Journal of Insects as Food and Feed, 2022; 8 (5): 565-577

Wageningen Academic Publishers

Exploring edible insects' acceptance through subjective perceptions: a visual Q study

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Received: 27 January 2021 / Accepted: 16 August 2021

RESEARCH ARTICLE

Abstract

The practice of eating insects, known as entomophagy, is part of a regular diet for millions of people in Asia, Latin America and Africa. However, the use of insects as food is relatively new in Western countries. The present paper explores the willingness to adopt edible insects as food among Italian consumers using Q methodology. A sample of 'experts' (e.g. entomologists) and 'non-experts' (e.g. students and other researchers) formed the participant sample (P sample). Participants were asked to rank-order a set of 36 images of food dishes prepared using insects (Q sample). Results showed that visual appearance plays an important role in influencing consumers acceptance of insects as food. The Q analysis identified three distinct viewpoints or consumer profiles: Factor 1 'The Traditionalist'; Factor 2 'The Fast Food Addicted'; and Factor 3 'The Insectivore'. This study confirms that visible insects in food may be problematic for the more traditional viewpoint, while results for the other two factors identify possible avenues for better communicating insect-based food.

Keywords: consumers, edible insects, appearance, entomophagy, q methodology

1. Introduction

Food safety and environmental sustainability, the key emerging issues in food production and consumption, are expected to influence the food sector strategies (Belluco *et al.*, 2013; FAO, 2009, 2013). An expanding world population, which also implies people ageing, urbanisation, and globalisation, brought quantitative and qualitative food requirements changes (FAO, 2009; FAO/IFAD/UNICEF/WFP/WHO, 2018). Western dietary habits, spreading in developing countries, contributed to increased consumption of animal-based proteins and reduced food variety (Belluco *et al.*, 2013).

In this framework, changes in consumer food choices could positively impact the environment and reduce environmental damages related to food production (Aiking, 2011; Belluco *et al.*, 2013; De Boer *et al.*, 2013; Hartmann and Siegrist, 2017).

The reduction of animal-based proteins in favour of other protein sources (including insects) is considered beneficial for the environment in terms of biodiversity, climate change, land and water use (Aiking, 2011; De Boer *et al.*, 2013; Hartmann and Siegrist, 2016, 2017; House, 2016; La Barbera *et al.*, 2018; Van Huis *et al.*, 2013). According to the life cycle assessment performed by Oonincx and De Boer (2012), insects-as-food production has a substantially lower environmental impact than other animal proteins. Moreover, insects are a nutritious source of proteins and cheaper than traditional animal proteins (FAO, 2013; Patel *et al.*, 2019; Van Huis *et al.*, 2013).

The practise of eating insects, known as 'entomophagy', is part of regular eating habits for millions of people in Asia, Latin America and Africa (Chakravorty *et al.*, 2013; Hanboonsong, 2010; Obopile and Seeletso, 2013; Sneyd and Q., 2013; Van Huis *et al.*, 2013; Verbeke, 2015). Nevertheless, in European countries, the interest in consuming insects is growing only in recent years (Jensen and Lieberoth, 2019; Lombardi *et al.*, 2019). The EU legislation is quite conservative regarding this novel food (Belluco *et al.*, 2013; La Barbera *et al.*, 2018). Only very recently, the European Food Safety Authority declared the safety of dried yellow mealworm (*Tenebrio molitor* larva) as a novel food pursuant Regulation (EU) 2015/2283 (Turck *et al.*, 2021). Besides, only a few EU countries have regulated the production and commercialisation of insects for human consumption (Mancini *et al.*, 2019a). However, there are still many legal issues regarding these regulations' compliance with the novel food Regulation (EU) 2015/2283 (La Barbera *et al.*, 2018), and the EU demand for insect-based foods remains very low.

Research findings show that Western consumers are cautious regarding the consumption of insects and, for them, none of the envisaged advantages associated to their consumption is a sufficient condition for their general acceptance (DeFoliart, 1999; Hartmann and Siegrist, 2016; Hartmann *et al.*, 2015; House, 2016; Jensen and Lieberoth, 2019; Mancini *et al.*, 2019b,a; Vanhonacker *et al.*, 2013; Verbeke, 2015).

Food neophobia, a personal trait that expresses the tendency of a person to avoid new or unfamiliar foods (Pliner and Hobden, 1992), is often reported as a reason influencing consumer acceptance of insects as food (La Barbera *et al.*, 2018; Lombardi *et al.*, 2019; Modlinska *et al.*, 2020; Sogari *et al.*, 2019; Tan *et al.*, 2015; Tuccillo *et al.*, 2020; Verbeke, 2015). In the Western context, the mere idea of consuming insects also evokes feelings of disgust (the so-called 'Yuck' factor); consumers don't even consider this new ingredient as 'edible' (Rozin, 2007; Rozin and Fallon, 1987). Disgust is the most significant barrier when considering insects as a food ingredient (Halloran *et al.*, 2018).

Researchers found that unfamiliarity and a lower sensory attractiveness of these new products compared to meat are the key barriers to consumption (Hoek *et al.*, 2011). In one study (House, 2016) affirmed that the acceptance of novel foods (like insects) 'is not simply a case of whether or not an individual will eat a particular product once, but also the extent to which that food becomes an accepted and integrated part of their established culinary regimes'. In other words, a radical change in the individual dietary habit cannot be obtained without envisaging a cultural and social change in Western society (Hartmann *et al.*, 2015; Shelomi, 2015). Other studies also suggested a general prejudice against insect-based food, which affect their liking more than their real taste (Caparros Megido *et al.*, 2016; Modlinska *et al.*, 2020; Tan *et al.*, 2016a).

Consumer research has shown that Western consumers attitude toward insects is often characterised by rejection for psychological reasons (Belluco *et al.*, 2013; DeFoliart, 1999; House, 2016; Jensen and Lieberoth, 2019; Tan *et al.*, 2017) and disgust (Halloran *et al.*, 2018). Little knowledge, lack of previous taste experience and high levels of food neophobia also generally hold for a scarce sensory appeal of insects as food (Gmuer *et al.*, 2016; Hartmann *et al.*, 2015; House, 2016; Ruby *et al.*, 2015; Schösler *et al.*, 2012; Tan *et al.*, 2017; Verbeke, 2015). Furthermore, consumers eventually prefer locally available insects, culturally accepted preparations expected to fit the insects' sensory properties (Tan *et al.*, 2015).

Willingness to eat insects is associated with product preparation, food processing and appearance (Caparros Megido *et al.*, 2014; Tan *et al.*, 2015; Tuccillo *et al.*, 2020). Using familiar preparations and creating more appealing insect-based products can increase both liking and willingness to eat novel foods like insects (Caparros Megido *et al.*, 2016; Deroy *et al.*, 2015; Hartmann *et al.*, 2015; Modlinska *et al.*, 2020; Pliner and Hobden, 1992; Tan *et al.*, 2016b). Hence, several studies showed how a poor appearance or an inadequate presentation of a food dish can effectively arouse a disgusting response from consumers (Hartmann *et al.*, 2015; Rozin and Fallon, 1987). Using insects as ingredients in aesthetically pleasing forms or preferred foods (like desserts) can encourage eating insects (Modlinska *et al.*, 2020).

According to literature, processed insects (e.g. insect flour), rather than those presented as a whole, may contribute to increasing hedonic ratings and consumption intention (Gmuer *et al.*, 2016; Hartmann *et al.*, 2015; Ruby *et al.*, 2015; Tuccillo *et al.*, 2020) and reduce the typically associated sense of disgust (De Boer *et al.*, 2013; Deroy *et al.*, 2015; Hartmann *et al.*, 2015; Schösler *et al.*, 2012). The insect visibility negatively affects the consumers' willingness to eat and purchase: as the level of visibility increases, the hedonic experience decreases (Ruby *et al.*, 2015; Schösler *et al.*, 2012; Tuccillo *et al.*, 2020). Often the mere presence of insects in food decreases the willingness to eat that preparation, due to the perceived contamination of the original fare (Rozin and Fallon, 1987). Schösler *et al.* (2012), when investigating readiness to adopt different types of meat substitutes, found that dishes prepared with visible insects were the least liked compared to others; consumers would pay the lowest price for insect-based dishes.

Another key driver for the consumption or rejection of insects in foods is health (Rozin, 2007). Many Western consumers believe that insects are harmful pathogens and food contaminants, which may contribute to the repulsion for this unfamiliar ingredient (Van Huis, 2013). Food safety issues are also associated with the extra-EU origin of many insect-based foods, representing another deterrent to consumption (Mancini *et al.*, 2019a).

Most of the studies on European consumers acceptance of insects as food appeared in the past ten years (Balzan *et al.*, 2016; Caparros Megido *et al.*, 2014, 2016; Cicatiello *et* *al.*, 2016; Gere *et al.*, 2017; Gmuer *et al.*, 2016; Halloran *et al.*, 2018; Hartmann and Siegrist, 2016; Hartmann *et al.*, 2015; Jensen and Lieberoth, 2019; Lombardi *et al.*, 2019; Modlinska *et al.*, 2020; Schösler *et al.*, 2012; Schouteten *et al.*, 2016; Sogari *et al.*, 2017; Tan *et al.*, 2015, 2016b; Tuccillo *et al.*, 2020; Vanhonacker *et al.*, 2013; Verbeke, 2015; Verneau *et al.*, 2016). Questionnaires and hedonic tasting are the most widely used approaches, compared to qualitative methods such as focus groups and interviews (Mancini *et al.*, 2019a). Behaviours, as well as consumer reactions to different insect food products, have been investigated, but consumer discourses as well as potential segmentation patterns are still largely unknown (Dagevos, 2021).

The aim of this study was to explore consumer acceptance of edible insects as food from a psychological standpoint to identify how different visuals may shape different consumer personalities (Stephenson, 1953), profiles or 'personas'.

A persona is a fictional and archetypal characterisation of a user or consumer created to represent a consumer group or segment (Miaskiewicz and Kozar, 2011).

Q methodology (Brown, 1980; McKeown and Thomas, 2013; Stephenson, 1935, 1936) and specifically, visual Q methodology (Naspetti *et al.*, 2016; Zanoli *et al.*, 2015) was applied to investigate knowledge structures regarding the visual appeal of both familiar and unfamiliar dishes prepared with visible and not visible edible insects as ingredients (Balzan *et al.*, 2016; Gallen *et al.*, 2019; Roma *et al.*, 2020; Tuccillo *et al.*, 2020).

Q methodology is especially suited to study individuals' subjective viewpoints towards various issues, including food perception (Fisher *et al.*, 2012; Iofrida *et al.*, 2018). This method is especially suitable in identifying potentially market-relevant discourses, in this case viewpoints towards insects as food that could lead consumers 'to integrate them in their diets' (House, 2016). These discourses characterise archetypal profiles of users or consumers.

Further, Q methodology allows to 'analyse subjectivity, in all its forms, in a structured and statistically interpretable form' (Barry and Proops, 1999).

Unlike common applications of factor analysis where the focus is to find correlations between variables across a sample of individuals, Q methodology focuses on discovering the correlations between individuals across a sample of variables. In Q methodology, factor analysis is applied to identify shared viewpoints – named 'discourses', 'factors' – on a specific topic by grouping people with similar opinions (Brown, 1980). Viewpoints or discourses as conceptualised by Stephenson are strictly connected to Bartlett's (1932) schemas (Gauld and Stephenson, 1967; Iran-Nejad and Winsler, 2000). A schema is an abstract or generic knowledge structure, stored in memory, that helps people to structure, organise and interpret new information (Crocker *et al.*, 1984). In advertising, schemas may be used to develop the product concept (East *et al.*, 2016).

Q methodology has been extensively applied to many research fields ranging from psychology, political science, agricultural research, environmental science, ecology (Barry and Proops, 1999; Brown, 1980; Mandolesi *et al.*, 2015; Naspetti *et al.*, 2016), and food (Eden *et al.*, 2008; Fisher *et al.*, 2012; Iofrida *et al.*, 2018; Kraak *et al.*, 2014; Yarar and Orth, 2018).

Among Q methodology most recognised advantages are its ability to identify the different patterns of opinions in a more systematic and efficient way than other qualitative approaches and its exploratory role, albeit statistically valid. Unlike standard surveys, its typical ranking process allows uncovering 'how different but related topics are interconnected and require to consider those topics simultaneously' (Zabala *et al.*, 2018).

The potential of this methodology is also linked to the possibility of measuring individual subjectivity without imposing *a priori* meanings (Watts and Stenner, 2005). Thus the Q ranking process is a 'self-referent' one; the participants, directly engaged in expressing their personal views, are not influenced by the researcher's view (McKeown and Thomas, 2013). Consumer experiments often serve a similar purpose but can only test predetermined hypotheses on the stimuli. Q method allows to let the subjective schemas emerge from the stimuli. However, as in qualitative studies, supplementary information that could be missed with standard surveys can be gathered with post-sorts interviews (Zabala *et al.*, 2018) to explain the quantitative results. Finally, Q methodology may be eventually combined with other methods, and its results can be used as a base for defining structured surveys.

The use of Q methodology, in summary, mitigates the limitations of both quantitative and qualitative methods used in previous studies of consumers' acceptance towards edible insects (Balzan *et al.*, 2016; De Boer *et al.*, 2013; Gmuer *et al.*, 2016).

In this study photographs of food dishes containing insects were preferred to statements because of their higher capacity to elicit emotional reactions compared to words (Azizian *et al.*, 2006). Neuroscience studies highlight that images are processed faster, embed multiple symbolic meanings and are more open to interpretation than words (Schlochtermeier *et al.*, 2013). Images are expected to elicit greater emotional reactions than verbal stimuli and provide a better proxy to a real sensory experience with food (Kiefer and Pulvermüller, 2012). Additionally, the use of images in

Q studies makes the sorting process easier and straighter compared to a ranking process based on reading sentences (Naspetti *et al.*, 2016). The use of visuals in Q methodology is a recent but consolidated practice (Chung and Kinsey, 2019; Fairweather and Swaffield, 2001; Naspetti *et al.*, 2016; O'Neill *et al.*, 2013; Thomson and Greenwood, 2017; Zanoli *et al.*, 2015)

In the following, we first describe this specific application of visual Q methodology to individuals' acceptance of insects as food in the Italian contest. The results, consisting of different viewpoints gathered from two different groups of consumers clustered by knowledge and experience, are then presented and discussed. Conclusions are drawn on how the identified discourses may help in increasing the acceptance of edible insects on the Western market.

2. Materials and methods

A Q study involves the following steps:
1. definition of a 'concourse';
2. selection of the items to sort ('Q sample');
3. definition of the 'P sample' (participants);
4. Q sorting 'process';
5. extraction of factors and interpretation.

The 'concourse' (step 1) contains the overall population of stimuli around the subject under investigation (Brown, 1980). Populations in Q methodology may be composed of statements, photographs, art objects, personality traits, and any stimulus that allow eliciting subjective behavioural responses to them (Brown, 1980; Stephenson, 1953). Stimuli can be obtained from several sources such as newspapers, scientific publications, social networks or interviews (McKeown and Thomas, 2013). To provide the widest range of situations to the participants, the concourse of this study consisted of over 100 photographs of food dishes prepared with edible insects. These images were collected by searching on food books and online sources or original photographs of different existing food images.

Later the 'concourse' was reduced to a manageable number of items following a structured sampling approach (McKeown and Thomas, 2013). This reduction was aimed to provide 'a miniature which, in major respects, contains the comprehensiveness of the larger process being modelled' (Brown, 1993). Usually, in order to achieve this goal, Fisher's experimental design principle (Fisher, 1960) is applied to obtain a final set of stimuli, forming a structured (not random) sample (Stephenson, 1953). This sample (step 2) is referred to as a Q sample (Brown, 1980). Nine categories were created to classify and select food images to be included in the final Q sample according to a factorial design (3×3=9-cell matrix) (McKeown and Thomas, 2013). The factorial design included three dimensions related to the visual appearance of the insects in the food: 'Larvae', 'Adult insects' and 'Processed (invisible) insects'. Each dimension had three levels, each one about the type of a typical Italian course menu ('first course', 'second course' and 'dessert'). Four images were selected for each cell of the sample matrix and had a balanced set of images. Thus, the final Q sample included 9×4=36 food images (see Table S1 for the entire Q sample). When possible, selected photos referred to traditional Italian dishes to contextualise the sorting and reduce rejection due to the unfamiliarity of the dish. To minimise possible bias, images were selected among those with the same size and resolution and were randomly numbered.

Q methodology, applying small-sample statistics, uses a person-sample – the P sample (step 3) – which is generally smaller than the Q sample (Brown, 1980; McKeown and Thomas, 2013; Van Exel and De Graaf, 2005). The P sample is not based on the sampling logic used in surveys. In surveys, samples are required to be representative of the population of potential respondents, to allow external validity. Any application of this sampling logic to a Q study would be misplaced. Q methodology follows a replication logic, analogous to that used in multiple experiments or case studies (Coleman, 2018; McKeown and Thomas, 2013; Yin, 2014).

In Q studies, 'the rule of thumb that larger [person] sample sizes are better does not necessarily apply' (Zabala *et al.*, 2018). Simple, pragmatic considerations, such as mere availability, often inform the selection of participants, which is non-random. In some cases, participants are selected following observable characteristics or according to snowball or convenience sampling (Zabala *et al.*, 2018). However, other – more systematic – criteria need to be met. Theoretical considerations often guide the factorial design of a P sample, marking the attempt to sample people of theoretical interests. Participants selection should guarantee that all potentially relevant perspectives are represented (Brown and Ungs, 1970) by including those that are likely to represent a particular perspective and 'to express a particularly interesting or pivotal point of view' (Watts and Stenner, 2012). As in experiments, innumerable replications of a Q study can be conducted under various conditions of experiment or instructions and different P samples. However, in Q methodology, the focus is not on the representativeness of sorters but the representativeness of the Q sample. Furthermore, increasing the number of participants is rarely necessary and 'increasing the number of persons on a factor merely fills up factor space, but has very little impact on the scores' (Brown, 1980).

In this study, the P sample was selected to include those participants 'theoretically relevant to the problem under consideration' (Brown, 1980) and guaranteeing a variety in the participant group. Participants involved were those with specific knowledge towards insects, that already had experience in consuming ('experts'), and consumers without any particular knowledge or experience, having different backgrounds ('non-experts'). The point was not to measure the prevalence or frequency of a particular phenomenon but to understand the differences in viewpoints and explain them in terms of visual acceptance. According to this, the sample of participants was composed of 11 individuals: four entomologists as 'experts' of insects and seven 'non-experts' recruited among students and other university staff. Participants were aged between 24 to 46 years and included four females and seven males.

Participants were asked to rank the images (step 4) – the Q sample – over the sorting grid according to a condition of instruction (from most liked to most disliked), following the shape of a quasi-normal distribution (Figure 2). Then, participants were asked to describe the rationale of their sorts in the most extreme columns of the sorting grid. This ranking procedure, known as 'Q sorting process', generates individual Q sorts that reflect the participants' subjective viewpoints. Each Q sort is like a picture that represents the 'individual's conception of the way things stand', and it is 'subjective and self-referent' because it only depends on the participant's view (Brown, 1980). By this sorting process, participants emphasise what is 'meaningful' from their viewpoints, providing personal configurations (called Q sorts) of their subjectivity that can only be interpreted *a posteriori* (Watts and Stenner, 2005).

The analysis of Q sorts (step 5) starts with the construction of the correlation matrix. Once collected, all Q sorts are inter-correlated in a correlation matrix, factor analysed (and, eventually, rotated) to systematically synthesise the results and search for similarity between them. By looking for correlations between participants, factor analysis attempts to reduce multivariate data down to a small number of relevant factors or perspectives. Each extracted factor is designed to capture a different viewpoint shared by participants who similarly ordered the items. Different factor types represent distinct patterns of response. Q sorts highly correlated with a specific factor are the 'defining sorts' (Eden *et al.*, 2005). The selection of the number of factors to extract can be quite arbitrary in the context of Q methodology (Watts and Stenner, 2005, 2012), even though some theoretical rules are suggested. This number can be chosen by selecting only those factors with an eigenvalue over 1.00, but it is possible to go below this minimum (Watts and Stenner, 2005). Another suggested strategy recommends selecting only those factors that have at least two Q sorts that load significantly upon it (Brown, 1980). According to Brown (1980), the number of factors to extract are those with at least two statistically significant factor loadings at the 0.01 level (i.e. those exceeding ±2.58 × standard error [S.E.]; with S.E. = 1/√ (no. of items)). Factor loadings in Q methodology represent the correlation between each Q sort and the factor.

In traditional factor analysis, factors are often rotated to a final solution with the aid of automated statistical routine like varimax or quartimax. The varimax rotation maximises the variance between factors. In Q methodology, these 'objective' routines are not discarded but often complemented with so called theoretical or judgmental rotation (Ramlo, 2016; Stephenson, 1953; Thompson, 1962). In judgemental rotation, the structure of the collected data is preserved, though the role of the investigator is emphasised since rotated factors provide information regarding 'which subjects' views are similar' (Brown, 1980). Judgemental rotation allows the theory and its interpretation to enter the rotation, providing a bridge between factor extraction and interpretation. From different theoretical perspectives, different strategies of rotation may suggest themselves (Brown, 1980).

Once extracted and rotated, factors are then interpreted, looking at all factor scores that indicate the correlation between each item of the Q sample with each factor. Factor scores are calculated as a weighted average of the scores given to a specific item by the Q sorts related to that factor (Zanoli *et al.*, 2015). It is important to note that a useful interpretation can be obtained focusing not only on those few items characterised by higher factor scores (i.e. items placed into the extremes of the distribution) but also on those items placed into the 'neutral' area of the Q sorting distribution.

Data collection

Before starting with the sorting process, all participants were informed about the presence of insects in the food images presented. According to the conditions of instructions of the experiment, participants were asked first to divide the images into three groups (those that they most liked; those that they most disliked; and those that they felt neutral about); then, they were asked to sort the 36 images into a forced quasi-normal distribution sheet, from 'most dislike' (-4) to 'most like' (+4) (Figure 1). Post-sort questions were also collected, especially in relation to the images at the ends of the scales that scored +4 and −4, to gain more information about the participants' sorts and enrich the information collected through the ranking.

3. Results

The 11 Q sorts were cross-correlated, and then a factor analysis was performed using the KADE software (Banasick, 2019). Centroid factor analysis (Thurstone, 1947) with varimax and judgemental rotation was applied to extract factors. The centroid method, albeit it is regarded as an approximation to more refined methods of factor extraction, produce virtually the same results of principal axes factoring or PCA. However, in Stephenson's approach, the centroid factor was actually preferred because of its inherent indeterminateness, which allows the use of

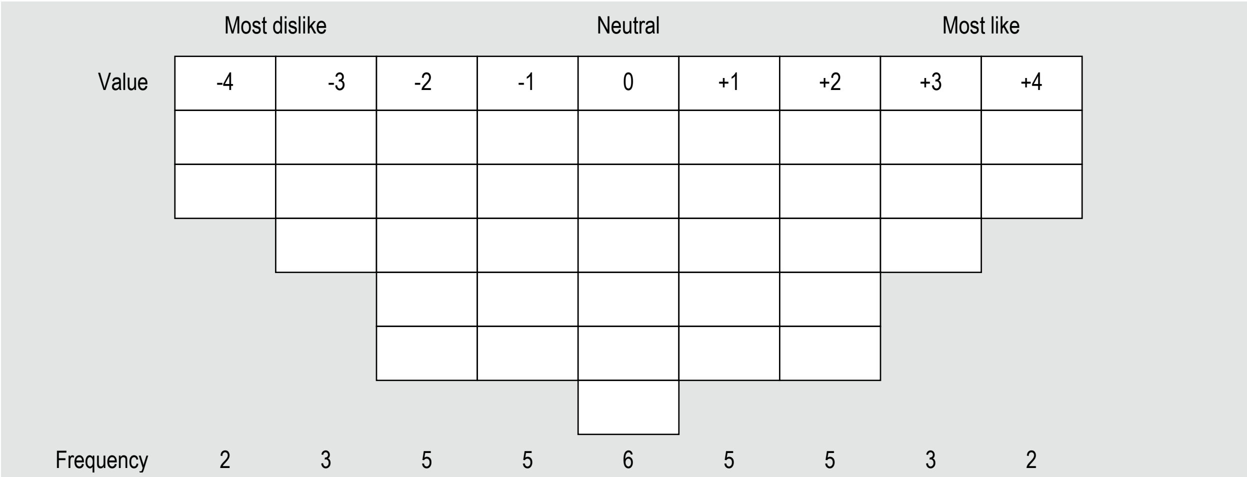


Figure 1. The quasi-normal distribution (sorting grid).

deliberate, theoretical rotation of factors 'so as to bring unexpected but not unsuspected results to light, that is to make discoveries' (Stephenson, 1961). Although both the Brown and Kaiser-Guttman criteria suggested extracting only two factors, a three-factor solution was preferred in this study (Brown, 1980). This choice was motivated by the need to provide a more comprehensive and wide-ranging representation of the existing viewpoints on the topic under investigation (Watts and Stenner, 2012). Moreover, the correlation between factors was relatively low (Table 1). This three-factor solution accounted for 62% of the study explained variance. The first factor, named 'The Traditionalist' accounting for the majority of the Q sorts and the explained total variance; the second factor, named 'The Fast-Food Addict'; and the third factor 'The Insectivore'. Factor loadings are shown in Table 2.

Factor 1 – 'The Traditionalist'

This factor accounted for 8 Q sorts (six males and two females) and 46% of the explained total variance. Only one Q sort was performed by an entomologist, while the others belonged to the 'non-experts' group. Items loading on this factor referred to food images in which insects were mostly hidden or highly processed. By contrast, those images presenting whole visible insects as an ingredient (both larvae and adult insects) were negatively evaluated (Table 3). The disgust towards those food images was also confirmed by participants in the post-sorts interviews specifying terms like 'too many insects', 'disgusting', 'it remembers me a horror scene of a movie', etc.

Moreover, participants loading on this factor expressed a higher level of acceptance for those foods in which edible insects were mostly hidden: cupcakes based on insect flour (Table 3: image 29*, +4)[1] and muffins (Table 3: image 30*, +4). For this viewpoint, the visual appearance of a food dish is very important, and the visibility of a whole insect as ingredient negatively impact their liking. This factor also believed that traditional Italian food (e.g. pasta or pizza) should not be combined with novel ingredients such as edible insects.

[1] In the brackets from this point on, there are the number of the image and the factor scores.

Table 1. Characteristics of the three rotated factors.

Characteristics	Factor 1 – The Traditionalist	Factor 2 – The Fast-Food Addict	Factor 3 – The Insectivore
Eigenvalue	5.0873	1.1637	0.5328
No. of defining variables (sorts)	8	2	1
% of explained variance	46%	11%	5%
Cumulative % of explained variance	46%	57%	62%
Correlation between factor scores			
Factor 1	1	-0.0289	0.0093
Factor 2	-0.0289	1	0.2057
Factor 3	0.0093	0.2057	1

Table 2. Factor matrix (defining sorts are flagged with an 'X').

Q sort	Expert 'E' – Non-Expert 'N'	Factor 1 – The Traditionalist		Factor 2 – The Fast-Food Addict		Factor 3 – The Insectivore	
Q1	N	0.844	X	-0.0907		-0.1262	
Q2	N	0.8186	X	0.0899		0.0114	
Q3	N	0.7667	X	-0.1316		0.1001	
Q4	N	0.7738	X	0.0851		0.2578	
Q5	N	0.926	X	-0.0782		0.0741	
Q6	N	0.8153	X	0.4125		-0.1183	
Q7	N	0.832	X	-0.1991		-0.0817	
Q8	E	0.0656		0.4677	X	-0.1187	
Q9	E	0.0176		-0.0016		0.5823	X
Q10	E	0.6514	X	0.2344		-0.115	
Q11	E	-0.1243		0.7065	X	0.2031	

Factor 2 – 'The Fast-Food Addict'

The second factor was defined by 2 participants (1 male and 1 female), both belonging to the 'experts' group, and accounting for 11% of the explained variance. People who loaded this factor did not dislike the idea of having specific insects in the preparations; only those that they perceive as inviting and less exotic. For example, participants loading on this factor liked fried grasshoppers (Table 3: image 14*: +4) and mealworms used to garnish a hamburger (Table 3: image 20*: +4). The female Q sort was relatively familiar with grasshoppers and mealworms because she already tasted them more than once. By contrast, insects like cockroaches were negatively accepted (Table 3: image 2, +4; image 22, -2). Post-sort interviews clarified that cockroaches as food appear disgusting even to 'experts'.

Factor 3 – 'The Insectivore'

This factor only accounted for one 'expert' (a female entomologist with limited previous insect-tasting experiences) and 5% of the explained variance. A factor, by definition, is a shared point of view, so a single sort can't represent a 'factor' in the usual sense of the way we use the word. However, Q Methodology is a study of subjectivity, and there is nothing to keep a researcher from being interested in and discussing a unique point of view, as represented by any individual Q sort. A factor representing the viewpoint of just one person is not unusual or problematic (Brown, 1980: 41). Stephenson (1964) suggested that often the most important factor, from a theoretical standpoint, could be the one that is defined by only one Q sort.

This consumer expressed a preference for food images including a variety of different kind of visible insects (usually larvae and adults) in traditional recipes: spaghetti (Table 3: image 2*, +2), soup (Table 3: image 3*, +3), fillet (Table 3: image 16, +1). Contrary to people loading in Factor 2, only accepting certain specific recipes and insects, this participant expressed visual appreciation for all different kind of insect-based food. Though the sorter ranked higher images of food dishes that were more familiar to her, she also ranked high those dishes that she found 'inviting': In her post-sort interview, with reference to all these images she declared: 'Those foods make my mouth water'.

4. Discussion and conclusions

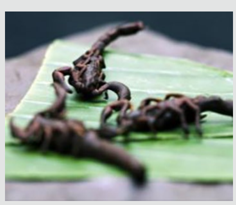
This study provided three empirically derived viewpoints that represent different schemas, i.e. generic knowledge structures towards the visual meaning of insect-based dishes. Each photograph included in the Q sample were ambiguous and allowed multiple subjective interpretations. People used different subjective schemas to 'give meanings' to the pictures, allowing three archetypal interpretative schemas to emerge. These schemas identify the discourses embedded in consumer profiles or personas and offer insights for visually communicating insect-based food.

These discourses or schemas are summarised by the three factors: Factor 1 'The Traditionalist'; Factor 2 'The Fast Food Addicted'; and Factor 3 'The Insectivore'. The first factor expressed a low level of acceptance; by contrast, the second and the third minor factor described a more positive attitude towards the use of insects as food.

As in previous studies (Caparros Megido *et al.*, 2016; Hartmann and Siegrist, 2016; Tuccillo *et al.*, 2020), appearance plays an important role in the acceptance of insects as food.

The results of this study confirm the general reluctance of Western consumers regarding the consumption of edible insects (Hartmann and Siegrist, 2016; Hartmann *et al.*, 2015; House, 2016; Verbeke, 2015). Unfamiliarity with

Table 3. Most distinguishing food images.[1]

	Factor 1 – The 'Traditionalist'		
like most	29* (+4) 	30* (+4) 	21* (+3) 
most dislike	11 (-4) 	20* (-3) 	7* (-3) 
	Factor 2 – Fast Food Addicted		
like most	14* (+4) 	20* (+4) 	35* (+2) 
most dislike	16 (-3) 	25 (-3) 	18* (-2) 
	Factor 3 – The Insectivore		
like most	3* (+3) 	2* (+2) 	16 (+1) 
most dislike	35 (-4) 	28 (-4) 	13 (-3) 

[1] Most distinguishing images at *P*<0.01 are marked with an asterisk. The signs preceding each factor score show agreement (+) or disagreement (-).

this novel ingredient and a low level of sensory appeal was often mentioned by most participants as the main barriers to consumption (Gmuer *et al.*, 2016; House, 2016; Pliner and Hobden, 1992; Tan *et al.*, 2017). This attitude may explain Factor 1 ('The Traditionalist') schema, implying acceptance of edible insects only as 'invisible' ingredients. Previous research showed that acceptance and willingness to eat insects increases when using processed (and invisible) insects (De Boer *et al.*, 2013; Deroy *et al.*, 2015; Gmuer *et al.*, 2016; Ruby *et al.*, 2015; Tuccillo *et al.*, 2020).

Different, and newer, lessons may be learned from Factor 2 and Factor 3, even if they represented a smaller number of Q sorts. Participants loading in these factors included only those familiar with eating insects and these factors exhibit higher rankings for food images in which insects were whole and well visible. Previous studies report that people familiar with eating insects generally show a lower level of disgust and food neophobia (Hartmann *et al.*, 2015). Caparros Megido *et al.* (2016) also reported that the greater familiarity of consumers with the consumption of insects increases their willingness to eat them.

In her post-sort interview the only participant loading in Factor 3 often used the term '*inviting*' or '*appetising*' to define some of the food images. In contrast with previous literature, the peculiarity of this factor relies on her willingness to accept bigger and creepier species like scorpions (Deroy *et al.*, 2015; Ruby *et al.*, 2015; Tuccillo *et al.*, 2020).

As counterevidence, results also indicated that the presence of insects in 'familiar' traditional recipes was not well accepted by 'The Traditionalist' factor (Factor 1). This result is only partially in contrast with other previous studies in which the use of familiar food is recommended in order to increase the willingness to take the first bite of foods prepared with unfamiliar ingredients (Schösler *et al.*, 2012; Tan *et al.*, 2015).

The viewpoint expressed by this single-sort 'factor' denotes the importance of the role of 'early adopters' in the diffusion of innovative foods, like insects. According to several studies, insects as a new food can gain popularity in a small group of the society (the 'early adopters'), before spreading among the others (Caparros Megido *et al.*, 2014; House, 2016; Verbeke, 2015). The initial curiosity for novel foods of those consumers could boost a high impact on the diffusion of insect-based foods. To overcome the general reluctance of eating insects in the West, their social appeal could be increased by promoting and increasing their exposure and occasion of consumption, for example, during collective tasting sessions (Jensen and Lieberoth, 2019; Mancini *et al.*, 2019b; Modlinska *et al.*, 2020; Shelomi, 2015; Van Huis *et al.*, 2013). Using food tasting campaigns in shops or supermarkets may help promote insects' consumption and, most importantly, to overcome the prejudice against this special ingredient (Modlinska *et al.*, 2020).According to literature (Hartmann *et al.*, 2015; Shelomi, 2015), increasing the adoption of insects as food requires a cultural and social change. With few exceptions, insects are not part of traditional food products in Italy and Europe. To some extent, innovations and exotic ingredients may reduce the original perceived value of traditional products, as it has been revealed by Factor 1.

Factor 2, exhibiting high rankings for images in which edible insects were presented as snacks or fast food (hamburgers, fried bites, sweets, etc.), indicate that an occasional, fun-related consumption could render insect-based food perceived as a treat, alleviate the 'yuck factor' and increase the acceptance of insect-based food. A similar mechanism could have been at work in the recent European sushi boom (Altintzoglou *et al.*, 2016). However, if traditional products of another ethnicity are introduced in a new market context, as in the case of insects and sushi, some hybridisation and localisation may be needed to ensure that they are acceptable to the majority of consumers in the new market (Sakamoto and Allen, 2011). Since personal experiences usually generate a highly significant impact on consumers' behaviour (Rozin and Fallon, 1987), increasing the exposure to edible insects in familiar contexts such as restaurants, canteens or food halls would have more impact than seeing them in more or less exotic TV programs (Jensen and Lieberoth, 2019; Mancini *et al.*, 2019b; Shelomi, 2015). Factor 2 is an expression of Stephenson's 'play theory': in his words, 'Q-factors are scientific models of sociability' (Stephenson, 1964), and communicating pleasure, enjoyment and fun in insect-based food would appeal at those who experience food as 'play', i.e. entertaining, and not as something that is just nourishing.

The study has some obvious limitations. The data collection has been concluded before insect-based food products could be legally available in the Italian market. Besides, the cultural context is limited to the Italian food culture as the person-sample included only Italian consumers.

Nevertheless, statistical inferences in Q methodology refer to the intra-individual differences between the stimuli and not the persons (Stephenson, 1953). Generalisations in Q methodology should be thought of in terms of the universe of subjectivity rather than in terms of the population of persons. Indeed, it is recognised that '… Q factors are themselves generalisations in which Q methodologists take the greatest interest; i.e. the factor arrays show how, in general, that persons of a particular type think about the issue under consideration. In a science of subjectivity, generalisations refer to the universe of subjectivity communicability, not to the facts of respondent characteristics' (Brown *et al.*, 2015: 534). Yet, the resulting factors of a Q study are usually 'entirely empirical and replicable' (Brown, 1980). The rules that provide a 'formal model' of subjectivity are associated with the collection of opinions defined as 'self-referent statements' (but also images or other raw material) and with the number of such items drawn from the diverse sources which define the Q sample (Brown, 1980).

Supplementary material

Supplementary material can be found online at https://doi.org/10.3920/JIFF2021.0016.

Table S1. The structured sample matrix of the Q sample.

Acknowledgements

This study was supported by the European Commission Horizon 2020 Research and Innovation Action (RIA) through the project 'SUStainable INsect CHAIN' – 'SUSINCHAIN', under grant agreement 861976 and by The Università Politecnica delle Marche through the Strategic Research Project 'Edible insects: new frontiers in food (FoodIN)'. The views expressed here are not in any way attributable to the European Commission or the University, as they are solely the responsibility of the Authors.

Conflicts of interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Ethical statement

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki and the ethical rules of the Università Politecnica delle Marche for consumer and socio-economic research.

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