming from aquaculture are raised in a cleaner and healthier environment than fish from fisheries", "Fish farming is a natural process", "Fish coming from aquaculture have more flavour than fish from fisheries", "Fish coming from aquaculture have more quality than fish from fisheries", "Wild-caught fish are not better than farmed fish for living in a natural habitat", and "Wild-caught fish have a natural diet, which is not good for them in comparison with farmed fish". These issues are mostly related to the conditions of fish on the farms, the naturalness of the fish farming process and the quality of aquaculture products. Consequently, stakeholders in the industry should look to promote positive aspects of aquaculture regarding these issues to promote a higher acceptance of aquaculture for younger and highly educated consumers on the island.

6. Conclusions

The current study aimed to understand the impact of positively and negatively worded items in surveys using Likert scales that look to assess consumers' acceptance of aquaculture and its products. Also, the investigation aimed to obtain marketing strategies on how to improve the acceptability of aquaculture and its products for young and highly educated consumers on the island of Gran Canaria. The results showed that the inclusion of negative statements on Likert scale instruments evaluating the acceptability of aquaculture and products might not be appropriate for various reasons. First, we found that the negative perception of respondents towards aquaculture was higher if the information was presented negatively, implicating a significant impact on the results. Second, the variance of the attributes is higher in most of the cases when negative information is used, suggesting that data are less reliable when negative statements are included. Third, when negative statements are reversed to carry out statistical analyses, the reliability and validity of the data were compromised, and the variability in responses increased, whereas data with positive statements retained their validity and reliability even if reversed. Fourth and most importantly, reverse negative statements do not seem to measure the same as positive statements. As a result, we conclude that if the goal of the instrument is to understand how well consumers perceive aquaculture and its products, only positively worded statements should be used, and to deal with acquiescence bias, it should be better to use different types of positive wording statements, but always using positive image statements towards aquaculture. Also, we could conclude that the information coming from questions worded positively is not equivalent to recoding information asked in a negatively worded manner.

Moreover, our results revealed important insights into the acceptance of aquaculture and its products. However, given the sample obtained in our study, our findings should not be generalized, as these are more representative of young and highly educated consumers on the island of Gran Canaria. Results suggest that marketing campaigns towards the consumption of these products should highlight the healthiness of the products, their consistency and affordability, as well as their sustainability features, considering that these were the most valued items by consumers. In addition, the results concluded that aquaculture and its products are less acceptable to respondents from the following segments: consider seabream one of their favourites species, prefer wild fish over farmed fish, do not read the information associated with the products, buy products at food markets, have a very low educational level, live in a small household, earn more than the national average, and are between 26 and 35 years of age. Future studies must address the analysis of solutions to increase aquaculture's acceptance in the segments with less acceptance.

We identified three clusters for consumers: Pro-Aquaculture, Anti-Aquaculture and Intermediate. While the first two clusters are in the extremes (perceived most attributes at the maximum or minimum values), there is more heterogeneity in the intermediate cluster, which is also the largest consumer segment. The lowest valued issues for this intermediate cluster are related to the conditions of fish in farms, the naturalness of the fish farming process and the quality of aquaculture products. Future research should focus on using similar instruments and methods of analysis with a more representative sample and see if there are variations in the findings of the current study.

The principal limitation of the study relates to data collection. The surveys were distributed online to students and staff members of the Las Palmas de Gran Canaria University, and although the survey could be shared with other individuals outside the university context, as clarified in emails, it is not possible to identify how many of the respondents were not related to the university, compromising the representativeness of the population. In fact, it is highly probable that most respondents were somehow related to the university, as the sample was formed by a high number of university students as well as a high number of respondents with a university degree, which is not representative of the whole population of the island of Gran Canaria, and as a consequence, the results cannot be generalized to the whole population, but rather to the relatively young and highly educated segment. Also, considering that this investigation was part of another study that looked to determine the preferences for seabream and seabass products in Gran Canaria, a convenience sample was used, requiring all respondents to consume these products and to be responsible for buying food in their households. For future research, one important aim is to surpass that major limitation of the study by extending the sample to more segments of the population in Gran Canaria as well as to more EU and world regions.

Data availability statement

The data that support the findings of this study are available from the corresponding author, J. Cantillo, upon reasonable request.

Disclosure statement

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

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CRediT authorship contribution statement

Javier Cantillo: Conceptualization, Methodology, Formal analysis, Writing – original draft. **Juan Carlos Martín:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Validation, Supervision. **Concepción Román:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Validation, Supervision.

Appendix A. Appendix

A.1. Sample features

Tables A1 and A2 present the description of the sample according to the sociodemographic characteristics and consumption patterns, respectively. Results are presented for the total sample, for respondents answering negative statements and for respondents answering positive statements.

A.2. Descriptive statistics – Frequencies of the responses

Table A3 show the frequencies of the responses for the different statements. For constructing the data of this table, the information of block 1 (Negative image sense) was reversed to be added with the information of block 2.

A.3. Positive and negative ideal solutions

Tables A4, A5 and A6 present the positive and negative ideal solutions for treatments 1, 2 and 3, respectively.

Table A1. Sample features. Sociodemographic characteristics.

Category	Element	Percentages		
		Full sample	Block 1 (Only negative statements)	Block 2 (Only positive statements)
Age	18–25	28.8%	35.3%	22.8%
	26–35	18.5%	22.8%	14.7%
	36–45	11.4%	9.0%	13.6%
	46–55	23.9%	19.2%	28.3%
	56 or older	17.4%	13.8%	20.7%
Gender	Male	39.3%	40.1%	38.6%
	Female	60.7%	59.9%	61.4%
Marital status	Single	47.9%	54.5%	41.8%
	Married	34.8%	29.9%	39.1%
	Living with a partner	16.8%	15.0%	18.5%
	Widow	0.6%	0.6%	0.5%
Income	Below national average	13.7%	13.8%	13.6%
	Around national average	70.4%	73.1%	67.9%
	Above national average	16.0%	13.2%	18.5%
Education level	Primary school	1.4%	0.6%	2.2%
	High school	10.5%	14.4%	7.1%
	Technician degree	6.6%	5.4%	7.6%
	University degree	43.3%	47.9%	39.1%
	University postgrad	38.2%	31.7%	44.0%
Occupation	Independent worker	6.0%	6.6%	5.4%
	Public employee	39.0%	32.3%	45.1%
	Private sector employee	14.3%	17.4%	11.4%
	Student	36.2%	40.1%	32.6%
	Unemployed	2.0%	1.8%	2.2%
	Retired	0.9%	0.6%	1.1%
	Housekeeper	1.7%	1.2%	2.2%

Table A2. Sample features. Consumption patterns.

Category	Element	Percentages		
		Full sample	Block 1 (Only negative statements)	Block 2 (Only positive statements)
Frequencies of consumption of seafood and fish at-home	Never/Almost never	1.1%	1.2%	1.1%
	Sometimes in a year	1.4%	1.2%	1.6%
	Once a month	4.3%	3.6%	4.9%
	2 or 3 times a month	12.0%	14.4%	9.8%
	Once a week	43.3%	44.9%	41.8%
	2 or 3 times a week	37.0%	34.7%	39.1%
	Everyday	0.9%	0.0%	1.6%
Frequencies of consumption of seafood and fish outside-home	Never/Almost never	15.1%	15.0%	15.2%
	Sometimes in a year	32.2%	31.7%	32.6%
	Once a month	22.8%	25.7%	20.1%
	2 or 3 times a month	17.4%	16.2%	18.5%

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Category	Element	Percentages		
		Full sample	Block 1 (Only negative statements)	Block 2 (Only positive statements)
Frequencies of consumption of seabream and seabass	Once a week	10.5%	9.6%	11.4%
	2 or 3 times a week	2.0%	1.8%	2.2%
	Everyday	0.0%	0.0%	0.0%
	Never/Almost never	9.4%	10.2%	8.7%
	Sometimes in a year	31.1%	29.9%	32.1%
	Once a month	23.7%	25.1%	22.3%
	2 or 3 times a month	21.7%	21.0%	22.3%
	Once a week	11.1%	10.8%	11.4%
	2 or 3 times a week	3.1%	3.0%	3.3%
	Everyday	0.0%	0.0%	0.0%

Category	Element	Proportion in comparison to the full sample		
		Full sample	Block 1 (Only negative statements)	Block 2 (Only positive statements)
Species more consumed	Tuna	59.0%	58.7%	59.2%
	Hake	44.7%	46.7%	42.9%
	Seabream	38.5%	37.1%	39.7%
	Salmon	35.3%	32.9%	37.5%
	Seabass	25.6%	26.3%	25.0%
	Sole	21.7%	24.6%	19.0%
	Cod	17.4%	19.2%	15.8%
	Mackerel	14.2%	12.6%	15.8%
	Wreckfish	13.1%	13.2%	13.0%
	Sama	12.3%	13.8%	10.9%
	Other	17.4%	13.8%	20.7%
Locations to buy fish and seafood	Markets	55.0%	55.7%	54.3%
	Supermarkets	86.0%	86.8%	85.3%
	Fish companies	1.1%	0.0%	2.2%
	Fishers directly	5.1%	4.2%	6.0%

Table A3. Descriptive statistics. Frequencies of the responses.

Statement	Frequencies of the responses (%)				
	Totally disagree	Disagree	Neither disagree nor agree	Agree	Totally agree
Img1	11.68%	20.80%	38.18%	18.80%	10.54%
Img2	10.26%	18.23%	41.31%	25.07%	5.13%
Img3	15.95%	27.92%	32.48%	16.24%	7.41%
Img4	13.11%	22.79%	34.47%	22.79%	6.84%
Img5	13.96%	24.22%	33.62%	21.65%	6.55%
Img6	19.94%	26.78%	25.64%	19.66%	7.98%
Img7	9.40%	18.52%	30.77%	29.91%	11.40%
Img8	10.54%	16.52%	33.33%	28.49%	11.11%
Img9	13.96%	13.68%	30.20%	26.21%	15.95%
Img10	10.54%	17.66%	39.32%	25.36%	7.12%
Img11	9.12%	16.52%	45.87%	19.09%	9.40%
Img12	18.23%	22.51%	35.61%	15.10%	8.55%
Img13	15.95%	21.37%	37.32%	18.23%	7.12%
Img14	17.38%	28.21%	32.76%	13.39%	8.26%
Img15	19.37%	27.35%	29.34%	14.81%	9.12%
Img16	13.39%	25.36%	31.91%	21.37%	7.98%

Table A4. Positive and negative ideal solutions. Treatment 1 (Complete sample).

Statement	Positive ideal solution	Segment of the positive ideal solution	Negative ideal solution	Segment of the negative ideal solution	% of variation
Img1	63.41	It is not clear at all	28.33	Every day (Home)	123.80%
Img2	59.55	Once per month (Canned)	18.75	Almost never (Home)	217.58%
Img3	54.00	Sometimes per year (Home)	18.75	Almost never (Home)	188.00%
Img4	60.00	Every day (Frozen)	23.75	Almost never (Home)	152.63%
Img5	55.12	I prefer farmed fish over wild fish	7.50	Every day (Home)	634.96%
Img6	60.00	Every day (Other)	20.50	Primary	192.68%
Img7	71.25	Every day (Other)	40.00	Almost never (Home)	78.13%
Img8	71.25	Every day (Other)	36.67	Almost never (Canned)	94.32%
Img9	70.43	I prefer farmed fish over wild fish	40.71	2–3 times a week (Shellfish)	72.98%
Img10	63.05	I prefer farmed fish over wild fish	35.83	Every day (Home)	75.95%
Img11	63.41	It is not clear at all	29.17	Every day (Home)	117.40%

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(*continued*)

Statement	Positive ideal solution	Segment of the positive ideal solution	Negative ideal solution	Segment of the negative ideal solution	% of variation
Img12	62.14	2–3 times a week (A-H)	15.00	Every day (Home)	314.29%
Img13	62.33	EU preference	28.86	2–3 times a week (Seabream + Seabass)	115.96%
Img14	61.59	Once per month (Canned)	16.00	Primary	284.94%
Img15	67.50	Almost never (Canned)	15.00	Every day (Home)	350.00%
Img16	62.50	2–3 times a week (A-H)	20.50	Primary	204.88%

Source: Own elaboration.

Table A5. Positive and negative ideal solutions. Treatment 2 (Only negative statements).

Statement	Positive ideal solution	Segment of the positive ideal solution	Negative ideal solution	Segment of the negative ideal solution	% of variation
Img1	71.25	Once per month (Canned)	23.21	Technical degree	206.92%
Img2	63.33	Once per month (Home)	7.50	Almost never (Home)	744.44%
Img3	70.00	Once per month (Canned)	24.38	2–3 times a week (Seabream + Seabass)	187.18%
Img4	81.25	Once per month (Canned)	7.50	Almost never (Home)	983.33%
Img5	54.72	Sometimes per year (Frozen)	24.38	2–3 times a week (Seabream + Seabass)	124.50%
Img6	70.00	Sometimes per year (Home)	13.13	2–3 times a week (Seabream + Seabass)	433.33%
Img7	70.67	I prefer farmed fish over wild fish	22.50	Every day (Canned)	214.07%
Img8	70.00	Sometimes per year (Home)	21.67	2–3 times a week (Shellfish)	223.08%
Img9	69.50	I prefer farmed fish over wild fish	21.67	2–3 times a week (Shellfish)	220.77%
Img10	70.00	Sometimes per year (Home)	21.67	2–3 times a week (Shellfish)	223.08%
Img11	68.61	Once per month (Home)	21.67	2–3 times a week (Shellfish)	216.67%
Img12	64.64	Living alone	18.75	2–3 times a week (Seabream + Seabass)	244.76%
Img13	71.25	Primary	21.67	2–3 times a week (Shellfish)	228.85%
Img14	70.00	Sometimes per year (Home)	7.50	Almost never (Home)	833.33%
Img15	61.25	Once per month (Canned)	18.75	Primary	226.67%
Img16	65.89	Once a week (Seabream + Seabass)	7.50	Almost never (Home)	778.57%

Source: Own elaboration.

Table A6. Positive and negative ideal solutions. Treatment 3 (Only positive statements).

Statement	Positive ideal solution	Segment of the positive ideal solution	Negative ideal solution	Segment of the negative ideal solution	% of variation
Img1	92.50	It is not clear at all	28.33	Every day (Home)	226.47%
Img2	61.25	It is not clear at all	21.67	Every day (Home)	182.69%
Img3	60.00	Sometimes per year (Home)	15.00	Almost never (Home)	300.00%
Img4	60.00	Every day (Frozen)	21.67	Primary	176.92%
Img5	81.25	It is not clear at all	7.50	Every day (Home)	983.33%
Img6	70.00	Every day (Other)	15.00	Primary	366.67%
Img7	92.50	Every day (Other)	39.17	Once per month (Home)	136.17%
Img8	92.50	Every day (Other)	38.00	Almost never (Canned)	143.42%
Img9	81.25	It is not clear at all	42.67	Other	90.43%
Img10	70.00	Every day (Other)	35.83	Every day (Home)	95.35%
Img11	81.25	It is not clear at all	29.17	Every day (Home)	178.57%
Img12	64.17	2–3 times a week (A-H)	7.50	Primary	755.56%
Img13	58.50	EU preference	7.50	Primary	680.00%
Img14	61.94	Once per month (Canned)	7.50	Primary	725.93%
Img15	75.00	Almost never (Canned)	15.00	Every day (Home)	400.00%
Img16	64.17	2–3 times a week (A-H)	21.67	Primary	196.15%

Source: Own elaboration.

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