



Consumer understanding of upcycled foods – Exploring consumer-created associations and concept explanations across five countries

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ABSTRACT

To secure future protein demand in a sustainable food system, protein needs to come from a variety of alternative and novel sources, amongst others otherwise wasted side-streams. Such upcycled food is yet relatively unknown to consumers which makes it difficult for producers to decide on the best approach to communicating the product benefit to consumers. In a unique mixed-methods approach, we quantify qualitative data from a consumer survey of 2,405 respondents in five European countries to explore which type of associations emerge to the new concept and explore examples of how consumers with different associations would choose to explain it to a peer. We also test whether abstract or concrete presentation of the concept and different types of framing of the benefit (climate, frugal and taste) influences the associations and explore how this differs among socioeconomic consumer groups. Results show that consumers have mainly positive associations about the concept of upcycled food using words like innovation, recycling, avoid food waste, sustainability, while negative association include terms like sceptical, dislike, disgusting. Concrete (rather than abstract) presentation of upcycled foods leads consumers to provide fewer negative associations. Depending on the type of benefit framing, consumers have different associations towards upcycled foods: A climate framing of upcycled food leads to associations of innovation and environment and appears to steer associations away from 'waste'. Moreover, socio-demographic characteristics affect consumers associations to upcycled foods; Overall, females and younger consumers are more positive. Findings provide insights into communication of upcycled food to different target groups.

1. Introduction

Global issues such as obesity and climate change lead to calls for a food system change (Swinburn et al., 2019). Due to the high greenhouse gas emissions (GHG) emitted by meat and dairy products, the shift from animal-based food to greater quantity and diversity of plant-based products and alternative protein sources plays a particularly important role (Bowles et al., 2019; Poore & Nemecek, 2018; Xu et al., 2021). Alternative proteins are those that emerge as the alternative to protein from meat and dairy and encompass diverse plant-based sources but also novel sources such as insects, grass, algae, fungi and microbes, and technological processes such as cultured meat and precision fermentation. Many sources of alternative proteins are potentially edible but yet

underused or only partly used, such as when side-streams occur in food production – as for example whey protein, brewers spent grain, or press cake in oil production. A lot of research is invested into upcycling such side-streams through waste-to-value approaches (Donner et al., 2020; Teigiserova et al., 2020), resulting in so-called upcycled food (Aschemann-Witzel et al., 2023). Upcycling as a process and upcycled food as a result are thus part of the topic of alternative proteins, as upcycling is part of the endeavour to increase the quantity and quality of alternative and more sustainable protein sources.

Societal barriers to sustainable innovations in the circular bio-economy might be a greater challenge than technological issues (Kirchherr et al., 2018). Consumer understanding, perception and acceptance will be crucial for a successful transition to more sustainable

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alternative proteins, including upcycled food. Research on consumer behaviour, marketing and market trends with regard to upcycled food has been steadily increasing over the past years (Aschemann-Witzel & Stangherlin, 2021). It is important to understand and then address consumer concerns and explain and communicate the benefits of upcycled food including protein products. So far, however, few research studies have incorporated more in-depth qualitative insights (see e.g. Altintzoglou et al., 2021; Combest & Warren, 2019), particularly not in the form of mixed-methods studies that combine the strength of the deeper insights with the strength of the quantification.

This study uses open ended questions within experimental survey data across five countries to explore consumer associations to upcycled food, to identify how these associations differ depending on benefit framing of the message or concrete or abstract presentation of the concept, as well as how sociodemographic groups differ in their pattern of associations to upcycled food. Results provide quantifiable insights into how to design communication approaches for upcycled food to different target groups.

2. Background and theory

2.1. Qualitative insights on consumers perception of upcycled food

A growing number of quantitative studies investigate consumer acceptance and attitudes towards upcycled foods (see for example, Asioli & Grasso, 2021; Grasso & Asioli, 2020; Aschemann-Witzel et al., 2022; Bhatt et al., 2020; Grasso et al. 2023). Some work has applied qualitative approaches in research with experts or food sector stakeholders (Spratt et al., 2021; Thorsen et al., 2022). However, few studies have explored consumer expectations, preferences, and opinions for upcycled foods more in-depth by for example using qualitative approaches (Aschemann-Witzel & Stangherlin, 2021).

For example, Combest and Warren (2019) applied focus groups to explore in-depth US American students' behaviour for upcycled foods made with Brewers' Spent Grains (BSG). They found that the concepts of sensory, health and experience with BSG were the most discussed topics, and the target consumers generally enjoyed BSG foods although with some remarks on sensory shortcomings. They also found that consumers who are accustomed to eating wholegrain, are acculturated to whole-grain sensory attributes and nutritional benefits, and thus were more receptive towards upcycled foods made with BSG. Furthermore, Henschion et al. (2016) explored Irish consumer evaluation of upcycled foods containing beef by-products (i.e. offals) as ingredients, also using focus groups as an approach. They found that perceived naturalness and current physical state of the products as well as trust in food safety emerged as very important but results also showed the impact of past consumer life experiences, demographics, and familiarity with the products. Consumer acceptance is linked to the alignment of ingredients with existing culinary practices, naturalness, and communication of sensory or other benefits. Altintzoglou et al. (2021) combined qualitative elements into a survey experiment, exploring first associations to seafood products containing by-products; Results showed more positive views towards seafood compared to cosmetics.

2.2. Sociodemographic differences in upcycled food perception

There is an increasing market for upcycled food (Bhatt et al., 2021). However, consumers might lack familiarity with the concept, can be insecure about safety, and could have negative associations (Aschemann-Witzel et al., 2022; Goodman-Smith et al., 2021; Coderoni & Perito, 2021; Grasso & Asioli, 2020), all demand-side barriers for a further increase (Aschemann-Witzel et al., 2022; Flammini et al., 2020; Perito et al., 2020). People tend to avoid unknown/unfamiliar products and foods could be rejected "because of what they are, where they came from, or their social history (e.g., who touched them or ate them)" (Martins and Pliner, 2005; p. 215). Research has shown that there are

differences in sociodemographic characteristics such as gender, age, education level and socio-economic status, when it comes to acceptance or rejection of the upcycled products.

According to Rahmani and Gil Roig (2018), purchase intention is lower among females than males. These results are similar to previous findings of Henschion et al. (2016), who found that young women displayed the most negative responses to the use of offal-based products. These results are consistent with Verbeke (2015) who noted that females were more likely to be negative regarding different novel foods. Some studies have shown that older generation are more open to the idea of consuming upcycled products due to their early life experiences with similar processing methods (Henschion et al., 2016). Aschemann-Witzel et al. (2022), however, showed the opposite: young people were more willing to accept upcycled foods than older people. Considering different generations, Zhang et al. (2020) found that generation X (Gen X) have a lower intention to purchase upcycled foods compared to Gen Z, Gen Y, and Baby Boomers.

In terms of level of education, being a graduate appears to be related to higher willingness to buy upcycled foods (Coderoni & Perito, 2020), especially for educated women (Perito et al., 2020). This is in line with previous studies showing that people with higher degrees of education are more open to new products and technologies (Evans et al. 2010; Vidigal et al. 2015), especially when the communication underlines the quality of upcycled foods (Aschemann-Witzel & Stangherlin, 2021; Zhang et al. 2020). In this context, Cattaneo et al. (2019) demonstrated that higher education increase consumer confidence regarding food by-products. However, consumers are only willing to pay a lower price for upcycled foods compared to conventional alternatives (Bhatt et al. 2020; Grasso & Asioli, 2020). Coderoni and Perito (2020) showed that consumers with a lower income have a higher purchase intention for upcycled foods because the latter considered cheaper than equivalent conventional products.

3. Abstract or concrete presentation or benefit framing and upcycled food perception

Researchers have been looking into how to communicate and phrase upcycled food, as this can determine which type of associations consumers have, how they understand and perceive the concept or product, and which attitude they express towards upcycled food. It has been shown that portraying and framing (Smith & Petty, 1996) upcycled food as something that is 'frugal' – thus, a product that allows to carefully manage resources, which is an important aspect of sustainability – leads to favourable consumer response (Aschemann-Witzel et al., 2022). Communicating the food waste avoidance aspect has been shown to improve perception (Altintzoglou et al., 2021), however, other research indicated that it might be better to avoid triggering associations to 'waste' (de Visser-Amundson et al., 2021).

Recently, Taufik et al. (2023) experimented with the degree to which the benefit is more or less concrete versus abstract, finding that concrete product communication led to more self-rewarding feelings related to the choice of upcycled food among respondents. Studying product information in terms of more general product concepts or specific product examples is relevant because product innovations are often communicated as product concepts until specific product examples are available. According to construal level theory (Trope & Liberman, 2011), the more general product concepts will be construed at a higher, more abstract level, and this entails more psychological distance. Specific product examples will be construed at a lower, more concrete level and with less psychological distance. To give an example from Trope & Liberman (2010), a concrete level could be specifying a cell phone, while an abstract level could be talking about a communication device. As they write "moving from a concrete representation of an object to a more abstract representation involves retaining central features and omitting features that by the very act of abstraction are deemed incidental" (Trope & Liberman, 2010, p. 2). What characterises the abstract level is

that it focuses more on the ‘why’ instead of the ‘how’; As they further explain: “each action (e.g., study for an exam) has a superordinate, abstract level, which answers the question of why the action is performed (e.g., do well) and a subordinate, concrete level, which provides the details of how the action is to be performed (e.g., read a textbook)” (Trope & Liberman, 2010, p. 3). Applying this to the case of upcycled food, explaining upcycled food as a concept of foods that is environmentally and climate friendly, or that is frugal and traditional, presents the concept in an abstract way that tackles the ‘why’, but showing and explaining concrete products and ingredients, makes the ‘how’ of eating more sustainable food very concrete.

Previous research suggests that the level of ‘construal’ influences consumers’ reasoning about the perceived information as well as their choices (Kardes et al., 2006; Liberman & Förster, 2009; van Dam & van Trijp, 2013). Higher-level construals are associated with representations of more distant choices and outcomes, while lower-level construals are associated with representations of more near choices and outcomes (Bar-Anan et al. 2006; Todorov et al., 2007). Further, more abstract representations are more related with considerations of *why* actions should be taken, while more concrete representations are more related to considerations of *how* actions should be taken (Liberman & Trope, 1998; Trope & Liberman, 2010; van Dam and Fischer, 2013). Relatedly, research found that salience of arguments against an action is increased at lower levels of construal, while arguments in favour of an action are more salient at higher levels of construal (Eyal et al. 2004; Shabnam et al., 2021; Trope & Liberman, 2010).

For the question of associations to upcycled food, the theory would suggest that a more general description of the concept will increase the salience of higher-order arguments towards upcycled food, while much more concrete, specific product examples will increase salience of arguments related to the consumption process. Interestingly, results by Taufik et al. (2023) tend to contradict this, but the use of consumer-generated associations can shed more in-depth light on this question. From the theory, one could also assume that associations to the concept or products of upcycling would refer more to the ‘why’ of actions when represented in an abstract way, and more to the ‘how’ when shown in a concrete way. In line with the theory, we propose that the type of associations will be more ‘why’-like, general and positive when consumers are exposed to product concept description - such as considerations about the positive impact on the environment. We expect that associations will be more ‘how’-like, specific and critical when exposed to specific product examples - such as uncertainties about the taste or the usage situation.

4. Methodology

4.1. Sample and survey

We recruited 2,405 adult participants from representative online panels of a market research agency following the ESOMAR professional standards for an online survey experiment across five European countries, namely, United Kingdom, Denmark, Germany, Portugal, and Italy. These countries were chosen to represent countries of Southern versus Northern Europe. Quotas applied on age, gender, and region. Participants never or rarely doing household food shopping and taking less than 3 min to complete the survey were screened out. The study was pre-registered and approved by the University Research Ethics Committee. A sub-share of the data (only concrete product examples) and an analysis focusing on other variables (framing impact on attitude) has been presented in Aschemann-Witzel et al. (2022); In this study, the focus is on exploring a qualitative question on associations and their quantitative difference between experimental groups who saw either the general concept of concrete products or different framings.

At the beginning of the survey, respondents assessed familiarity with different terms used to explain of upcycling. Then, they were shown the product stimuli following an experimental survey design, stated their

general attitude measured with three items (Eating/drinking these products is extremely good / bad; I am strongly against / for eating/drinking these products; I dislike/like eating/drinking these products), and assessed their intention to purchase. Thereafter, the two open questions in focus in this study were asked: First, participants were prompted to indicate and write down which words spontaneously came to their mind while looking at the concept or product examples of upcycled foods, and second, to write how they would explain the concept or products to a sceptical friend. Participants were instructed to provide words, terms or statements, as many they could offer and were explained that there was neither right nor wrong answers. Each participant was allowed to write up to 10 words.

4.2. Product stimuli and experimental design

In line with previous research testing different communicational approaches including health and climate/environmental arguments as well as either concepts or concrete products (for example Asioli and Grasso, 2021; Taufik et al., 2023; Aschemann-Witzel and Peschel, 2019), an experimental between-subjects design was applied using three framing conditions (climate vs. frugal vs. taste) explaining the benefits of upcycled foods, and two construal levels (high construal level - upcycled food as a concept vs. low construal level - concrete product examples). The first experimental condition related to “climate” framing emphasized on the environmental and climate benefits of the upcycled foods. The second experimental condition referred to “frugality” and explained it in terms of an “ancient tradition” where all parts of the foods are used. Both were based on sections of the definition introduced by the Upcycled Food Association. Finally, the third condition related to “taste” and underlined the taste properties. All stimuli consisted of both pictures and text. The two construal levels differed in that in the high construal level condition, only the definition of the concept of upcycled food was presented, with pictures supporting the benefit framing, while in the low construal level condition, the definition of the concept was accompanied by five concrete upcycled food product examples, with pictures of the products (see Fig. 1).

4.3. Qualitative and quantitative data analysis

The data analysis follows a unique combined qualitative and quantitative approach, in that qualitative data on consumers associations (the first open question) was coded, quantified, explored whether the experimental set-up of how upcycled food was presented influenced consumers associations, and results of quantifiable relevance then exemplified with consumer quotes on how they would explain it to sceptical friend (the second open question).

The associations provided by participants across different experimental conditions were extracted as an excel file. We coded the associations of each participant into as many codes as appeared appropriate, adding a new column for each. That means one participant could be coded to have mentioned associations of multiple types. Both codes and sub-codes were generated for different themes expressed in the associations. In the process of coding, the data was ordered in alphabetical sequence as well as searched for themes, and then codes reviewed as suggested by Braun and Clarke (2006). Thus, inductive coding procedure was applied to capture the complexity, diversity and give “voice to the data”. This was followed by a discussion to reach a consensus regarding the generated themes. To account for reliability and validity, four criteria with regards to qualitative trustworthiness have been applied, and thus credibility, transferability, dependability and confirmability of the research assessed (Lincoln and Guba, 1993). The 29 codes and sub-codes were in English. Each language, however, was coded in its original language by one author who is either native speaker or speaks the language at professional level and cross-checked by a second author.

Further quantitative content analysis was performed. Frequencies of

Abstract construal level

Upcycling food is an approach aimed to reduce the negative environmental impact and fight climate change. It is about smart and efficient natural resource use to have a positive impact on the environment.

Upcycled foods use ingredients that otherwise would not have gone to human consumption. This reduces food waste.

The pictures on the right represent why upcycled foods are produced. What do you think about this idea?



Upcycling food is an ancient tradition based on the philosophy of using all of what you have. It's about doing more with less, and elevating all food to its highest and best use.

Upcycled foods use ingredients that otherwise would not have gone to human consumption. This reduces food waste.

The pictures on the right represent why upcycled foods are produced. What do you think about this idea?



Upcycling food is an approach for creating high quality, nutritious food products with even better taste to enjoy.

Upcycled foods use ingredients that otherwise would not have gone to human consumption. This reduces food waste.

The pictures on the right represent why upcycled foods are produced. What do you think about this idea?



Concrete construal level

Upcycling food is an approach aimed to reduce the negative environmental impact and fight climate change. It is about smart and efficient natural resource use to have a positive impact on the environment.

Upcycled foods use ingredients that otherwise would not have gone to human consumption. This reduces food waste.

The pictures on the right show upcycled foods. How do you feel about buying or eating these products with fibre and protein from ...

Rye bread with spent grain from beer brewing
Crisps with oilcake from oil pressing of sunflower, rapeseed and hemp

Muesli bar with berry skin from smoothie pressing

Protein drink with whey from cheese production

Chocolate oat cookie with used coffee ground



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Fig. 1. Stimuli in the abstract versus concrete construal level condition. Note: Visualisation from the survey in the UK. The first row is the climate, the second the frugal, and the third the taste framing. The concept explanation in the concrete construal level is the same as in the abstract construal level, but followed by concrete products and ingredients. A detailed explanation of the benefit framing can be found in [Aschemann-Witzel et al. \(2022\)](#).

elicitation were compared of different words provided by participants in each of the defined category and subcategory. Only those categories mentioned by at least 2.5 % of the participants were included. This cut-off was chosen so that at least 50 observations were available for each category. To explore whether the experimental design had an influence on the type of associations, chi-square tests were conducted to account for differences in participants' associations in different experimental conditions. To exemplify consumers own phrasings, we then looked at respondents within an experimental condition who had expressed a specific association that emerged as relevant and give examples of how they would explain the concept to a 'sceptical friend' in their own words.

Then, also differences in emergence of associations were tested for different sociodemographic variables. Further, we also tested whether attitude to upcycled food differed depending on whether it was presented as a concept, thus abstract, or with concrete ingredients and products.

5. Results

5.1. Types of associations

In this section, we present the results of all the types of associations provided by the 2405 participants. An overview of the codes and their percentage is displayed in [Table 1](#).

Overall, we can observe that respondents' associations emerged as predominantly positive. These positive associations were coded into different themes that are clearly positively associated, as well as into words that merely express the positive assessment. Because negative comments were rarer, we introduced a code for any negative comment, whether it was simply a negative assessment, a negatively associated

theme, or an otherwise neutral theme that was phrased in a way that it had to be understood as negatively connotated. Further, the emerging themes show that positively associated associations majorly relate environmental sustainability and the innovativeness and ingenuity of efficient recycling and food waste avoidance, negative associations express scepticism, dislike and disgust, and the associations that are neutral (or only negative or positive in specific context) mainly relate to nutritional and gustatory aspects and the word 'waste'.

The "Praise" code, without further explanation of why upcycled food are 'good', has the highest share of mention (16.4 %). The 'innovation' code (a predominantly positive association) emerged for 13.3 % of respondents and examples of words to describe the upcycled food were 'trendy', 'innovative idea' as well as 'genius'. The other main positive associations, taken into consideration by more than 10 % of the respondents, are 'recycling' (e.g., 'reuse') and 'avoid food waste' (e.g., 'reduce food waste'). The 'environment' (e.g., 'good for the environment') and 'sustainability' (e.g., 'sustainable production') associations were chosen by 9.9 % and 9.1 % of respondents, respectively.

The predominantly negative associations are mostly connected to the codes 'sceptical' (e.g., 'unsure' or 'seems strange'), with a relatively low percentage of respondents (5.4 %). Furthermore, straightforward aversion towards upcycled food was expressed overall by only a limited number of respondents. Specifically, 2.6 % of the respondents wrote words coded a 'dislike' association (e.g., 'do not care' and 'bad') and 2.5 % a 'disgust' association (e.g., this food 'sounds disgusting').

Finally, we verified other associations, which are by and large neither negative nor positive or first emerge as such in the context of words or text written by the respondent. These related mainly to the 'nutrition' and 'taste' codes, with words like e.g. 'looks healthy', with 'interesting nutritional content', this food has 'lots of additives' or, they

Table 1
List of codes, explanation, and examples, and share of mention by respondents.

| Code | Explanation of code or alternative words | Example quote | % of respondents |
|---|--|---|------------------|
| Do not know | Do not know/Unrelated answer or without meaning/asking questions/ commenting on pictures | “Nothing” “Do not know what this is” | 9.5 |
| Negative comments | Comment with a clearly negative connotation (not further explained as well as including those specified, then double coded) | “Boring” “Too creative” “Not good” | 11.1 |
| Praise | Praise and positive comments without further explanation of why it is ‘good’ | “Thaís good” “Ok for me” | 16.4 |
| Primarily positive associations: | | | |
| Innovation | Innovation/creative/innovative/new/different/ ingenious/alternative/future/ trend/modern/new thinking | “Trendy” “Progress” “Innovative idea” “Genius” | 13.3 |
| Recycling | Recycling/Reuse | “Reuse” | 11.3 |
| Avoid food waste | Writing about avoidance of food waste | “Reduce food waste” | 10.7 |
| Environment | Environment/environmentally friendly | “Good for the environment” | 9.9 |
| Sustainability | Sustainability/sustainable | “Sustainable production” | 9.1 |
| Efficient | Efficiency/t, smart, makes sense, needed, save | “Sensible use of leftovers” | 6.2 |
| Interesting | Interesting/Inspiring/curious/fun | “Interesting” “I am curious” | 4.6 |
| Primarily negative associations: | | | |
| Sceptical | Sceptical/unsure/risk/fraud/do not trust | “Unsure” “Seems strange” | 5.4 |
| Dislike | Dislike | “Do not care” “Bad” | 2.6 |
| Disgusting | Disgusting/Gone bad | “Sounds disgusting” | 2.5 |
| Other associations: | | | |
| Nutrition | Nutrition, Health/y | “Looks healthy” “Interesting nutritional content” “Lots of additives” | 9.7 |
| Taste | Tasty/Taste/looks good/depends on taste | “Unique taste” “If taste is ok I would eat it” “Does not look appealing” | 6.3 |
| Waste | Mention of the word waste without writing ‘food waste’, in negative or positive connotation | “Waste from other production” | 4.7 |
| Price | Price/cheap/expensive (mention of price in some way or other) | “Cheap reuse of waste” | 3.5 |
| Examples | Mentioning examples of food categories from the study or other | “Bread” | 3.3 |
| Resources | Resources, Earth | “Resource use” | 3.0 |

Note: From the 29 codes, only those are listed above who are mentioned by at least 2.5% of the respondents. The codes not listed above are as follows: Quality 1.8%, Artificial/chemical/plastic/unnatural 0.8%, Organic 0.2%, Strange 1.9%, Getting used to/needs getting used to it, become familiar 0.9%, Traditional/archaic/frugality/as at home 1.3%, Hunger/FoodSafety/3. World 0.7%, Climate 1.1%, Natural/Nature 1.8%, Responsible 1.6%.

have ‘unique taste’, ‘if taste is ok I would eat it’, or this food ‘does not look appealing’. Specifically, in the ‘nutrition’ code we find 9.7 % of the respondents, while in the ‘taste’ code there are 6.3 % of the respondents.

5.2. Impact of presentation of upcycled concept on types of associations

We explored whether the type of presentation of the upcycled food concept led to different associations. Firstly, we tested a few selected associations for which one would, based on construal level theory, expect differences: We expected that respondents in the high construal level, being presented the upcycled food concept, more likely react with general (operationalised as the ‘Do not know’ code) or general as well as positive (operationalised as the ‘Praise’ code) associations. We expected that respondents in the low construal level condition will be more specific and critical (operationalised as the ‘Negative comments’ code). In the high construal level conditions, 11.7 % of respondents expressed that they do not know what it is or made unrelated comments, and in the low construal level condition this was 8.4 %. A Pearson Chi-Square test showed that the relation between these two variables was significant ($\chi^2(1, N = 2405) = 7.038, p = .008$). There were no differences in the extent to which respondents had associations of unspecified ‘praise’. However, the high construal level triggered relatively more negative associations ($\chi^2(1, N = 2405) = 5.872, p = .015$): 13.3 % of respondents wrote a comment with a clearly negative connotations, compared to only 10.0 % in the low construal level condition, when concrete products were shown. The results indicate that a concrete presentation of upcycled food by example products leads to less negative connotations in associations, and also less likely leads to unrelated associations or comments on not knowing what this is.

Second, we explored the same for the different types of framing. There were no significant differences for ‘I do not know’ and for negative comments, but significant differences for ‘praise’ ($\chi^2(1, N = 2405) =$

8.221, $p = .016$). Indeed, of those who as association wrote something coded as ‘praise’, 40.0 % made this type of comment in the climate benefit framing, compared to the frugal and the taste condition with 29.1 % and 30.9 % respectively. This result suggests that a non-specified ‘praise’ more likely follows after the concept has been framed as a climate contribution.

We then tested differences for all other types of associations, based on the assumption that different benefit framing should impact the type of associations that emerge. The results are listed in Table 2. Among the primarily positive associations, words coded as ‘innovation’ and ‘environment’ were significantly more often named in the climate benefit framing condition. Comments coded as being ‘sceptical’ emerged most often in the taste framing condition. Moreover, the taste framing condition also led to relatively more associations related to ‘nutrition’ and ‘taste’, but also ‘quality’. A comment on ‘waste’ was significantly less likely made in the climate framing condition compared to the frugal and taste framing; In addition, comments relating to ‘tradition’ and ‘responsible’ were more often among respondents who had seen upcycled food presented in a frugal framing. These findings indicate that the climate framing leads associations towards ‘innovation’ and ‘environment’ and away from ‘waste’, while a taste framing triggers thoughts on ‘nutrition’, ‘taste’, ‘quality’ and also expressions of being ‘sceptical’. Meanwhile, the frugal framing leads to associations on ‘tradition’ and being ‘responsible’.

5.3. Explanation in own words

To provide examples of how the benefit framings and subsequent types of associations are expressed in the respondents’ own words, we selected respondents who saw the same type of benefit framing and whose associations had been coded as a type significantly more frequent for this framing. Then, we inspected the answers these respondents had

Table 2
Differences in frequency of association between benefit framing conditions.

| Association | Df | N | χ^2 | p | Nr | % Climate | % Frugal | % Taste |
|------------------|----|------|----------|--------|-----|-----------|----------|---------|
| Innovation | 2 | 2405 | 19.380 | <0.001 | 321 | 44.5 | 26.2 | 29.3 |
| Recycling | 2 | 2405 | 1.442 | 0.486 | 272 | 32.0 | 35.3 | 32.7 |
| Avoid food waste | 2 | 2405 | 5.671 | 0.059 | 257 | 28.0 | 37.7 | 34.2 |
| Environment | 2 | 2405 | 27.472 | <0.001 | 237 | 48.9 | 23.2 | 27.8 |
| Sustainability | 2 | 2405 | 1.085 | 0.581 | 218 | 30.7 | 34.4 | 34.9 |
| Efficient | 2 | 2405 | 4.680 | 0.096 | 149 | 26.2 | 38.3 | 35.6 |
| Interesting | 2 | 2405 | 1.833 | 0.400 | 110 | 37.3 | 34.5 | 28.2 |
| Sceptical | 2 | 2405 | 6.203 | 0.045 | 130 | 34.6 | 23.1 | 42.3 |
| Dislike | 2 | 2405 | 2.920 | 0.232 | 63 | 23.8 | 38.1 | 38.1 |
| Disgusting | 2 | 2405 | 2.246 | 0.325 | 60 | 36.7 | 23.3 | 40.0 |
| Nutrition | 2 | 2405 | 6.594 | 0.037 | 233 | 30.9 | 27.5 | 41.6 |
| Taste | 2 | 2405 | 10.975 | 0.004 | 151 | 25.8 | 27.8 | 46.4 |
| Waste | 2 | 2405 | 6.959 | 0.031 | 113 | 23.0 | 40.7 | 36.3 |
| Price | 2 | 2405 | 0.371 | 0.831 | 83 | 31.3 | 34.9 | 33.7 |
| Examples | 2 | 2405 | 4.736 | 0.094 | 80 | 25.0 | 42.5 | 32.5 |
| Resources | 2 | 2405 | 5.451 | 0.066 | 72 | 44.4 | 20.8 | 34.7 |
| Tradition | 2 | 2405 | 8.679 | 0.013 | 32 | 21.9 | 56.3 | 21.9 |
| Quality | 2 | 2405 | 10.478 | 0.005 | 44 | 25.0 | 18.2 | 56.8 |
| Responsible | 2 | 2405 | 6.056 | 0.048 | 38 | 28.9 | 50.0 | 21.1 |

Note: The data shows results of Pearson Chi-Square tests. The percentages indicate how many of those whose association was coded as this type, had been presented with the respective framing condition. All test results are shown for associations that have been mentioned by at least 2.5% of respondents; The sequence is the same as in the previous table (first primarily positive, then primarily negative, then the remaining association types). For associations mentioned by less than 2.5% of respondents, only significant results are given. The Nr is the number of respondents in total that wrote an association of this type.

given to the second open question, phrased as ‘Please write in your own words, how you would explain this concept / these products to a sceptical friend.’ We identified examples of consumer explanations that reflect the respective code and chose quotes that contained greater elaboration than just a few words. We did so in each respective language and translated it, of these, we give examples in the below.

In the climate benefit framing condition, 141 respondents had written word associations coded as ‘innovation’. Quotes to the question on how to explain it to a friend that reflect the use of words such as ‘innovation’ and ‘intelligent’ are for example these explanation by an Italian respectively Portuguese respondent:

“The future is in recycling and saving, we need to use these types of innovative production!” (Italian respondent)

“Intelligent reuse with benefits for the environment and local economy!” (Portuguese respondent)

The following quote from a Danish respondent also shows how the idea is portrayed as ‘forward looking’ the idea is, and the person also includes taste as an argument:

“Making the most of resources is the way forward. The better the use, the less the climate impact. And in the end, it depends on the taste!” (Danish respondent)

We then looked at respondents who had used words coded as ‘environment’ in their association to upcycled food. In the climate benefit framing condition, 116 respondents had written word associations coded as ‘environment’. Explanations of the concept to a ‘sceptical friend’ from respondents that reflect this are for example:

“Food ingredients that would otherwise have gone to waste are put to use. Good for the environment, and good for us. With an emphasis on “food ingredients” - not just ingredients..... So I’m thinking things that would NOT otherwise have ended up in food...” (Danish respondent)

“It is an important action that would make it possible to use natural resources efficiently, preserving the environment and allowing us to fight climate change, the cause of many natural disasters.” (Italian respondent)

A much shorter and concise explanation was provided by this German respondent, who also emphasised that the product is otherwise ‘normal’:

“It’s a normal biscuit and you’re helping to improve the environment and reduce waste.” (German respondent)

Among respondents who had seen upcycled food presented in the taste framing we chose those consumers whose associations we had coded as ‘sceptical’. Among these 56 respondents, we identified explanations of the concept to a friend that express this scepticism in relation to ‘nutrition’, ‘taste’, or ‘quality’. Quotes from respondents that reflect this are shown below:

“Food waste is sterilized and then processed to look ‘appealing’ again.” (Danish respondent)

“I’m afraid of their quality. But I’ve been told it depends on where and who makes them.” (Portuguese respondent)

“Basically, its food made with second hand ingredients.” (UK respondent)

Additional text written by consumers show that a source of scepticism is lack of information and not enough knowledge yet about processing and products, as in the following example:

“I would need to know more about what these foods are and what they are made of.” (German respondent)

Finally, we explored explanations in the respondents’ own words to a friend, now among those who had seen the frugal benefit framing, and whose associations we had coded as ‘tradition’ or ‘responsible’. Taken together, 38 respondents had written associations coded respectively. Quotes from respondents that reflect this are for example:

“To do experiments in the kitchen it is normal, dishes that are part of our tradition are often the result of mistakes or creative experiments. So, it seems to be a good option to integrate some foods into other foods that would risk being discarded.” (Italian respondent)

“It’s entirely healthy & normal to use ingredients in this way that would otherwise (scandalously) just go to waste. We should all be doing more to consume products like this to save vital resources & reduce waste.” (UK respondent)

This Danish respondent began to elaborate on the own household behaviour in response to the question:

“Once I have invested time, resources, money, etc. in food and food production, I never throw it out again unless it has germs in it. I enjoy being creative and innovative and thinking, what can I use it for or

I'll throw it in the freezer. At the moment I throw asparagus peel in the freezer for the next time I have soup or make vegetarian stock.” (Danish respondent)

These qualitative examples of how respondents rephrased their understanding of the concept in own words allow a deeper understanding of what lies behind the quantitative relations between the benefit framing and the resulting associations among consumers.

5.4. Sociodemographic differences in use of associations

Previous studies shows that there are differences in perception and acceptance of the upcycled food concept among different sociodemographic groups. Therefore, we explored differences in the type of associations between gender, age, and education. All types of associations listed in table 2 were tested, but only significant results are mentioned in the following.

Exploring **gender differences**, we find that males were slightly more likely to give answers coded as ‘do not know’ than females ($\chi^2(1, N = 2405) = 3.871, p = .049$; from among male respondents, 10.7 % gave such answers versus 8.3 % among female respondents). Females were more likely associating ‘smart’ to the upcycled food concept ($\chi^2(1, N = 2405) = 4.699, p = .030$; females 7.2 % versus 5.1 %). Meanwhile, males were more likely expressing associations coded as ‘interesting’ ($\chi^2(1, N = 2405) = 6.438, p = .011$; males 5.7 % versus 3.5 %). Females were more likely mentioning words coded as ‘responsible’ ($\chi^2(1, N = 2405) = 5.727, p = .017$; females 2.2 % versus 0.9 %) and at the same time, they also mentioned the word ‘waste’ more often ($\chi^2(1, N = 2405) = 5.771, p = .016$; females 5.7 % versus 3.6 %) as well as significantly more often wrote about food waste avoidance ($\chi^2(1, N = 2405) = 15.549, p < .001$; among females 13.1 % versus 8.1 % among males). Females also significantly more often associated ‘environment’ with the upcycled food concept ($\chi^2(1, N = 2405) = 4.339, p = .037$; females 11.1 % versus 8.5 %).

Exploring the three **age brackets** 18–34, 35–49, and 50–75 years, we find that negative comments are more often found among the older respondents ($\chi^2(2, N = 2405) = 33.040, p < .001$; with 6.3 % negative comments among the younger, 10.8 % the middle, and 15.1 % of respondents among the older age bracket writing associations coded as negatively connotated). The same holds for ‘sceptical’ associations (which are majorly included in the former) ($\chi^2(2, N = 2405) = 26.693, p < .001$; with 2.2 %, 5.3 %, and 7.9 %, respectively), as well as for ‘disgusting’ ($\chi^2(2, N = 2405) = 8.693, p = .013$; with 1.5 %, 2.1 %, and 3.6 %) which seems to increase with each age bracket.

The opposite, in turn, can be seen for ‘efficient’, which is more often coded among younger and middle-aged respondents ($\chi^2(2, N = 2405) = 7.945, p = .019$; with 7.3 % and 7.4 % among the young and middle age group, versus 4.5 % among the oldest). Similarly, ‘recycling’ emerges more often among respondents of younger age ($\chi^2(2, N = 2405) = 15.494, p < .001$; with 14.5 %, 11.7 %, and 8.5 % ranging from young to middle to older age bracket). Also, ‘sustainability’ appears more top of mind among younger respondents ($\chi^2(2, N = 2405) = 9.069, p = .011$; with 11.0 %, 9.9 %, and 7.0 %), and the same pattern is seen for ‘environmental’ ($\chi^2(2, N = 2405) = 26.294, p < .001$; with 14.4 %, 8.5 %, and 7.3 %). Younger respondents were more likely to mention food or product examples in their associations ($\chi^2(2, N = 2405) = 34.572, p < .001$; with 6.5 %, 1.5 %, and 2.2 %).

Associations coded as ‘nutrition’ were more often among the relatively younger ($\chi^2(2, N = 2405) = 9.157, p = .010$; with 12.0 %, 9.9 %, and 7.7 %), while associations coded as relating to ‘taste’ seemed more often among the middle age bracket ($\chi^2(2, N = 2405) = 7.063, p = .029$; with 4.8 %, 8.2 %, and 6.2 %), with a similar pattern for ‘quality’ ($\chi^2(2, N = 2405) = 7.570, p = .023$; with 1.7 %, 3.0 %, and 1.1 %).

Interestingly, ‘responsible’ is more often coded among the younger age group ($\chi^2(2, N = 2405) = 15.669, p < .001$; 3.0 %, 1.2 %, 0.7 % from younger to older). Unsurprisingly, though, comments coded as

‘tradition’ came from respondents in the older age bracket ($\chi^2(2, N = 2405) = 6.605, p = .037$; 0.9 %, 0.7 %, 2.1 % from younger to older).

Looking at respondents with or without a **higher education**, that is, a university education, it emerges that unspecified ‘praise’ is more likely among those who do not have a higher education ($\chi^2(1, N = 2405) = 9.637, p = .002$; without 18.4 % versus with high education 13.6 %). However, those with a higher education were more likely to express associations such as ‘innovative’ ($\chi^2(1, N = 2405) = 6.377, p = .012$; without 11.9 % versus with 15.4 %), ‘interesting’ ($\chi^2(1, N = 2405) = 10.932, p < .001$; without 3.4 % versus with 6.3 %), ‘sustainability’ ($\chi^2(1, N = 2405) = 31.949, p < .001$; without 6.3 % versus with 13.0 %), ‘environment’ ($\chi^2(1, N = 2405) = 5.811, p = .016$; without 8.6 % versus with 11.6 %), ‘resources’ ($\chi^2(1, N = 2405) = 4.103, p = .043$; without 2.4 % versus with 3.8 %), and ‘responsible’ ($\chi^2(1, N = 2405) = 4.439, p = .035$; without 1.1 % versus with 2.2 %).

5.5. Impact of presentation of upcycled concept on attitude

We tested whether attitude towards upcycled food differed, depending on whether respondents had been presented with upcycled food as a concept (high construal level) or as concrete examples (low construal level). An independent samples t-Test was conducted for this purpose. Attitude tended to be more favourable in the low construal level condition ($M = 4.85, SD = 1.41 (n = 1603)$) compared to the high construal level condition ($M = 4.74, SD = 1.52 (n = 802)$), but the difference is not significant ($t(1504) = 1.720, p = .086$ (equal variances not assumed)). We tested the same question for the three types of benefit framing presented in both the high and low construal level presentation. A one-way ANOVA was conducted to compare attitude in dependence of climate, frugal, and taste framing, followed by a post-hoc test. Although the ANOVA result is significant at $p > .05$ ($F(2, 2402) = 3.234, p = .04$), post-hoc Scheffe test does not identify a significant difference between the three conditions. Attitude tended to be more favourable in the climate ($M = 4.87, SD = 1.44$) and the frugal benefit framing condition ($M = 4.87, SD = 1.38$) compared to the taste framing ($M = 4.71, SD = 1.50$), but insignificantly so ($p = .086$). The results indicate that the type of benefit framing or concrete versus abstract presentation do not necessarily result in differences in overall attitude towards upcycled food.

6. Discussion

In this manuscript, we explored consumers’ associations to the concept of upcycled foods in five European countries through a mixed-methods study combining qualitative and quantitative approaches. We present results on which types of associations emerged, how the share of these differed depending on whether products were presented in abstract or concrete way as well as on which benefit framing was used, give examples of consumers own explanations in line with predominant associations, and explore sociodemographic differences. We discuss selected findings in the following.

6.1. Types of associations

First, findings show consumers react with predominantly positive associations. That consumers react with overall mainly positive associations about the concept of upcycled food is corroborated by a previous qualitative study by Combest and Warren (2018) who found that consumers generally ‘enjoyed’ the upcycled foods, as well as Altintzoglou et al. (2021), who showed that consumers in general responded positively. However, there is so far little research using qualitative methods or open-ended questions within quantitative approaches, thus little insight on which types of direction associations take that are voiced or written to the concept in general or products more specific. It is interesting to note that from the fewer negative associations, many were coded as expressing scepticism and often were about the taste and

quality. This reflects that consumers expect foods to be good in taste and safe as well as nutritious, but also that they did not have a chance to assess this aspect, therefore lack knowledge and experience about how well it tastes and which ingredients or nutrients these foods have. Thus, it needs more research on improving sensory aspects of upcycled food or consumer behaviour experiments that include consumers being able to test the actual products or read the ingredient list, to provide a more complete picture of consumer perception and ultimately adoption.

6.2. Effect of benefit framing and concrete versus abstract presentation on types of associations

Second, we found that the benefit framing impacted the type of associations. In particular, the 'climate' benefit framing creates more positive associations. This is in line with previous research, such as e.g. [Grasso and Asioli \(2020\)](#) who found that environmental and food waste prevention were the most relevant reasons for consumers buying upcycled foods. This aspect speaks to an important purchase motive, as well as to a topic that many consumers value and would like to support. Associations to the climate benefit framing were general praise, but also 'innovation' and 'environment', thus potentially showing how upcycled food is understood as a new innovation. Interestingly, it appears as if thoughts in direction of 'environment' and 'innovation' seem to lessen the salience of associations about 'waste'. Considering that recent consumer research cautioned to address '(food)' waste' avoidance in communication because of the negative connotation of waste in relation to food ([de Visser-Amundson et al., 2021](#)), moving the focus of the benefit communication to the climate outcome could be a potential way to alleviate this.

Moreover, a taste framing triggers thoughts on 'nutrition', 'taste', 'quality' and also expressions of being 'sceptical'. In addition, the frugal framing leads to associations on 'tradition' and being 'responsible'. These findings can be explained by the fact that by emphasizing specific framing benefits make consumers naturally associate upcycled foods to the specific benefits highlighted in the frame (e.g. taste framing triggers associations as well as questions related to taste, nutrition, etc.).

Third, we found that a concrete presentation of upcycled foods, using real products, leads to fewer negative associations and fewer unrelated associations and 'do not know' comments. In that sense, the results do not follow our theoretical reasoning only in part: We find more general, unrelated and "do not know" comments in the abstract communication condition. This suggests that upcycling of food products is a complex concept, which is difficult to grasp without specific examples. Consequently, we do not find that abstract presentations lead to more general positive associations, instead, there is no significant difference. Instead of more negative associations to the concrete presentations, we find less negative associations. This finding is corroborated by [Taufik et al. \(2023\)](#) who found that more concrete product communication led to stronger self-rewarding feelings associated with purchasing upcycled food, relative to abstract communication of their benefits. The results seem to indicate that presenting upcycled food with concrete examples is worthwhile and might lessen consumer scepticism towards the concept. It seems that having specific, appetizing product examples of upcycled food products makes the concept more tangible and therefore also does not elicit more negative reactions. It should be noted that the more negative reactions are not necessarily a consequence predicted by construal level theory. More so, the theory suggests that concepts, which relate to the usage situation become more salient. If these concepts are not negative in nature, because the product examples seem safe, nutritious and tasty, construal level theory still can explain the observed pattern. From a food marketing point of view, it is important to consider this point and aim for specific communications with upcycled food products instead of vague and abstract communications as the concept is too complex.

A point to consider in further research with construal level theory is that we did not control for degree of environmental concern in the

analysis. Sustainability is generally assumed to be construed at a higher level of psychological distance, however, mostly so for consumers who are interested in the topic ([van Dam and Fischer, 2013](#); [van Dam & van Trijp, 2013](#)). It seems reasonable that those consumers with less concern for sustainability also find the general communication less appealing, due to lack of relevance or understanding. A specific product, however, might still lead to positive associations, if the product in itself is appealing, irrespective of concern for the environment.

6.3. Types of associations depending on sociodemographic characteristics

Exploring the age of respondents, a general distinction emerges that shows that the respondents from the oldest of three age brackets in the study were more negative and sceptical, while the younger were more positive through various types of associations. That negative comments and 'sceptical' associations were more often found among the older respondents differs in part from the findings of [Zhang et al. \(2021\)](#) that revealed that the likelihood of purchase upcycled food was higher among Baby Boomers (namely people born between the end of second war world and the mid-1960 s) than other generations. Our findings also suggested that the middle age group gave more often associations with 'taste' and 'quality'. According to [Seppä et al. \(2013\)](#), hedonistic aspects are crucial in shaping consumers' food-related decisions, also for new food ingredients ([Aschemann-Witzel et al., 2019](#)). One can wonder why precisely these two aspects emerge more prominent in the middle group of the three age brackets, and one reason could be that these include respondents with families including children to take care of, and such aspects might be more top of mind in this stage of life and the family cycle.

In our study, younger respondents significantly more often mentioned a range of associations, including efficient, recycling, sustainability, environment, responsible, and nutrition, as well as examples of food products. This could be explained by the interest of the younger individuals to express an opinion on the environmental issues, in recognizing environmental messages ([D'Souza et al., 2007](#)) and in their knowledge about reusing/recycling techniques ([Laroche et al., 2001](#)). Younger people are more likely to be more sensitive to environmental issues ([Straughan & Roberts, 1999](#)), and younger consumers are more interested to sustainable foods ([Anvar & Venter, 2014](#); [Singh & Verma, 2017](#)), and they have the lowest rejection towards upcycled products ([Perito et al., 2020](#); [Grasso & Asioli, 2020](#)).

According to our results, the youngest age bracket was more likely to mention food or product examples in their associations. This might reflect that they have more likely been exposed to upcycled food, but maybe also that product categories used could be more common among younger consumers, which might make them remember and mention the categories more likely at later parts of the survey (as e.g. muesli bars or smoothies). There were no differences in the extent to which different age groups mentioned 'food waste', which could suggest that this topic is equally relevant (or irrelevant, depending on how prominent one thinks this association was for the whole sample) for respondents of all age groups, thus neither a young nor old 'topic'.

With regard to the evidence on gender, our study showed that females were more likely mentioning words coded as 'responsible', 'smart', 'food waste', 'waste' and 'environment' to the upcycled food concept. However, males were more likely expressing associations coded as 'do not know' or 'interesting'. Scientific literature does not have a univocal position on gender aspects relatively the acceptance of upcycled food. In fact, some studies indicated that males are more open to these products ([Aschemann-Witzel & Peschel, 2019](#); [Rahmani and Gil Roig, 2018](#)). A potential explanation for these findings is that males are more interested in new food ingredient ([Verbeke, 2015](#)). However, other studies suggested that females are more aware of food waste and are more likely to purchase upcycled food than males ([Coderoni & Perito, 2020](#); [McCarthy et al., 2020](#)). In general, according to [Hartmann and Siegrist \(2017\)](#), females are more likely than males to prefer

environmentally friendly products. The broader set and more frequent associations seem to confirm more interest in the subject among female respondents. Notably, there was no gender difference in the likelihood of mentioning 'nutrition' related associations.

Diamantopoulos et al., (2003) showed a strong correlation between environmental knowledge and high educational level. Within upcycled food research, it has been shown that there is a more favourable attitude to upcycled food or a higher willingness to accept among respondents of higher education (Cattaneo et al., 2019; Perito et al., 2019). It is therefore not surprising that in our study, people with a high level of education are more likely to express many associations codes related to upcycled food such as 'innovative', 'interesting', 'sustainable' and 'environmental', 'resources' and 'responsible'.

6.4. Limitations and further research

We acknowledge the possibility of epistemic biases such as confirmation and social desirability bias. To alleviate these issues, we have applied a number of techniques to address these, such as researcher triangulation, data collection triangulation, debriefing and checking the findings against the raw data (Lincoln and Guba, 1993). Further, we included reasons for theoretical, methodological, and analytical choices, so that other researchers can transfer, depend, and confirm how and why our choices have been made (Koch, 1994). To further minimize the possibility of social desirability bias we have also used strategies as introducing the study and establishing rapport, as well as analysed the relevance and consistency between the research objectives and the used methods (Bergen & Labonté, 2020).

The sociodemographic differences that we have found might partly be related to different answering behaviour of these groups, and less because of a different stance to the topic. For example, younger consumers might be faster in typing, and more educated consumers more elaborate in their usage of word, while there might be gender roles at play in how meticulously to answer a survey, to give a few examples. Thus, interpretation of these differences should be done with that in mind.

We decided against analysing differences between countries for two reasons: First, there are many differences between countries that might come into play with regard to the topic, such as cultural differences in answering behaviour, differences in types of foods regarded as edible or not, media attention differences in how prominent the topic of waste or food waste is discussed or market context differences such as whether upcycled food is seen on shelves in stores or not. For example, the topic of food waste avoidance had been high on the societal agenda in Denmark for quite some years, which could influence the extent to which this is mentioned by consumers. It would be difficult to interpret how differences might be explained. Second, each country data set was in a different language, and because of that, the main coder was also a different person. Even though we counteracted the latter by having a second author checking another language data set and its coding, both language differences and inter-coder variability could be partly affecting country differences. Instead, we chose to use the overall dataset and using it to represent consumers in five European countries.

With regard to construal level theory, one could debate whether the use of general product concept messages compared to concrete product examples, as it is has been used by us and some other previous research in the food context, is the most adequate way of applying the theory to a research context. Maybe it is simply comparing the effect of concepts versus examples, and the theory is not necessarily relevant or most adequate to develop a hypothesis in this setting. The contradictory findings from literature might support this. We regard the use of the theory as exploratory and only of smaller relevance within this paper.

Future research on upcycled food would gain from applying a greater diversity of methods, moving into further qualitative approaches, sensory science methods, and into point-of-sale interventions or realistically designed choice behaviour studies.

Finally, we would like to underline that we argue the use of open-ended questions can bring an element of consumer co-creation and brainstorming into an otherwise researcher-defined and quantitative method. Reading the comments made by respondents, one can observe how some consumers - or rather citizens - perceive the researcher's language as too different from their own, and that comments reveal expectations about which societal norms or political objectives might underly the survey. Examples are comments to the second open question such as "hippies are back", or "Don't get the message, but is what I normally consider common sense, but here wrapped in academic and politician rhetoric". We argue that including open, qualitative research elements or to a greater extent conducting research in collaboration and co-creation with consumer-citizens of different backgrounds has two advantages: Firstly, it allows to better understand and integrate divergent views, which can also serve to correct researchers misconceptions and misinterpretations, and secondly, it can allow to bring in new perspectives and brainstorm ideas, not least of how to portray, phrase and frame innovations with new or old examples, comparisons, or exaggerations, as for example in the following quote:

"It has always been done like that. When you slaughter a pig it's only the scream that is wasted." (Danish respondent)

7. Conclusion

Alternative proteins sourced sustainably will come from a diversity of mostly plant-based sources, amongst others novel foods and side-streams currently wasted. Consumer perception and acceptance will be crucial for a transition to these alternative proteins. Thus, it is important to identify best ways to address consumer concerns upfront as well as explain and communicate the benefits of these new products, so that they align with consumers thoughts and attitudes.

Based on the unique mixed-methods and cross-country study on upcycled food, we can conclude that mostly positive associations emerge. Positive thoughts circle around environmental sustainability aspects, innovation and efficiency, recycling, and food waste avoidance, while negative associations reveal concerns about taste, nutritional quality, and lack of more information. We can further conclude that presentation of the concepts and products in text and visualisation impacts consumers associations: We find that – contrary to theoretically based expectations – concrete rather than abstract presentations of products reduce such negative associations; Meanwhile, benefit framing towards 'climate' leads thoughts towards environment and innovation, and, interestingly, away from waste, while benefit framing towards taste raises sceptical associations about this characteristic. Moreover, we can conclude that differences can be found for which type of associations consumers respond with, depending on gender, age bracket, and education, showing an overall picture of more positive associations among females and younger consumers.

8. Implications

Results imply that market stakeholders should choose concrete product presentations to introduce the idea of upcycled food, and that they should be framing the products as having a benefit to reducing climate impact and improving environmental sustainability. At the same time, however, results imply that it is important to address consumers concern and information needs regarding taste and quality, upfront.

Moreover, there are differences between sociodemographic characteristics of consumers, which might reflect different interests and top of mind of product aspects. In particular females and younger consumers appear to be more interested and favourable to the upcycled food examples shown. Communication of a concrete product should be designed having in mind the target group of the respective product in mind.

9. Author statement

The first author has suggested the study, analysed the quantitative data, and wrote the first manuscript draft. All authors have jointly developed the study design, participated in data analysis, and contributed to manuscript writing. After the first author, co-authors are listed in alphabetical order.

Declaration of Competing Interest

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

Data availability

Data will be made available on request.

References

- Altintzoglou, T., Honkanen, P., & Whitaker, R. D. (2021). Influence of the involvement in food waste reduction on attitudes towards sustainable products containing seafood by-products. *Journal of Cleaner Production*, 285, Article 125487. <https://doi.org/10.1016/j.jclepro.2020.125487>
- Anvar, M., & Venter, M. (2014). Attitudes and Purchase Behaviour of Green Products among Generation Y Consumers in South Africa. Retrieved from *Mediterranean Journal of Social Sciences*, 5(21), 183 <https://www.richtmann.org/journal/index.php/mjss/article/view/4191>.
- Aschemann-Witzel, J., Asiola, D., Banovic, M., Perito, M. A., & Peschel, A. O. (2022). Communicating upcycled foods: Frugality framing supports acceptance of sustainable product innovations. *Food Quality and Preference*, 100, Article 104596. <https://doi.org/10.1016/j.foodqual.2022.104596>
- Aschemann-Witzel, J., Asiola, D., Banovic, M., Perito, M. A., Peschel, A. O., & Stancu, V. (2023). Defining upcycled food: The dual role of upcycling in reducing food loss and waste. *Trends in Food Science & Technology*, 132, 132–137. <https://doi.org/10.1016/j.tifs.2023.01.001>
- Aschemann-Witzel, J., & Peschel, A. O. (2019). How circular will you eat? The sustainability challenge in food and consumer reaction to either waste-to-value or yet underused novel ingredients in food. *Food Quality and Preference*, 77, 15–20. <https://doi.org/10.1016/j.foodqual.2019.04.012>
- Aschemann-Witzel, J., & Stangherlin, I. D. C. (2021). Upcycled by-product use in agri-food systems from a consumer perspective: A review of what we know, and what is missing. *Technological Forecasting and Social Change*, 168, Article 120749. <https://doi.org/10.1016/j.techfore.2021.120749>
- Aschemann-Witzel, J., Varela, P., & Peschel, A. O. (2019). Consumers' categorization of food ingredients: Do consumers perceive them as 'clean label' producers expect? An exploration with projective mapping. *Food Quality and Preference*, 71, 117–128. <https://doi.org/10.1016/j.foodqual.2018.06.003>
- Asiola, D., & Grasso, S. (2021). Do consumers value food products containing upcycled ingredients? The effect of nutritional and environmental information. *Food Quality and Preference*, 91, Article 104194. <https://doi.org/10.1016/j.foodqual.2021.104194>
- Bar-Anan, Y., Liberman, N., & Trope, Y. (2006). The association between psychological distance and construal level: Evidence from an implicit association test. *Journal of experimental psychology. General*, 135(4), 609–622. <https://doi.org/10.1037/0096-3445.135.4.609>
- Bergen, N., & Labonté, R. (2020). "Everything Is Perfect, and We Have No Problems": Detecting and Limiting Social Desirability Bias in Qualitative Research. *Qualitative health research*, 30(5), 783–792. <https://doi.org/10.1177/1049732319889354>
- Bhatt, S., Ye, H., Deutsch, J., Ayaz, H., & Suri, R. (2020). Consumers' willingness to pay for upcycled foods. *Food Quality and Preference*, 86, Article 104035. <https://doi.org/10.1016/j.foodqual.2020.104035>
- Bhatt, S., Ye, H., Deutsch, J., Jeong, H., Zhang, J., & Suri, R. (2021). Food Waste and Upcycled Foods: Can a Logo Increase Acceptance of Upcycled Foods? *Journal of Food Products Marketing*, 27(4), 188–203. <https://doi.org/10.1080/1045446.2021.1955798>
- Bowles, N., Alexander, S., & Hadjikakou, M. (2019). The livestock sector and planetary boundaries: A 'limits to growth' perspective with dietary implications. *Ecological Economics*, 160, 128–136. <https://doi.org/10.1016/j.ecolecon.2019.01.033>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp0630a>
- Cattaneo, C., Lavelli, V., Proserpio, C., Laureati, M., & Pagliarini, E. (2019). Consumers' attitude towards food by-products: The influence of food technology neophobia, education and information. *International Journal of Food Science & Technology*, 54(3), 679–687. <https://doi.org/10.1111/ijfs.13978>
- Coderoni, S., & Perito, M. A. (2020). Sustainable consumption in the circular economy. An analysis of consumers' purchase intentions for waste-to-value food. *Journal of Cleaner Production*, 252, Article 119870. <https://doi.org/10.1016/j.jclepro.2019.119870>
- Coderoni, S., & Perito, M. A. (2021). Approaches for reducing wastes in the agricultural sector. An analysis of Millennials' willingness to buy food with upcycled ingredients. *Waste Management*, 126, 283–290. <https://doi.org/10.1016/j.wasman.2021.03.018>
- Combest, S., & Warren, C. (2019). Perceptions of college students in consuming whole grain foods made with Brewers' Spent Grain. *Food science & nutrition*, 7(1), 225–237. <https://doi.org/10.1002/fsn3.872>
- D'Souza, C., Taghian, M., Lamb, P., & Peretiakto, R. (2007). Green decisions: Demographics and consumer understanding of environmental labels. *International Journal of Consumer Studies*, 31(4), 371–376. <https://doi.org/10.1111/j.1470-6431.2006.00567.x>
- Diamantopoulos, A., Schlegelmilch, B. B., Sinkovics, R. R., & Bohlen, G. M. (2003). Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. *Journal of Business Research*, 56(6), 465–480. [https://doi.org/10.1016/S0148-2963\(01\)00241-7](https://doi.org/10.1016/S0148-2963(01)00241-7)
- Donner, M., Gohier, R., & de Vries, H. (2020). A new circular business model typology for creating value from agro-waste. *Science of The Total Environment*, 716, Article 137065. <https://doi.org/10.1016/j.scitotenv.2020.137065>
- Evans, G., Kermarrec, C., Sable, T., & Cox, D. N. (2010). Reliability and predictive validity of the Food Technology Neophobia Scale. *Appetite*, 54(2), 390–393. <https://doi.org/10.1016/j.appet.2009.11.014>
- Flaminii, F., Gonzalez-Ortega, R., Di Mattia, C. D., Perito, M. A., Mastrocola, D., & Pittia, P. (2020). Applications of compounds recovered from olive mill waste. In C. Galanakis (Ed.), *Food Waste Recovery. Processing Technologies, Industrial Techniques, and Applications : Processing Technologies, Industrial Techniques, and Applications*. San Diego, UNITED STATES: Academic Press.
- Goodman-Smith, F., Bhatt, S., Moore, R., Mirosa, M., Ye, H., Deutsch, J., & Suri, R. (2021). Retail Potential for Upcycled Foods: Evidence from New Zealand. *Sustainability*, 13(5). <https://doi.org/10.3390/su13052624>
- Grasso, S., & Asiola, D. (2020). Consumer preferences for upcycled ingredients: A case study with biscuits. *Food Quality and Preference*, 84, Article 103951. <https://doi.org/10.1016/j.foodqual.2020.103951>
- Grasso, S., Fu, R., Goodman-Smith, F., Lalor, F., & Crofton, E. (2023). Consumer attitudes to upcycled foods in US and China. *Journal of Cleaner Production*, 388, Article 135919. <https://doi.org/10.1016/j.jclepro.2023.135919>
- Hartmann, C., & Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends in Food Science & Technology*, 61, 11–25. <https://doi.org/10.1016/j.tifs.2016.12.006>
- Henchion, M., McCarthy, M., & O'Callaghan, J. (2016). Transforming Beef By-products into Valuable Ingredients: Which Spell/Recipe to Use? *Frontiers in Nutrition*, 3. Retrieved from. <https://www.frontiersin.org/articles/10.3389/fnut.2016.00053>.
- Kardes, F. R., Cronley, M. L., & Kim, J. (2006). Construal-Level Effects on Preference Stability, Preference-Behavior Correspondence, and the Suppression of Competing Brands. *Journal of Consumer Psychology*, 16(2), 135–144. https://doi.org/10.1207/s15327663jcp1602_4
- Kirchherr, J., Piscicelli, L., Bour, R., Kostense-Smit, E., Muller, J., Huibrechtse-Trijens, A., & Heekert, M. (2018). Barriers to the Circular Economy: Evidence From the European Union (EU). *Ecological Economics*, 150, 264–272. <https://doi.org/10.1016/j.ecolecon.2018.04.028>
- Koch, T. (1994). Establishing rigour in qualitative research: The decision trail. *Journal of advanced nursing*, 19(5), 976–986. <https://doi.org/10.1111/j.1365-2648.1994.tb01177.x>
- Laroche, M., Bergeron, J., & Barbaro-Forleo, G. (2001). Targeting consumers who are willing to pay more for environmentally friendly products. *Journal of Consumer Marketing*, 18(6), 503–520. <https://doi.org/10.1108/EUM000000006155>
- Liberman, N., & Förster, J. (2009). Distancing from experienced self: How global-versus-local perception affects estimation of psychological distance. *Journal of personality and social psychology*, 97(2), 203–216. <https://doi.org/10.1037/a0015671>
- Liberman, N., & Trope, Y. (1998). The role of feasibility and desirability considerations in near and distant future decisions: A test of temporal construal theory. *Journal of personality and social psychology*, 75, 5–18. <https://doi.org/10.1037/0022-3514.75.1.5>
- Lincoln, Y. S., & Guba, E. G. (1993). *Naturalistic inquiry* ((11. print.)). Newbury Park [u. a.]: Sage.
- Martins, Y., & Pliner, P. (2005). Human food choices: An examination of the factors underlying acceptance/rejection of novel and familiar animal and nonanimal foods. *Appetite*, 45(3), 214–224. <https://doi.org/10.1016/j.appet.2005.08.002>
- McCarthy, B., Kapetanaki, A. B., & Wang, P. (2020). Completing the food waste management loop: Is there market potential for value-added surplus products (VASP)? *Journal of Cleaner Production*, 256, Article 120435. <https://doi.org/10.1016/j.jclepro.2020.120435>
- Perito, M. A., Di Fonzo, A., Sansone, M., & Russo, C. (2020). Consumer acceptance of food obtained from olive by-products. *British Food Journal*, 122(1), 212–226. <https://doi.org/10.1108/BFJ-03-2019-0197>
- Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, 360(6392), 987–992. <https://doi.org/10.1126/science.aag0216>
- Rahmani, D., & Gil Roig, J. M. (2018). Valorisation of food surpluses and side-flows and citizens' understanding. Retrieved from. https://upcommons.upc.edu/bitstream/handle/2117/364570/Food%20waste%20valorisation%20and%20citizens%20undersanding%20_Final%20report.pdf?sequence=1.
- Seppä, L., Railio, J., Vehkalahti, K., Tahvonen, R., & Tuorila, H. (2013). Hedonic Responses and Individual Definitions of an Ideal Apple as Predictors of Choice. *Journal of Sensory Studies*, 28(5), 346–357. <https://doi.org/10.1111/joss.12059>
- Shabnam, S., Quaddus, M., Roy, S. K., & Quazi, A. (2021). Consumer belief system and pro-environmental purchase intention: Does psychological distance intervene?

- Journal of Cleaner Production*, 327, Article 129403. <https://doi.org/10.1016/j.jclepro.2021.129403>
- Singh, A., & Verma, P. (2017). Factors influencing Indian consumers' actual buying behaviour towards organic food products. *Journal of Cleaner Production*, 167, 473–483. <https://doi.org/10.1016/j.jclepro.2017.08.106>
- Smith, S. M., & Petty, R. E. (1996). Message Framing and Persuasion: A Message Processing Analysis. *Personality and Social Psychology Bulletin*, 22(3), 257–268. <https://doi.org/10.1177/0146167296223004>
- Spratt, O., Suri, R., & Deutsch, J. (2021). Defining Upcycled Food Products. *Journal of Culinary Science & Technology*, 19(6), 485–496. <https://doi.org/10.1080/15428052.2020.1790074>
- Straughan, R. D., & Roberts, J. A. (1999). Environmental segmentation alternatives: A look at green consumer behavior in the new millennium. *Journal of Consumer Marketing*, 16(6), 558–575. <https://doi.org/10.1108/07363769910297506>
- Swinburn, B. A., Kraak, V. I., Allender, S., Atkins, V. J., Baker, P. I., Bogard, J. R., & Dietz, W. H. (2019). The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report. *The Lancet*, 393(10173), 791–846. [https://doi.org/10.1016/S0140-6736\(18\)32822-8](https://doi.org/10.1016/S0140-6736(18)32822-8)
- Taufik, D., Rood, R., Dagevos, H., Bouwman, E. P., & Reinders, M. J. (2023). Effects of abstract and concrete communication on moral signalling and purchase intention of upcycled food products. *Cleaner and Responsible Consumption*, 100110. <https://doi.org/10.1016/j.clrc.2023.100110>
- Teigiserova, D. A., Hamelin, L., & Thomsen, M. (2020). Towards transparent valorization of food surplus, waste and loss: Clarifying definitions, food waste hierarchy, and role in the circular economy. *Science of The Total Environment*, 706, Article 136033. <https://doi.org/10.1016/j.scitotenv.2019.136033>
- Thorsen, M., Nyhof, F., Goodman-Smith, F., Deutsch, J., & Miroso, M. (2022). Accessing Supermarket Shelves: Retail Category Managers Advice to Upcycled Food Manufacturers. *Journal of Food Products Marketing*, 28(4), 179–192. <https://doi.org/10.1080/10454446.2022.2072695>
- Todorov, A., Goren, A., & Trope, Y. (2007). Probability as a psychological distance: Construal and preferences. *Journal of Experimental Social Psychology*, 43(3), 473–482. <https://doi.org/10.1016/j.jesp.2006.04.002>
- Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological review*, 117(2), 440–463. <https://doi.org/10.1037/a0018963>
- Trope, Y., & Liberman, N. (2011). Construal level theory. In P. A. M. van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (pp. 118–134). Los Angeles: Sage.
- van Dam, Y. K., & Fischer, A. R. H. (2013). Buying Green Without Being Seen. *Environment and Behavior*, 47(3), 328–356. <https://doi.org/10.1177/0013916513509481>
- van Dam, Y. K., & van Trijp, H. C. (2013). Relevant or determinant: Importance in certified sustainable food consumption. *Food Quality and Preference*, 30(2), 93–101. <https://doi.org/10.1016/j.foodqual.2013.05.001>
- Verbeke, W. (2015). Profiling consumers who are ready to adopt insects as a meat substitute in a Western society. *Food Quality and Preference*, 39, 147–155. <https://doi.org/10.1016/j.foodqual.2014.07.008>
- Vidigal, M. C., Minim, V. P., Simiqueli, A. A., Souza, P. H., Balbino, D. F., & Minim, L. A. (2015). Food technology neophobia and consumer attitudes toward foods produced by new and conventional technologies: A case study in Brazil. *LWT - Food Science and Technology*, 60(2, Part 1), 832–840. <https://doi.org/10.1016/j.lwt.2014.10.058>
- de Visser-Amundson, A., Pelozo, J., & Kleijnen, M. (2021). How Association with Physical Waste Attenuates Consumer Preferences for Rescue-Based Food. *Journal of Marketing Research*, 58(5), 870–887. <https://doi.org/10.1177/00222437211031243>
- Xu, X., Sharma, P., Shu, S., Lin, T.-S., Ciais, P., Tubiello, F. N., & Jain, A. K. (2021). Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. *Nature Food*, 2(9), 724–732. <https://doi.org/10.1038/s43016-021-00358-x>
- Zhang, J., Ye, H., Bhatt, S., Jeong, H., Deutsch, J., Ayaz, H., & Suri, R. (2021). Addressing food waste: How to position upcycled foods to different generations. *Journal of Consumer Behaviour*, 20(2), 242–250. <https://doi.org/10.1002/cb.1844>