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Impact of packaging color on choice and health perception: Insights from chickpeas and ravioli in Germany

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ABSTRACT

The global rise in obesity linked to poor nutrition behavior underscores the importance of promoting a healthy diet. This study investigates the impact of packaging color on consumer choice and health perception of chickpeas (a healthy product) versus ravioli (an unhealthy product) in Germany. Two choice experiments (CEs) were conducted with 222 participants aged 19 to 35, examining the influence of packaging color, label, price, and origin on product selection. Additionally, an image query assessed health perceptions associated with six different colored chickpea cans.

The results indicate that price is the most influential factor in product choice for both chickpeas and ravioli, while packaging color has the least influence. However, green packaging significantly enhances health perception, with participants associating it with healthiness and environmental friendliness. In contrast, red packaging does not convey health value and is not linked to healthiness. Light blue packaging negatively affects health perception, partly due to associations with artificial additives. Beige packaging slightly improves health perception, while silver and black are perceived as indicators of quality but can also make the product appear less healthy.

These findings highlight the complex role of packaging color in consumer behavior and suggest that while price remains a dominant factor, strategic use of color can enhance health perceptions and potentially influence healthier food choices. Future research should explore these effects across different cultural contexts and incorporate psychophysical methods to further understand the underlying mechanisms of color perception.

Abbreviations:

AIC	Akaike information criterion
ANOVA	analysis of variance
BIC	Bayesian information criterion
BMEL	Bundesministerium für Ernährung und Landwirtschaft
BMI	body mass index
BTS	Bartlett test for sphericity
CAIC	consistent Akaike information criterion
CE	choice experiment
HB	hierarchical Bayesian
HSD	honestly significant difference
IT	information technology
KMO	Kaiser-Meyer-Olkin test
LCA	latent class analysis
SD	standard deviation
WHO	World Health Organization

1. Introduction

A healthy diet is essential for maintaining human health [1]. The global increase in overweight, obesity [2] and associated secondary diseases is linked, among other things, to unfavorable diets – which underlines the importance of addressing nutrition for societal health [3]. A well-known approach to health promotion is 'nudging'. Popularized by Richard Thaler and Cass Sunstein, the concept aims to help facilitate and promote healthy choices through various intervention approaches. One of these is called 'priming', which may involve visual stimuli that can influence our behavior, even unconsciously. For example, products can be designed to be visually appealing [4], such as with colors. Certain colors, such as traffic light colors, could directly convey information such as health value [4]. In this context, examining color perception is interesting.

The design of product packaging has a major influence on which product consumers choose, with color being a key element. A series of

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studies [5] have already examined packaged foods and their health perception through different packaging colors. It has been found that cool colors often lead to a healthier perception of products than warm colors [5]. Using a questionnaire on functional smoothies, a study by Plasek et al. [6] found that the color combination white-blue (cool) – in comparison to white-red (warm) – contributes four times more to health perception. The effect was therefore stronger than the white-green (cool) color combination, which was about twice as strong as white-red. Among the attributes examined – 'claims related to ingredients', 'organic origin', 'health claims', 'shape', 'color of packaging' and 'domestic origin' – color was the decisive factor in this context [6]. These results can be supported by a study by Hallez et al. [7], in which a more distinctive health perception was found for both beverages and snacks (with different health values) when using cool colors (blue, green) compared to warm colors.

While a study investigating meat alternatives found that color (cool vs. warm) did not affect health perception [8], there are also studies with contrary results [9,10] to those described above. The study by Wasowicz et al. [10] shows, through findings from a focus group, that colors can evoke a wide variety of associations, but that these can also be very context-dependent. In the context of frozen pizza, the warm colors yellow and red were associated with ingredients such as vegetables and thus with health. With yoghurt, however, these colors seemed inappropriate, and red was associated with the addition of artificial colorants (unhealthy). While blue was generally associated with healthy products, it seemed appropriate for yoghurt, but not for pizza. Green was associated with nature and perceived as health-promoting by association with vegetables. However, it only appeared to be appropriate for pizza [10].

In addition to product category-dependent color perception, the study by Huang & Lu [11] makes it clear that a distinction should be considered between foods that are intended to provide an actual physiological benefit (utilitarian: e.g. yogurt, muesli) and those consumed more for pleasure (hedonic: e.g. potato chips, ice cream). The importance of health perception and the evaluation of color linked to it can vary due to purchasing motives. In the study, the packaging color (blue vs. red) had an impact on health perception and thus also on purchasing behavior, but only significantly for utilitarian products. Blue was associated with healthier and red with unhealthier products [11].

Additionally, to studies on color hues, which the present study will also focus on, some studies in the literature also focus on the investigation of color brightness and saturation, and some studies investigate several color aspects simultaneously. Moreover, colors have been studied for their impact on front-of-pack nutrition labels, aiming to facilitate label comprehension [5]. A review by Su et al. [12] found that warm-colored packaging enhances purchase intentions for indulgent, less healthy foods, while cool-colored packaging is more effective for promoting healthier options. Similarly, a study by Spence et al. (2019) [78] highlighted that packaging colors can influence taste expectations and overall product appeal, with green and blue often associated with healthiness and freshness. Another review by Singh [13] emphasized the psychological effects of color, noting that red and yellow can stimulate appetite and attract attention, making them popular choices for snack foods. Additionally, a comprehensive review by Silayoi and Speece [14] discussed how packaging color, along with other design elements, plays a crucial role in brand recognition and consumer trust. A study by Garber et al. [15] explored the cultural variations in color perception, indicating that while certain colors may universally convey healthiness, their effectiveness can vary significantly across different cultural contexts.

Individual differences in color perception and environmental factors significantly influence how consumers perceive packaging colors. Emery and Webster [16] highlight that color perception varies widely among individuals due to genetic differences, such as color blindness, and physiological factors, including variations in cone photoreceptor sensitivity. These differences can lead to color misperception, where colors are seen differently by individuals with normal vision compared to those with color vision deficiencies. Additionally, environmental factors such as the spectral composition of illumination, test geometry, and luminance play crucial roles. For instance, the type of lighting (natural vs. artificial) can alter the perceived color of packaging, as different light sources emit varying spectral distributions [17]. Test geometry, including the angle and distance of viewing, also affects color perception, as demonstrated by Xiong et al. [18]. Furthermore, luminance levels can influence the visibility and attractiveness of packaging colors, with higher luminance generally enhancing color vividness and appeal [19].

As previous studies, albeit not exclusively, have tended to examine unhealthier foods such as sweet or salty snacks [5], the present study aimed to focus on a healthier product and choose one outside the snack category. Chickpeas were chosen since legumes still play a rather minor role in the diet of the German population [20]. The Bundesministerium für Ernährung und Landwirtschaft (BMEL) Nutrition Report 2022 showed that only 47 % of respondents make sure to buy or consume legumes [21]. Dietary fiber, which is contained in chickpeas [20], is often consumed too little [22]. Additionally, the proportion of vegetarians and vegans is increasing [23] and chickpeas are a good source of plant-based protein [24]. It should therefore be a product that could possibly gain more popularity among consumers through a well-chosen packaging color and ultimately benefit health.

For comparison with previous studies, which relate exclusively to opaque packaging – without visibility of the product itself [5], the present study uses a can as packaging and provides it with banderoles in different colors. Ravioli (highly processed convenience product) serve as an unhealthy comparison product to chickpeas. Chickpeas (*Cicer arietinum* L.) are highly nutritious, offering a rich source of protein, dietary fiber, vitamins, and minerals. They contain essential amino acids and bioactive compounds that contribute to various health benefits, including improved digestion, reduced risk of cardiovascular diseases, and better glycemic control [25]. Chickpeas also exhibit antioxidant, anti-inflammatory, and anticancer properties due to their high content of polyphenols and other phytochemicals [26]. On the other hand, ravioli, typically a highly processed food, tends to be lower in nutritional value compared to chickpeas. It often contains higher levels of saturated fats, sodium, and refined carbohydrates, which can contribute to adverse health outcomes such as obesity, hypertension, and metabolic syndrome when consumed in excess [27]. Specifically, the average canned ravioli contains 4.5–6.0 g of saturated fat and 350–550 mg of sodium per 100 g [28]. These values significantly exceed the World Health Organization's (WHO) recommendations for a healthy diet, which state that saturated fat should contribute less than 10 % of total daily energy intake and sodium intake should not exceed 2000 mg per day [3]. In contrast, canned chickpeas on average contain 0.5 g of saturated fat, 240–300 mg of sodium, 7.0 g of dietary fiber, and 8.9 g of protein per 100 g. They are also rich in essential vitamins and minerals, such as folate, iron, and magnesium [29]. The aim is to use two choice experiments (CEs) to find out to what extent packaging color, additionally to the product attributes label, price and origin, (positively) influences the selection of a healthy product (chickpeas) in opposition to a comparatively unhealthy product (ravioli). CEs effectively simulate decision-making situations [30–32]. A subsequent hierarchical Bayesian (HB) analysis can be used to estimate both part-worth utilities [33] of the individual attribute levels and relative importances [34] of the individual attributes – detailed in chapter 3.2. Sant'anna et al. [35] conducted a choice experiment (CE) on sodium-reduced cracker packaging, examining the attributes 'color', 'sodium reduction information' and 'additional product information'. The study aimed to identify which attributes increase product consumption [35]. Furthermore, an image query was used to determine how different packaging colors of a chickpeas' can are perceived, particularly regarding health perception, and what associations they go along with.

The colors used in this study were selected based on their prevalence in the current market as well as their theoretical classification as warm

or cool shades, which is consistent with existing literature on color perception and health associations. This dual rationale ensured that the study considered both practical relevance and theoretical underpinnings in the choice of colors for the packaging design. Colors chosen were red, green, beige, light blue, silver and black. Red and beige represent warm colors. Red can be associated with feelings of excitement and can negatively affect health perception [5], but could also be (positively) linked to tomato sauce (vegetables) in the context of ravioli. Beige could appear natural, like the colors examined in the study by Wąsowicz et al. [10], and is maybe particularly suitable for chickpeas. Green and light blue represent cool colors, whereby green can probably evoke a healthier and more sustainable perception of the product [7]. Light blue is often found on supermarket shelves in the context of 'light products' – blue is often also associated with healthier products [7]. The colors silver and black convey luxury and could promise quality. However, a higher-priced product could also lead to the assumption of a healthier product [5].

The primary objective of this research is to investigate the impact of food packaging color on consumer product choice and healthfulness perception, specifically focusing on chickpeas (a healthy option) and ravioli (an unhealthy option) in Germany. This study aims to complement existing literature by examining these effects in the context of non-snack food products. Additionally, the research seeks to determine the relative importance of packaging color compared to other product attributes such as label, price, and origin. By conducting two choice experiments and an image query, the study aims to provide insights into how different packaging colors influence consumer perceptions and choices, thereby contributing to the development of effective packaging strategies that promote healthier food choices.

2. Materials and methods

2.1. Data collection

Data collection took place from February 5th to 28th, 2024. Participants were recruited through email to all students at the Hamburg University of Applied Sciences (Faculty of Life Sciences), through personal contacts via WhatsApp, Instagram or by approaching them personally. Additionally, calls for participants were launched via Instagram (story) and WhatsApp (status). Sharing the survey brought in more participants, too. Participation was voluntary, with the option to withdraw at any time.

To closely represent the gender distribution of the German population, quotas were set: 49.2 % women, 49.2 % men and 1.6 % diverse. The age range was limited to 18–35 years to represent the group of young adults and balance age distribution. A total of 250 fully completed questionnaires were collected. Before further use, 25 participants were excluded for completing the questionnaire too quickly and showing patterns that indicated random or non-serious answers, such as identical ratings across all items or illogical response patterns. Participants who provided the same rating for all questions or showed significant inconsistencies in their responses were excluded from the analysis. Participants showing patterns that indicated random or non-serious answers were the same who completed the survey too quickly. For estimating the time usually needed to complete the survey, two timed test runs were conducted: One with skimming of the instructions and random clicking, and one with very rapid reading and quite spontaneous answers. Additionally, responses via laptop and cell phone were compared, with hardly any difference being observed. Filtering out the 5–10 % fastest participants is a well-established practice [36] and for this survey, 10 % was a good choice regarding completion times to evaluate high-quality results. Participants with completion times of more than 12.65 min were included. During data cleaning, three participants were excluded based on their responses to the question at the end of the survey regarding colorblindness. As a result, the final dataset included 222 participants who reported no color vision deficiencies.

2.2. Survey design

The survey had five sections. First, participants provided their age and gender for eligibility based on quotas. Next, two choice experiments (CEs) aimed to investigate the participants' preferences when buying canned chickpeas (experiment 1) and ravioli (experiment 2) regarding packaging color, label, price and origin. The third section involved rating different colored chickpea cans on a 5-point Likert scale (indication of level of agreement) regarding various statements to assess product healthfulness perception differences among colors. The fourth part contained psychographic constructs, whereby various statements on different values/attitudes were rated on a 5-point Likert scale (indication of level of agreement). Lastly, demographic data were collected, and participants were asked if they were colorblind.

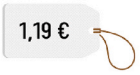
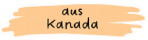
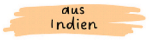
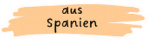
2.3. Design of the choice experiments

Two CEs recorded participants' preferences for various product attributes in a purchase scenario. These were created using Sawtooth Software Lighthouse Studio (version 9.15.4, Sawtooth Software, Inc., Provo, UT, USA). One experiment utilized a chickpea can (healthy product) and the other a ravioli can (unhealthy product). Participants were asked to imagine a decision-making situation in front of a supermarket shelf and to choose, in the context of eight consecutive choice-sets (randomized), which of three options they would choose or whether they would choose none. Product attributes included packaging color, label, price, and origin, each with six attribute levels, as shown in Table 1 and Table A1 (appendix). Using the same number of attribute levels for each attribute helps to balance the design and avoid potential biases that could arise from unequal representation of attribute levels [37]. Additionally, this method aligns with best practices in discrete choice experiments, which recommend a systematic and consistent approach to attribute level selection to enhance the reliability and validity of the results [38]. The cans were created using the applications 'Blender' and 'Canva'. The use of the fictious brand name 'FNISE' (= to giggle) aims to prevent bias from brand associations. The cans used in the survey had a capacity of 400 g, representing a standard size commonly found in retail for chickpeas and ravioli in Germany. This choice aimed to maintain consistency with consumer expectations and real-world purchasing scenarios.

The present study focuses on the influencing factor of color but includes other attributes in the CEs to make the experiments more realistic and depict other, obvious influencing factors. Additionally, the overall importance of packaging color compared to other attributes for a decision can be determined here.

The six levels for labeling, price, and origin were selected to reflect realistic market conditions and ensure a comprehensive analysis of consumer preferences. Label levels were based on common certifications and claims frequently encountered on food packaging. No label represents a baseline or control scenario. Organic reflects growing consumer interest in environmentally sustainable and health-conscious products. Fairtrade captures ethical considerations in purchasing decisions. Vegan targets plant-based dietary preferences, increasingly relevant in food markets. The Nutri-Score provides a standardized healthfulness indicator commonly found on European food products. The Klimaneutral (climate-neutral) label was chosen to represent the growing consumer interest in environmentally sustainable products and their carbon footprint, aligning with increasing demand for eco-conscious purchasing options. Price levels were derived from the typical range observed for chickpeas in the German market. Origin levels represent a mix of domestic and international sources, providing a realistic context for consumer decision-making. Germany represents domestic products and is likely to resonate with national consumers. Italy is a neighboring country with strong food-related cultural associations in Germany. Argentina is one of the top chickpea-producing countries. Spain is another European source known for quality food products. France is

Table 1
Attributes and their levels used in the chickpea choice experiment.

Attributes	Levels					
Packaging color	Red	Green	Beige	Light blue	Silver	Black
						
Label	Nutri-Score A	Organic seal	Fairtrade	No label	Climate neutral	Vegan
						
Price	0,59 €	0,89 €	1,19 €	1,49 €	1,79 €	2,09 €
						
Origin	Italy	Argentina	Canada	Germany	India	Spain
						

known for its culinary reputation, adding diversity to the European origins. India represents a more distant, exotic source, contrasting with European origins. The consistent use of six levels across these attributes follows established practices in choice experiment design, promoting balance and comparability in the evaluation of attribute preferences.

The experiments prioritized preferences without assessing perceived healthiness. Figs. A1 and A2 (appendix) illustrate the selection scenarios. As a result, it may be possible to draw conclusions about a nudging-effect as part of the evaluation, and/or it may be possible to establish a link between color and the personal attitudes and values of consumers.

2.4. Design of the image query

To record the respondents' perception of packaging colors, an image query followed the CEs. Participants viewed the different chickpea cans (red, green, beige, light blue, silver, black) individually and rated the same fourteen (freely phrased) statements for each can on a 5-point Likert scale ('Do not agree at all' = 1, 'Strongly agree' = 5). Three items focused on health perception. Other aspects, possibly influencing product selection, were also queried: Preferences (design, color), quality, environmental friendliness, sustainability, emotions, price, artificial additives, product content and taste. Fig. 3 lists the items. The image query was only for chickpeas to avoid a higher drop-out rate due to survey length. Moreover, ravioli were included only for comparison.

2.5. Design of the psychographic constructs

In designing the psychographic constructs, we aimed to capture a comprehensive range of consumer attitudes and values that could influence food choice behavior. Constructs were selected based on their relevance to food consumption and health perception, drawing from established scales in the literature, helping to describe the consumer segments. The independent factors (psychographic constructs) extracted in the factor analysis (chapter 3.5) may reveal differences between consumer segments (latent class analysis, chapter 3.3). Furthermore, such constructs could serve as explanatory variables in regression analysis ([39], p. 198). Ten constructs were queried, each with up to five items. Items were selected from existing scales in the literature covering the topics to be queried. For each construct, the items with the highest factor loadings were preferred, aiming for accurate measurement. Only positively formulated items were used, allowing a consistent 5-point Likert scale ('Do not agree at all' = 1, 'Strongly agree' = 5). Consequently, some items were rephrased. Two constructs were presented per survey page (randomized order).

The construct 'pleasure' originates from Roininen et al. [40] and was intended to capture how much value respondents place on pleasure in relation to food. 'Visual product aesthetics' (response and value) come from Mumcu & Kimzan [41] and were intended to assess how much value people place on product appearance. On the one hand, it is about the value it has for individuals and, on the other hand, the extent to which it plays a role in purchasing behavior. Kaiser and Shimoda's [42] 'responsibility feeling' construct was used to measure environmental consciousness. Price consciousness is likewise interesting in decision-making and was surveyed in relation to food to determine the relevance of prices to the members of the different consumer segments [43]. As people can tend to give answers that they think are socially expected of them [44], the construct 'social desirability' [45] was integrated. This makes it possible to assess whether respondents tended to remain true to their own views or not. Additionally, 'health-conscious eating behavior' [46], 'motivation for health prevention and promotion' [47] – related to one's own body, and 'weight-controlling eating behavior' [46] were surveyed.

2.6. Socio-demographic characteristics

The socio-demographic characteristics collected included gender, age, current situation (e.g., student, employee), occupational field, diet, migration background, height, and weight. These variables were chosen to ensure a representative sample of young adults in Germany (quota set

for age and gender) and to explore potential differences in food choice behavior across different demographic groups. The data was analyzed to identify patterns and correlations between socio-demographic factors and consumer preferences, providing insights into how these characteristics influence food packaging color perception and product choice. Participants also rated on a 5-point Likert scale ('Do not agree at all' = 1, 'Strongly agree' = 5) to what extent they use packaging colors in the supermarket to assess the food's health value, they regularly go food shopping in the supermarket, and they have comprehensive, healthy nutritional knowledge (one item per subject).

2.7. Statistical methods

Statistical analysis was conducted using Sawtooth Software Lighthouse Studio (version 9.15.4, Sawtooth Software, Inc., Provo, UT, USA) and IBM SPSS Statistics (version 28.0, IBM Corp., Armonk, NY, USA). Hierarchical Bayesian (HB) analysis was employed to estimate part-worth utilities and relative importances of the attributes in the choice experiments. This method was chosen for its ability to handle individual-level preference data and provide robust estimates. Latent class analysis (LCA) was used to identify homogeneous consumer segments based on choice behavior, with model selection guided by information criteria such as Akaike information criterion (AIC) and Bayesian information criterion (BIC). Factor analysis and reliability analysis were conducted to validate the psychographic constructs, and analysis of variance (ANOVA) with Tukey honestly significant difference (HSD) tests were used to compare mean values and factor scores of the psychographic constructs across segments. These methods ensured a comprehensive and reliable analysis of the data, allowing us to draw meaningful conclusions about the impact of packaging color on consumer behavior.

2.7.1. Analysis in Sawtooth Software Lighthouse Studio

After completing the survey, the data was processed in Sawtooth Software Lighthouse Studio (version 9.15.4, Sawtooth Software, Inc., Provo, UT, USA) and cleaned by removing certain participants' data (chapter 2.1).

Hierarchical Bayesian (HB) analysis was then performed to determine which attribute levels of packaging color, label, price, and origin were preferred by respondents overall in the CEs. HB analysis provides individual and average part-worth utilities to illustrate the preferences sought [48]. Furthermore, relative importances of attributes can be assessed. Oltman et al. [34] used HB analysis to investigate the relative importance of different attributes such as color, texture, and health benefits – as well as preferences of attribute levels for tomatoes.

Since similarities in choice behavior can occur in groups within a sample, a latent class analysis (LCA) was carried out. LCA can identify homogeneous segments within the sample with the help of so-called indicator variables and based on corresponding participant responses [49]. These groups combine respondents with similar preferences [50]. Each group, in turn, is characterized by different preferences compared to the others [51]. In this study, the CEs were used, and groups were formed from the resulting answers based on choice behavior. Thus, people were assigned to a group that exhibited similar decision-making behavior, or more precisely, similar preferences in form of part-worth utilities [51]. In a study on infant formula by Benni et al. [52], LCA identified two consumer segments that differed in their preference for cheaper or more expensive products.

2.7.2. Analysis in IBM SPSS statistics

The data from Sawtooth Software Lighthouse Studio (version 9.15.4, Sawtooth Software, Inc., Provo, UT, USA) was exported to IBM SPSS Statistics (version 28.0, IBM Corp., Armonk, NY, USA), excluding irrelevant technical information.

Descriptive statistics were used to describe the sample, presenting socio-demographic data (chapter 2.6) as frequencies respectively percentages or mean values ([39], p. 18–26). The latent classes were also differentiated this way and used in IBM SPSS Statistics (version 28.0, IBM Corp., Armonk, NY, USA) for group-by-group presentation of part-worth utilities and relative importances from the CEs (chapter 2.7.1).

In the course of using constructs (chapter 2.5) to describe the participants' values and attitudes more detailed, a factor and reliability analysis were conducted. A lot of what is to be measured in the social sciences is quite complex, cannot be measured directly and is based on various facets [39]. Factor analysis is used to determine whether and to what extent individual phrased items represent a common factor to be measured [53]. A reliability analysis is used to assess whether a compiled scale (several items that load onto a factor) can be used for measurement and actually measures the desired factor [39]. For example, in the study by Marques da Rosa et al. [9], three items for measuring 'preference' were successfully combined to one factor using factor analysis.

Subsequently, based on the factor analysis, an ANOVA was conducted to show whether there were significant differences between the groups within the sample in terms of mean values of the extracted factors (constructs) [39]. Tukey HSD tests [54], a methodology that was also used in the study by Tijssen et al. [55], were then conducted to find out exactly between which groups there were significant differences [54].

The image query was evaluated using descriptive statistics in terms of mean values for the individual items surveyed (separately for each color).

3. Results

This result section is structured to present the findings of the study in a comprehensive and organized manner, divided into several subsections. It begins with 3.1, which provides an overview of the demographic characteristics of the participants, including gender, age, and other relevant socio-demographic factors. This is followed by 3.2 where the part-worth utilities and relative importances for the chickpea and ravioli choice experiments are detailed, highlighting the preferences for different attributes. Next, 3.3 describes the segmentation of consumers into distinct groups based on their preferences, with separate analyses for chickpeas and ravioli, and includes a presentation of the socio-demographic characteristics of these segments. 3.4 further explores the socio-demographic profiles of the identified segments, providing insights into how these factors influence consumer behavior. 3.5 presents the findings from the factor analysis of psychographic constructs, detailing the extracted factors and their implications for understanding consumer segments. Finally, 3.6 reports on the image query results, showing how different packaging colors affect perceptions of healthiness and other attributes.

3.1. Sample description

The sample includes 222 participants: 110 female, 109 male, and 3 of diverse gender (Table 2). 76.1 % did not indicate a migration background; those who did most frequently mentioned Europe and Asia. The average age is 25.90 years. The average body mass index (BMI) is 22.28 kg/m^2 for women and 24.93 kg/m^2 for men. The range of normal BMI is between 18.5 kg/m^2 and 24.9 kg/m^2, which accounts for weight relative to height, meaning that the men's value in the sample has a slight tendency to overweight [56]. However, BMI calculation does not differentiate between fat and muscle mass and only a limited statement can be made about individual's health status [57]. Most respondents are students, followed by employees. The most frequently represented occupational fields are 'natural sciences', 'health' and 'economy, administration'. Nearly half of the participants are omnivores, followed by flexitarians and vegetarians.

Participants rated three additional items on a 5-point Likert scale ('Do not agree at all' = 1, 'Strongly agree' = 5). According to responses,

Table 2
Summary of the socio-demographic analysis (N = 222).

Variables	Description	Frequency Sample	Share (%) Sample	Share (%) Population Germany - Young Adults between the Ages of 18 and 35[g]
Gender	Female [a]	110	49.5	48.2
	Male [a]	109	49.1	51.8
	Diverse[b]	3	1.4	–
Current situation	Apprentice [a,c]	4	1.8	5.8
	Student [a,d]	134	60.4	23.9
	Employed [a,e]	77	34.7	57.2
	Other [a,c,d,e]	7	3.2	13.1
Occupational field [f]	Construction, architecture, surveying	10	4.5	N.A.
	Services	11	5.0	N.A.
	Electrical	2	0.9	N.A.
	Health	36	16.4	N.A.
	IT, computers	16	7.3	N.A.
	Art, culture, design	2	0.9	N.A.
	Agriculture, nature, environment	8	3.6	N.A.
	Media	4	1.8	N.A.
	Metal, mechanical engineering	7	3.2	N.A.
	Natural sciences	44	20.0	N.A.
	Production, manufacturing	9	4.1	N.A.
	Social work, education	12	5.5	N.A.
	Technology, technology fields	16	7.3	N.A.
	Transportation, logistics	3	1.4	N.A.
	Economy, administration	26	11.8	N.A.
	Other	14	6.4	N.A.
Diet	Omnivorous (all-eaters)	94	42.3	N.A.
	Pescetarian (fish-eating vegetarian)	14	6.3	N.A.
	Flexitarian (occasional meat eater)	54	24.3	N.A.
	Vegetarian (no meat or fish, but honey, eggs, milk, etc.)	35	15.8	N.A.
	Vegan (no animal products)	22	9.9	N.A.
	Other type of diet	3	1.4	N.A.
Migration background	None	169	76.1	N.A.
	Asia	18	8.1	N.A.
	Africa	2	0.9	N.A.
	Europe	38	17.1	N.A.
	Latin America, Caribbean	6	2.7	N.A.
	North America	3	1.4	N.A.
	Australia, Oceania	2	0.9	N.A.

Variables	Unit of measurement	Mean	Standard deviation (SD)	Mean Population Germany - Young Adults between the Ages of 18 and 35[g]
Age	Years	25.90	3.94	N.A.
Height (women)	Meter	1.70	0.06	N.A.
Height (men)	Meter	1.84	0.07	N.A.
Weight (women)	Kilogram	64.34	9.15	N.A.
Weight (men)	Kilogram	84.46	17.05	N.A.
BMI (women)	Kilogram per meter squared	222772.10	–	N.A.
BMI (men)	Kilogram per meter squared	249323.04	–	N.A.
I use packaging colors in the supermarket to assess the health value of food.	5-point Likert scale (Do not agree at all = 1; Do not agree = 2; Neither agree nor disagree = 3; Agree = 4; Strongly agree = 5)	2.23	1.05	N.A.
I go to the supermarket regularly (1 or more times a week) to buy food.	5-point Likert scale (Do not agree at all = 1; Do not agree = 2; Neither agree nor disagree = 3; Agree = 4; Strongly agree = 5)	4.18	0.91	N.A.
I have comprehensive, healthy nutritional knowledge.	5-point Likert scale (Do not agree at all = 1; Do not agree = 2; Neither agree nor disagree = 3; Agree = 4; Strongly agree = 5)	3.59	0.99	N.A.

Note.

[a] Source: Census Data in the version of December 31, 2022, result 12411-0006 (Federal Statistical Office, 2022). for age group 18–35.

[b] "For methodological reasons, cases with the gender characteristics 'unknown' and 'diverse' (as of 2019) cannot be reported separately at this time. Cases with these gender characteristics are allocated to the gender characteristics male and female using a defined recoding procedure." (translated into English) Source: Federal Statistical Office [58]. Bevölkerungsstand. Wie wird mit den Daten von Personen mit den Geschlechtsausprägungen 'unbekannt' oder 'divers' verfahren? Destatis. https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Bevoelkerungsstand/Methoden/Erlauterungen/geschlechtsauspraegungen.html accessed April 3, 2024.

[c] Source: Census Data in the version of December 31, 2022, result 21211-0002 (Federal Statistical Office, 2022). for age group 18–24 and more.

[d] Source: Census Data in the version of winter term 2022/2023, Table csv-21311-15 (Federal Statistical Office, 2022/2023). Data for universities and higher education institutions as a whole, for age group 18–35.

[e] Source: Census Data in the version of June 30, 2023, Employees with social insurance contributions at the workplace by age group (Federal Statistical Office, 2023). for age group 20–34.

[f] Source: Federal Employment Agency (BA). (n.d.). Erkunde die Berufsfelder. (Federal Employment Agency (BA)) Retrieved January 29, 2024, from Arbeitsagentur: https://www.arbeitsagentur.de/bildung/ausbildung/erkunde-die-berufsfelder.

[g] The values have been calculated using the referenced data and approximately represent the values for the age group.

the participants go to the supermarket at least once a week on average. Regarding knowledge about a healthy diet, participants tended to be neutral on average, but in the direction of agreement. On average, it is stated that packaging colors are not (consciously) used to assess the health value of food.

Data from the Federal Statistical Office was used to assess the representativeness of the sample to the 18- to 35-year-olds in Germany. Diverse people are currently not recorded separately [58], so the data is limited to women and men. Men make up 51.8 % of this age group. The study's sample is fairly balanced with 49.5 % women and 49.1 % men. Regarding the 'current situation', the sample is not representative. While the sample mainly comprises students and in second place employees; in the population, employees are predominant, with students in second place.

3.2. Results of the hierarchical Bayes model

By applying HB analysis for both CEs, the average part-worth utilities for the individual attribute levels were estimated for the entire sample, revealing respondents' preferred attribute levels. A higher preference/benefit of an attribute level is associated with a higher part-worth utility score. For better comparability, one attribute level was set to zero for each attribute. Additionally, relative importances of the attributes packaging color, label, price, and origin were estimated to determine their overall importance in product choice.

3.2.1. Results of the hierarchical Bayes model – chickpea choice experiment

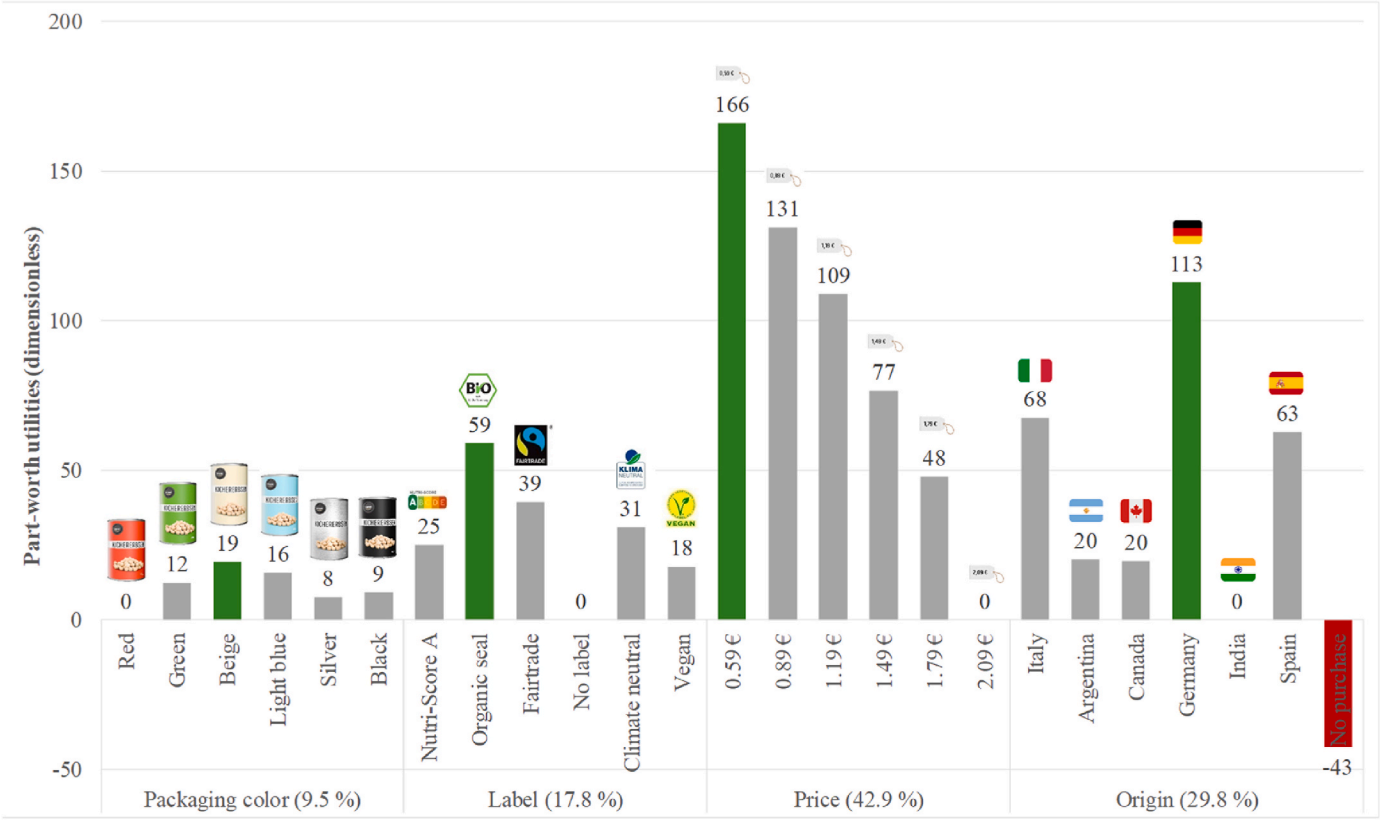
Fig. 1 shows the part-worth utilities and relative importances for the chickpeas.

For the entire sample, beige is the most preferred color, followed by light blue and green, with red being the least favored. The organic label ranks the highest, and the fairtrade label is also quite meaningful compared to the other labels or no label. Regarding prices, as expected, the lowest price is favored, with preference decreasing as the price rises. Germany is the most favored origin, followed by Italy and Spain. More distant countries have considerably lower part-worth utility scores, with India receiving the lowest. Overall, the decisive attribute for product choice is price, followed by origin, label and finally packaging color (9,5 %).

3.2.2. Results of the hierarchical Bayes model – ravioli choice experiment

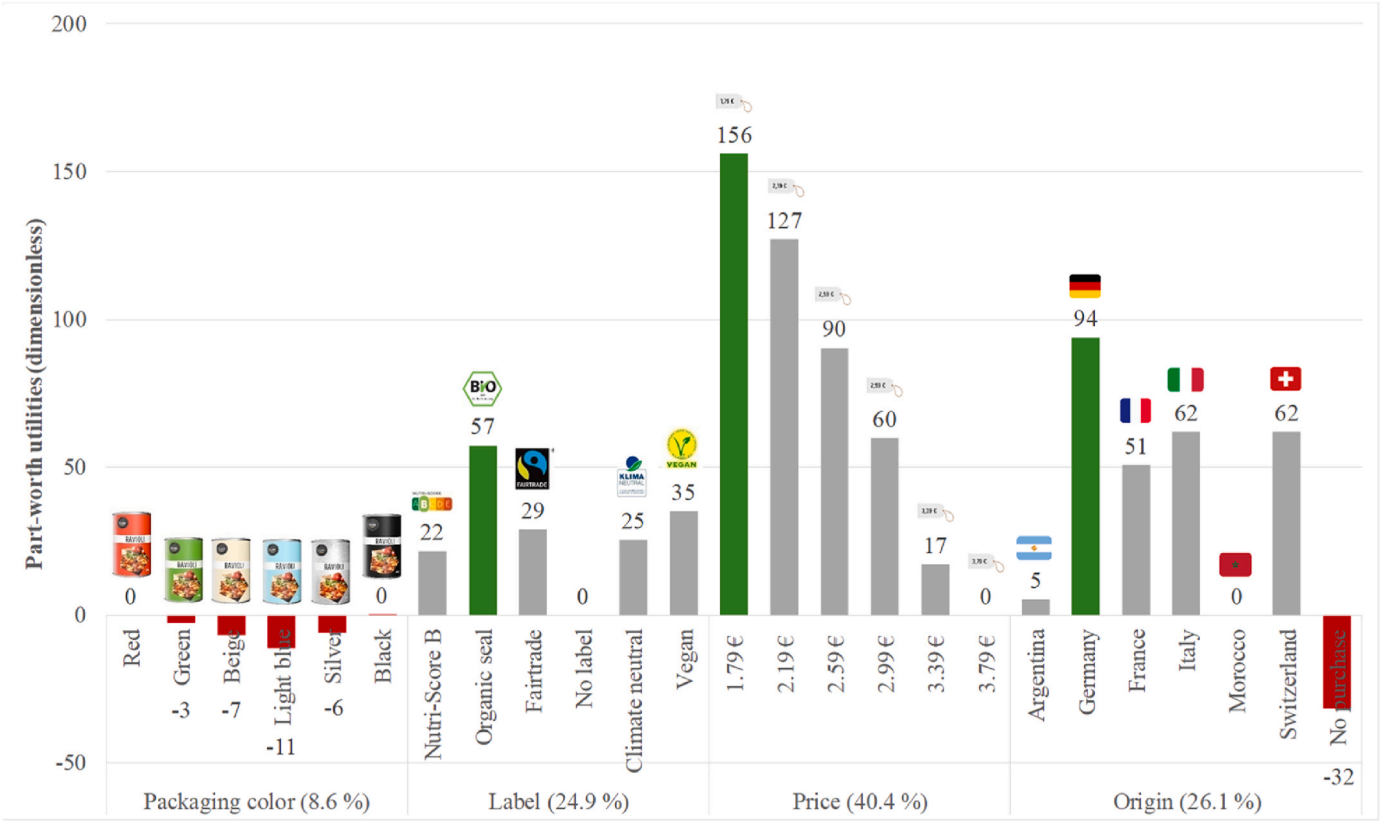
Fig. 2 shows the part-worth utilities and relative importances for the ravioli CE.

Participants prefer the colors red and black equally, closely followed by green, with light blue being the least preferred. The organic label ranks the highest, with the vegan label also appearing important in second place. The cheapest price is again most preferred, with preference decreasing as the price rises. Germany is the most preferred origin, followed by Italy, Switzerland, and France, with the lowest scores for the most distant countries. Overall, price is the most decisive attribute for product choice, followed by origin, label and, with the lowest value,



Note. The columns represent the part-worth utilities for the individual attribute levels that occurred in the choice-sets. The numeric values are used for comparability, but do not have a unit. For completeness, the choice option "none: I would not choose any of these canned chickpeas" is also presented as "no purchase". Below the attribute levels are the corresponding summarizing attributes. The percentage behind them represents the relative importance, so that the attributes can be weighted in terms of their importance for the study participants.

Fig. 1. Resulting part-worth utilities for 'purchase' of chickpea can ($N = 222$).



Note. The columns represent the part-worth utilities for the individual attribute levels that occurred in the choice-sets. The numeric values are used for comparability, but do not have a unit. For completeness, the choice option "none: I would not choose any of these canned ravioli" is also presented as "no purchase". Below the attribute levels are the corresponding summarizing attributes. The percentage behind them represents the relative importance, so that the attributes can be weighted in terms of their importance for the study participants.

Fig. 2. Resulting part-worth utilities for 'purchase' of ravioli can ($N = 222$).

packaging color (8.6 %).

3.2.3. *Product-related differences of preferences for packaging colors and labels*

Fig. 3 shows the part-worth utilities and relative importances the attributes packaging color and label resulting from the chickpea and ravioli CE.

Although packaging color is the least important attribute for both products, it has a slightly higher relative importance for chickpeas (9.5 %) compared to ravioli (8.6 %). For chickpeas, beige, light blue, and green are preferred, while for ravioli, red and black are favored. This indicates that the context and type of product significantly influence color preferences. Interestingly, the relative importance of the attribute label is much higher for ravioli than for chickpeas. The organic label is highly preferred for both products, but the vegan label is more important for ravioli than for chickpeas. Regarding price sensitivity, which is not shown in Fig. 3, both products show a strong preference for the lowest price, but the specific price points differ, reflecting the different market expectations for these products.

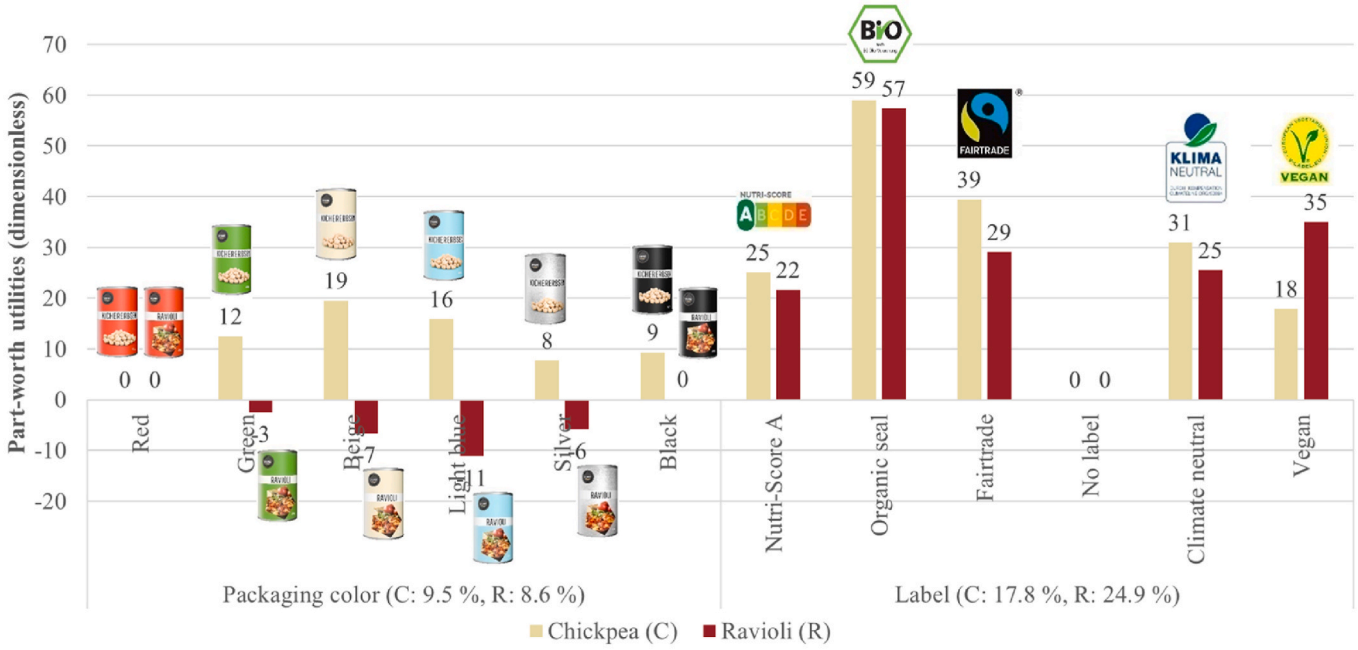
3.3. *Results of the latent class analysis*

In the LCA process, a decision must be made concerning which group model, i.e. how many segments, should be used for further work. There is no uniformly defined indicator for this decision [50,59]. Nevertheless, there are common numerical values, so-called information criteria, that can be used. The Bayesian Information Criteria (BIC) and Akaike Information Criteria (AIC) are frequently used [60]. Furthermore, according to the literature, the Consistent Akaike Information Criterion (CAIC) – a value that is linked to log likelihood – is also important for selection [51]. For the CAIC as well as for the BIC and AIC values, it is described that smaller values are the better choice [49–51,60]. The purposefulness of the segment size should also be considered. In the past, there were also recommended limits for the size of individual segments, but these were not used widely [49]. Generally, the practical benefits of the models must always be weighed up [43].

In this study, a LCA was conducted for both the chickpea and ravioli CE. In each case, a 3-group model was chosen after considering 2- to 5-group models. Tables 3 and 4 show the AIC, CAIC, and BIC values of the different models.

In both LCAs, the AIC values decrease as segments increase. The CAIC and BIC values increase continuously, but only slightly from a 2- to a 3-group model. As these values are not the only criterion, but also the extent to which the models are of practical use, a 3-group model was chosen. This enables better differentiation. The segment sizes appeared to be sufficiently large when considering the sample size.

The next two subchapters describe the segments formed by response behavior in the CEs. Tables A2 and A3 (appendix) list these groups, show



Note. The columns represent the part-worth utilities for the individual attribute levels that occurred in the choice-sets. The numeric values are used for comparability, but do not have a unit. Below the attribute levels are the corresponding summarizing attributes. The percentage behind them represents the relative importance (chickpea = C; ravioli = R), so that the attributes can be weighted in terms of their importance for the study participants.

Fig. 3. Resulting part-worth utilities and relative importances for packaging color and label from both CEs ($N = 222$). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Table 3
Model selection for latent class segmentation - Chickpea can.

No. of Latent Classes	Log-likelihood	AIC	CAIC	BIC	Average Max. Membership Probability
2	−1513.67	3113.33	3392.07	3349.07	0.95
3	−1448.48	3026.96	3448.29	3383.29	0.95
4	−1386.12	2946.24	3510.19	3423.19	0.91
5	−1355.79	2929.58	3636.14	3527.14	0.90

Table 4
Model selection for latent class segmentation - Ravioli can.

No. of Latent Classes	Log-likelihood	AIC	CAIC	BIC	Average Max. Membership Probability
2	−1643.66	3373.32	3652.05	3609.05	0.99
3	−1567.50	3265.01	3686.34	3621.34	0.93
4	−1499.20	3172.40	3736.34	3649.34	0.92
5	−1456.07	3130.14	3836.69	3727.69	0.93

the part-worth utilities for the attribute levels for each group, and the relative importances of the attributes. The first column provides the values of the entire sample for comparison.

This section is structured to provide a comprehensive analysis of the consumer segments identified through latent class analysis (LCA) for both chickpeas and ravioli. It begins with subsection 3.3.1, which details the results of the LCA for the chickpea choice experiment, including the identification of three consumer segments, their characteristics, and the part-worth utilities and relative importances for each segment. Subsection 3.3.2 follows with a similar structure for the ravioli choice experiment. The final subsection, 3.3.3, presents the socio-demographic variables for the estimated segments, providing an overview of the socio-demographic characteristics for each segment in both the chickpea and ravioli choice experiments.

3.3.1. *Results of the latent class analysis – chickpea choice experiment*

The largest group (57.2 %) is called 'price-conscious consumers'. Regarding relative importances, the value for price is the highest, indicating that this segment attaches the greatest importance to price when selecting products such as chickpeas. They prefer green packaging, followed closely by beige, which is the favorite color in the entire sample. Moreover, the organic seal is most important to this group, consistent with all other segments and the entire sample. They favor the lowest price, with preference decreasing as the price rises, as in the entire sample. For origin, Germany is preferred, followed by Italy and Spain. More distant countries are least preferred.

The second group (34.2 %), 'origin-conscious consumers', values origin the most. They prefer light blue packaging, followed by beige. Green has the lowest part-worth utility score. The organic seal is the preferred label, followed by fairtrade – as it is also the case for the 'price-conscious consumers' and the entire sample. They favor the lowest price of 0.59 €, with 1.19 € in second place instead of 0.89 €. Germany is the preferred origin, likewise, followed by Italy and Spain.

The smallest group (8.6 %), 'health-oriented consumers', prefers beige packaging, followed by silver and black, whereas green is in penultimate place. Just as for all other segments, the organic seal is the most important, but the Nutri-Score, rather than fairtrade, has the second-highest part-worth utility score. This suggests a heightened interest in health when selecting products. People in this segment are prepared to invest more money – prices of 0.89 € and 1.19 € have the highest part-worth utility scores. Germany is also the preferred origin, followed by the European countries. Overall, origin is the most

important attribute for this segment. Price and label also appear to be relatively important. While the presence of a label appears to be fundamentally important in the other segments and 'no label' has the lowest part-worth utility score, the lowest part-worth utility score is found here for 'vegan'.

Overall, price is the decisive factor in product choice for 'price-conscious consumers', while origin is the decisive factor for 'origin-conscious consumers'. 'Health-oriented consumers' also focus on origin, but there's a comparatively more balanced distribution of importance among attributes. Packaging color has the lowest relative importances, with the highest value (16.39 %) among 'health-oriented consumers'.

3.3.2. Results of the latent class analysis – ravioli choice experiment

The largest group (55.9 %) includes the 'price-conscious consumers'. The relative importance of price is the highest here, consistent with the entire sample. This segment favors red packaging, whereas the colors beige and light blue have the lowest part-worth utility scores. As in the entire sample, the organic seal scores the highest. The part-worth utility scores decrease as prices rise, with a price of 1.79 € being preferred – aligning with the entire sample. The part-worth utility scores for origin show that more regional products are preferred, with smaller values as countries are further away.

The second group (31.5 %), 'origin-conscious consumers', prioritizes origin, but label and price are also appearing to be quite important when it comes to product choice. The color black, closely followed by green, achieved the highest part-worth utility score. As for the 'price-conscious consumers', the organic seal is particularly beneficial. This group also prefers the lowest price and regional origin whenever possible.

Group 3 (12.6 %) are 'consumers with an interest in plant-based nutrition'. Regarding relative importances, labels rank first, and 'vegan' achieves the highest part-worth utility score among them. These people seem to place particular value on plant-based products. They favor beige packaging, and black color the least. A price of 2.19 € achieves the highest part-worth utility score among prices, indicating a willingness to buy slightly more expensive products. This group also attaches importance to regional origin, with Germany preferred.

Overall, origin preferences are similar across groups. The 'price-conscious consumers' clearly prioritize price when purchasing, whereas the 'origin-conscious consumers' and 'consumers with an interest in plant-based nutrition' find the origin respectively the label most important. Nevertheless, the other attributes (excluding packaging color) also play a relatively important role for the latter two segments, as the values differ less from each other than for the 'price-conscious consumers'. Packaging color is the least relevant for product choice, with the lowest relative importances.

3.4. Results of the socio-demographic variables for the estimated segments

The next two subchapters overview the socio-demographic data. The groups from the two LCAs (chickpeas, ravioli) are presented separately.

This section is structured to provide a detailed analysis of the socio-demographic characteristics of the consumer segments identified through latent class analysis for both chickpeas and ravioli. It begins with a description of the socio-demographic variables for the segments identified in the chickpea choice experiment, highlighting differences and similarities in gender distribution, employment status, occupational fields, dietary preferences, and migration backgrounds among the segments. This is followed by a similar analysis for the segments identified in the ravioli choice experiment.

3.4.1. Results of the socio-demographic variables for the estimated segments – chickpea choice experiment

While the gender distribution of women and men is relatively balanced among the 'price-conscious consumers' and the 'origin-conscious consumers', similar to the entire sample, the 'health-oriented consumers' have 15.8 % more men than women. This group also differs by having a more balanced employee-to-student ratio, with employees even 5.2 % higher than students. The other groups, like the overall sample, have distinctly more students. The 'price-conscious consumers' and 'origin-conscious consumers' have higher shares (17.5 % and 17.3 %) in the occupational field 'health', while the 'health-oriented consumers' show a similarly high share (15.8 %) in the field 'services'. The proportion of 'health-oriented consumers' in the field 'natural sciences' is at least half as high as in the other groups, whereas it is comparatively higher in 'social work, education'. Many people associate a vegan diet with a healthy diet [61], making it surprising that 'health-oriented consumers' include no vegans. This segment also stands out with a relatively high proportion with Asian migration background. Additionally, they scored the lowest on "I have comprehensive, healthy nutritional knowledge." compared to the other groups. Table A4 (appendix) provides a detailed overview.

3.4.2. Results of the socio-demographic variables for the estimated segments – ravioli choice experiment

The overall sample has a fairly balanced proportion of women and men, but groups show clear differences. The 'price-conscious consumers' have 15.4 % more men, the 'origin-conscious consumers' have 22.8 % more women, and the 'consumers with an interest in plant-based nutrition' have 14.2 % more women. It is striking that all three groups have relevant percentage shares in the occupational field 'health', but the value of the 'consumers with an interest in plant-based nutrition' is 14.9 % respectively 12.4 % higher in comparison. The field of 'natural sciences' has high values overall, with the proportion of 'origin-conscious consumers' at 26.5 %, which is 9.6 % respectively 8.6 % higher than the other segments. 'Economy, administration' is comparatively low at 3.6 % among 'consumers with an interest in plant-based nutrition'. Most 'price-conscious consumers' and 'origin-conscious consumers' are omnivores, while most 'consumers with an interest in plant-based nutrition' are vegans or flexitarians. European migration background varies greatly and is the highest among the 'price-conscious consumers' (21.0 %) and the lowest among the 'consumers with an interest in plant-based nutrition' (7.1 %). The BMI for men of the 'consumers with an interest in plant-based nutrition' is unexpectedly high at 26.51 kg/m^2, classified as overweight by the World Health Organization [56]. Table A5 (appendix) provides a detailed overview.

3.5. Results of the factor analysis for the psychographic constructs

Three principal component factor analyses with varimax rotation (with Kaiser normalization) were conducted.

The Kaiser-Meyer-Olkin (KMO) test and the Bartlett test for sphericity (BTS) were used to check the suitability of the factor analyses. KMO-values range between 0 and 1 [62]. Below 0.50, KMOs are considered unacceptable [63]. Using Bartlett's test, the hypothesis is tested "that all correlation coefficients in the population have the value zero" (translated into English) [62], which would mean that no variables correlate [43,62].

The first factor analysis for the factors 'pleasure', 'quality aspects' and 'social desirability' has a KMO-value of 0.750 and the BTS is significant (<0.001).

The second factor analysis for the factors 'environmental consciousness – responsibility feeling', 'visual product aesthetics – value', 'visual product aesthetics – response' and 'price consciousness' has a KMO-value of 0.811 and the BTS is significant (<0.001).

The third factor analysis for the factors 'weight-controlling eating behavior', 'motivation for health prevention and promotion' and 'health-conscious eating behavior' yields a KMO-value of 0.824 and the BTS is significant (<0.001).

According to Kaiser, the KMO-value for the first factor analysis can be classified as 'middling', while the values of the second and third are described as 'meritorious' [63]. The BTS is significant in all factor analyses, so that the null hypotheses can be rejected [62]. All factor

analyses can therefore be conducted.

Table A6 (appendix) lists all factors with their items and corresponding mean value, standard deviation and factor loading. The first factor analysis excluded two items in its final version. Negatively formulated items were rewritten positively for factor loadings having the same direction [43]. The individual scales' reliability was tested using Cronbach's alpha. It takes on values between 0 and 1 [64] and provides information on whether a scale with its items always measures the same thing – known as internal consistency [64]. There are no uniform recommendations in the literature, but higher values are better [62]. Values from 0.6 [43] or 0.7 are considered acceptable and a value of 0.9 should not be exceeded [64]. For the factors used, values range between 0.507 and 0.895. The factors 'social desirability' and 'price consciousness' are only slightly below the threshold value of 0.6 and were included in further evaluation.

The factors extracted from the factor analyses were used to describe respectively compare the individual groups from the LCAs based on the constructs. Tables A7 and A8 (appendix) list mean values for the extracted factors by group. Following an ANOVA, Tukey HSD tests were used to specify significant differences more precisely. Results are described in subsections 3.5.1 and 3.5.2. The extracted factors are described in terms of their mean values, standard deviations, and factor loadings, with reliability assessed using Cronbach's alpha. The section concludes with a discussion of the implications of these findings for understanding consumer segments.

3.5.1. Comparison of the estimated segments according to the psychographic constructs – chickpea choice experiment

The 'origin-conscious consumers' with the highest mean values for 'quality aspects' and 'health-conscious eating behavior' among the segments, differ significantly from the 'price-conscious consumers' with the lowest means of these factors, whereas the 'health-conscious consumers' belong to both subgroups. The 'origin-conscious consumers' most prefer regional food, value handmade products, traditional production and animal welfare, and seek natural products. They ensure, the most of all groups, a balanced diet with fresh vegetables, and prioritize seasonal and organic foods.

Regarding 'environmental consciousness – responsibility feeling', the 'origin-conscious consumers' also achieve a significantly higher mean value and are the most aware of their contribution to environmental pollution; however, the 'health-oriented consumers' have the lowest mean value here and the 'price-conscious consumers' belong to both subgroups.

When it comes to 'price consciousness', the 'price-conscious consumers' (the highest value) differ significantly from the 'health-oriented consumers' (the lowest value) and aim the most to spend minimally on food. The 'origin-conscious consumers' belong to both subgroups.

'Weight-controlling eating behavior', indicating concern for weight maintenance, achieves the highest mean value among the 'health-oriented consumers'. This distinguishes them significantly from the 'origin-conscious consumers' with the lowest value. The 'price-conscious consumers' can be assigned to both subgroups. The remaining constructs show no significant differences between the three groups.

3.5.2. Comparison of the estimated segments according to the psychographic constructs – ravioli choice experiment

The enjoyment of food is significantly more important for 'consumers with an interest in plant-based nutrition'. In comparison, the 'price-conscious consumers' score the lowest here, while the 'origin-conscious consumers' fit both subgroups.

For 'quality aspects' (regional food, handmade products, traditional production, animal welfare, and natural products), the 'origin-conscious consumers' with the highest value differ significantly from the 'price-conscious consumers' with the lowest. 'Consumers with an interest in plant-based nutrition' fit both groups.

The 'consumers with an interest in plant-based nutrition' score the highest for 'health-conscious eating behavior' (balanced diet with fresh vegetables; seasonal, regional and organic foods). The 'origin-conscious consumers' are in the same group. With the lowest value, the 'price-conscious consumers' differ significantly from the other groups. The remaining constructs show no significant differences among the groups.

3.6. Results of the chickpea image query – total sample

The image query describes the perception of the six packaging colors for canned chickpeas using fourteen different items (Fig. 4). Mean values shown increase outward on a spider web; interpreted via a 5-point Likert scale (Do not agree at all = 1, Strongly agree = 5). First, the entire sample's results are described. The following subchapters describe the results from the chickpea CE's latent classes.

Color seems to influence how the entire sample perceives the can's health value. Only the green can received quite clear agreement on the statement "The tin can contains healthy food". On average, green is also associated with healthy food. Red does not convey food health value.

Overall, respondents perceive the product in black packaging as high-quality and expensive. Green promises them an environmentally friendly product and they associate this color with sustainability, contrary to red, silver or black packaging. Light blue reflects the can's contents the least for respondents.

3.6.1. Results of the image query – price-conscious consumers (LCA chickpeas)

For 'price-conscious consumers' (Fig. A3 and Table A9, appendix), packaging color seems to influence perceived product healthiness. Only green packaging receives clear approval. Generally, this color is also associated with healthy food, whereas red tends to be rejected in this context. Red and silver are the least likely to convey health value.

Red packaging does not appeal to respondents design-wise. Chickpeas look classy in black packaging, contrary to red. Green promises 'price-conscious consumers' an environmentally friendly product; red does not – silver and black hardly either. According to this group, black packaging makes the product appear expensive. Light blue does not match the contents for these respondents.

3.6.2. Results of the image query – origin-conscious consumers (LCA chickpeas)

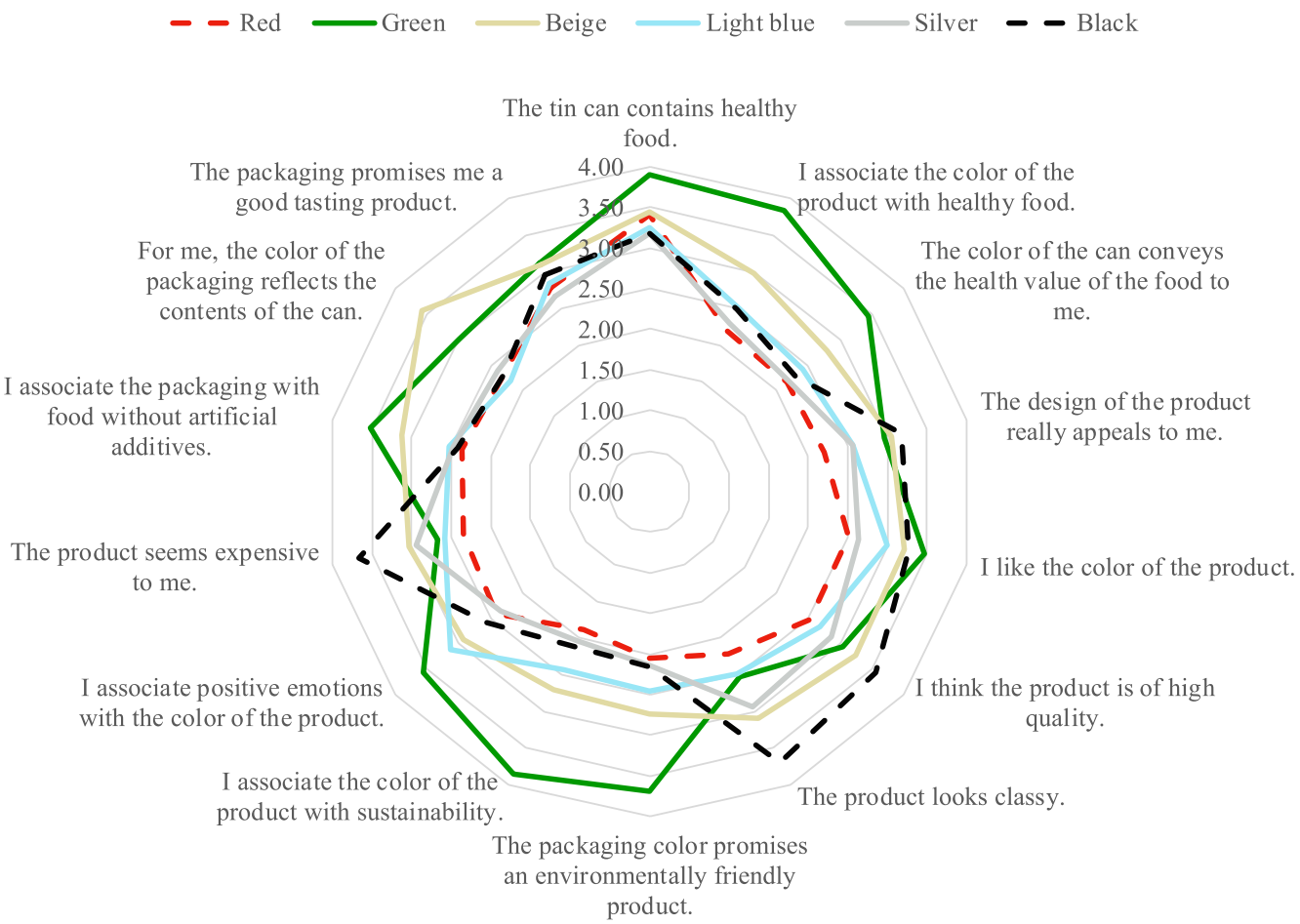
The 'origin-conscious consumers' (Fig. A4 and Table A9, appendix) clearly affirm the green can as containing healthy food. They also associate this color with healthy food, while clearly rejecting red. The red can also does not convey food's health value.

This segment finds a black can classy, unlike red. Green packaging promises an environmentally friendly product, in contrast red and silver ones are equally rejected. Sustainability is associated with green, but not with red, silver, or black. A black can makes the product appear expensive. The black packaging conveys an impression of luxury and quality, traits that align with the preferences of origin-conscious consumers, who often associate premium attributes with products of a specific geographic origin. The perception of black as expensive can amplify the perceived exclusivity of origin-conscious products, reinforcing consumer beliefs about the superior quality and authenticity associated with these origins. For 'origin-conscious consumers', the color light blue does not reflect the can's contents.

3.6.3. Results of the image query – health-oriented consumers (LCA chickpeas)

Color also seems to influence the perception of the product's health value among 'health-oriented consumers' (Fig. A5 and Table A9, appendix). The colors light blue and black are clearly rejected – surprisingly not red. Furthermore, light blue is clearly not associated with healthy food, with similar ratings for silver and black.

According to the 'health-oriented consumers', the packaging color black clearly does not promise an environmentally friendly product, but



Note. The six differently colored (red, green, beige, light blue, silver, black) chickpea cans from the choice experiment were each to be rated on the items shown. This was measured using a 5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5). The graphic illustrates the mean values of the results for the individual colors.

Fig. 4. Results image query total sample – Chickpea can (N = 222).

neither do silver and light blue. Silver and black are not associated with sustainability, similar to red. Respondents do not associate a product without artificial additives with the colors light blue and black. Additionally, black and silver do not reflect the can's contents.

4. Discussion

The CEs both showed that price is the decisive factor in product choice and that the lowest price is preferred overall. This can probably be explained by the fact that food is generally a low-involvement product, which means that a purchase decision is only accompanied by a slight examination of the product (packaging) attributes and the price, for example, is given priority when making a quick decision [65] – as can be seen here by the predominantly 'price-conscious consumers'.

Domestic products are favored by respondents – as is often shown by existing literature using con-joint analysis, according to Thøgersen [66]. Exceptions can be developing countries that prefer products from more developed countries [66]. The most distant countries represent a typical result with the lowest part-worth utilities for the product attribute origin [66]. Importance of country of origin can be influenced by intrinsic qualities such as fat content or extrinsic qualities such as production method [66]. Thus, not all latent classes in the present study attach the same importance to origin. Other study designs, apart from conjoint analysis, also show that origin is important, but they may not always highlight as strong effects, especially when attention is not specifically directed towards origin [66]. For consumers, origin is often associated with quality, but also shorter transportation routes (environmental aspect) or a sense of obligation to support one's own country [66].

Generally, the presence of labels (compared with 'no label'), especially the organic seal, appears to be important for respondents. Reasons for buying organic food can include the following: "free of harmful ingredients, sensory aspect, quality, health attribute, environment, and personal health concern" [67]. In the study by Plasek et al. [6], the organic attribute made the second strongest positive contribution to health perception of the product examined. Even though there can be many reasons for buying organic products, the likelihood of buying them does not necessarily have to differ from that of a conventional comparison product, as can be seen in the study by Ellison et al. [68] when comparing strawberries and chocolate sandwich cookies (conventional vs. organic), whereby expected higher costs may have played a role.

In the 'health-oriented consumers' segment, it is noticeable that they

only have a mean value of 3.26 for the statement "I have comprehensive, healthy nutritional knowledge." (Table A4, appendix) and therefore a fairly neutral attitude. One explanation could possibly be that there is little knowledge, but there is interest and therefore perhaps particular value is placed on the Nutri-Score compared to the other segments. People with more knowledge would perhaps pay little attention to the Nutri-Score, as they are aware of the health values of products. According to a study by Temmerman et al. [69], the Nutri-Score makes it easier for consumers to evaluate the healthiness of products. Additionally, the label can reinforce the health perception of healthy foods [69].

4.1. Role and perception of packaging Color

The packaging color plays the least role in the choice of chickpeas or ravioli when it comes exclusively to personal preferences. However, it can also be the most decisive factor in the targeted selection of the product perceived to be the healthiest, as shown by Plasek et al. [6]. However, the general importance may also depend on the consumer segment. The LCA of the chickpea's choice-experiment shows that the 'health-oriented consumers' segment has a comparatively high value of 16.39 % for the relative importance of packaging color. For 'health--conscious consumers', the effect of color seems to be more important, whereby the purchase intention [11], such as the search for healthier products, presumably plays a role in this context.

Overall, the warm color beige is the favorite for chickpeas. The color harmonizes with the chickpeas, i.e. with the contents of the packaging. This is consistent with the result of the image query regarding the reflection of the content by color, whereby the value for beige is surprisingly not particularly high (3.57). In the study by Wąsowicz et al. [10], for example, the color amber was associated with vegetables or fruit contained in the product and thus with health and naturalness. The image query shows an overall neutral attitude towards an association with healthy food for the color beige, as well as in conveying the health value through the color. However, the color seems to have a slightly positive influence on the perception of the health value (item: "The tin can contains healthy food."), especially for the segments 'price-conscious consumers' and 'origin-conscious consumers'.

The cool colors light blue and green follow in second and third place regarding the part-worth utility values of the entire sample for the packaging colors. Green creates some positive associations: The participants perceive the contents of the can as healthy and associate the color with healthy food. Additionally, it tends to convey an environmentally friendly product, thus confirming statements from the literature [8] and is associated with sustainability. This overall picture is well reflected by the 'price-conscious consumers' and 'origin-conscious consumers', whereas the 'health-oriented consumers' take a more neutral stance. Green is associated with nature and in direct relation to food, it can be associated with vegetables and therefore also with naturalness, as the study by Wąsowicz et al. [10] shows. In the study by Hallez et al. [7], green not only led to a higher perception of healthiness, but also to a higher perception of sustainability. Generally, it is the cool colors that often contribute to a greater health perception than warm colors [5]. There are hardly any meaningful evaluations of light blue in the image query, but for consumers the color does not reflect the content. Only the segment of 'health-oriented consumers' stands out with several negative attitudes. The color causes people in this group not to classify the can's contents as healthy. They also do not associate this color with healthy foods, although the color is often seen in the context of 'light' products. Huang & Lu [11] describe that a blue packaging color and the label 'light' lead to a healthier product perception. Possibly this color appears to be inappropriate for this product in particular, just as in the study by Wąsowicz et al. [10] colors are evaluated differently depending on the product. Huang & Lu [11] recommend blue in the context of low-fat foods. Furthermore, blue does not promise the 'health-oriented consumers' an environmentally friendly product and they do not associate it with a product without artificial additives.

The comparison product ravioli shows differences in terms of packaging colors and thus confirms that colors have an influence on preferences [8], even if the importance here is low. Red and black are preferred – equally. Presumably, red is associated with tomato sauce [10], while black could have a noble effect and presumably promises quality [5]. In the ranking, light blue takes last place, a color that is often found in connection with 'light' products in the supermarket, but perhaps seems inappropriate here, as ravioli is not necessarily associated with a low-fat product [11]. Moreover, it is probably the least harmonious color.

When designing products, you always must ask yourself which target group you want to address – for example, people with an interest in health or everyone, but with the aim of helping them to make healthier purchases. However, it is also important how strongly people react to visual stimuli. Of all groups (chickpea CE), the 'health-oriented consumers' place the least value on the 'visual product aesthetics', i.e. the design is not quite as important to them emotionally. In the context of purchasing behavior, however, appealing products seem to be able to entice this segment the most to make a purchase (the highest mean value in the comparison). This means that these people could actually react more strongly to an appropriate design. The relative importance of the packaging color was also quite high in relation to the other segments. However, the image query shows no positive (only negative) color effects for 'health-oriented consumers'. In the case of ravioli, 'origin-conscious consumers' are comparatively more likely to be tempted to buy by an appealing design ('visual product aesthetics – response'). All these differences mentioned regarding constructs are not significant though but could maybe show a tendency. Presumably, however, a certain willingness to consume healthy products must exist in principle.

4.2. Limitations and future research

The gender distribution in this study can be classified as representative for the German population. Regarding the current employment situation of respondents, the sample is not representative. In particular, the proportion of students and employees is almost the opposite of the population. As part of the recruitment process, primarily people from local areas were reached and therefore also people with a similar background (student status; same university, same campus and therefore: similar professional fields). Generalization to other countries is not possible straight away, as colors can have different associations for cultural reasons [70]. Additionally, the results of the LCA may not be that reliable due to a sample size <300 [60]. Furthermore, a positive or negative basic attitude towards the products may have influenced the results.

A shortcoming of the present study is the inclusion of, in many cases possibly meat-containing, ravioli as a control product, which may not fully address the dietary preferences of vegetarians and vegans, who constituted 25 % of the sample. This choice was made to represent a common, nutritionally contrasting processed food within the German market, aligning with the study's objective of exploring consumer perceptions influenced by packaging color and other attributes. However, we acknowledge that this limits the applicability of our findings to fully plant-based consumer groups. Future research could incorporate vegan or plant-based alternatives to better capture the preferences and perceptions of this demographic while maintaining the study's focus on packaging strategies for promoting healthier food choices.

The colors may have been perceived differently, as due to location-independent participation, no consistently calibrated screens were used, as in the study by Huang & Lu [11], and the environment was individual. It is also possible that the graphical illustrations (regarding size) had a different effect on participants, depending on whether they completed the questionnaire on a cell phone or a laptop, for example.

An online questionnaire contributes to good accessibility of people but does not recreate a real situation in the supermarket or the sight of a real product. By using a CE, respondents were inevitably exposed to

selected product attributes that they might not even pay attention to when simply looking at a product package, which can lead to a bias in the results [66]. By displaying the attributes separately, we did not assess the extent to which the packaging color has a (positive) supporting influence on the overall perception. For example, nutrition content claims and a matching color can interact to create a positive effect [11]. Nevertheless, the present study expands the state of knowledge regarding a healthy food outside the snack category regarding the effect of colors on health perception, while also including other potential aspects.

However, regarding previous studies [5], it is important to note that the findings cannot necessarily be transferred to other healthy products. Furthermore, a second image query for ravioli would be interesting to see to what extent there are differences in packaging colors regarding perception. Based on existing literature [5], differences can be assumed, as colors must be seen in connection with the context respectively product [11]. Therefore, a consideration to conduct the image query only once, but with 'blank' cans (without product category) would most likely not have been very informative, as the results could not have been transferred to any random product. We acknowledge the potential value of incorporating eye-tracking studies to supplement the image query and the choice experiment. Eye-tracking technology provides detailed insights into visual attention and cognitive processes, which can enhance our understanding of consumer behavior [71]. By capturing real-time eye movements, one can identify which packaging elements attract the most attention and how consumers visually navigate product choices [72]. This method has been shown to improve the accuracy of predicting consumer preferences and decision-making strategies [73]. For instance, Meyerding and Merz [71] demonstrated the effectiveness of combining choice-based conjoint analysis with eye-tracking to understand consumer preferences for organic labels on apples, highlighting how visual attention data can complement traditional survey methods to provide a more comprehensive analysis of consumer behavior. Additionally, the CEs could be conducted a second time with the task of choosing the healthiest product to determine how decisive the packaging color is compared to the choice according to personal preferences, which may also depend on purchase intention. This would enable the findings of this study to be expanded further. It would not have been purposeful to include these aspects as it would have overwhelmed the participants, and it would not have fitted the scope of this study. The investigation on a physiological level, e.g. using EEG or fNIRS [74,75], should be integrated in the future to better understand the underlying mechanisms of color perception and to be able to better evaluate previous results [5].

Individual variations in color perception can arise from several sources, including genetic differences, such as color blindness, and perceptual phenomena like color constancy and color induction [16]. Environmental factors, such as the spectral composition of illumination, test geometry, and luminance, also play a crucial role in how colors are perceived [76]. To comprehensively understand these influences, future research should incorporate psychophysical tests, including eye-tracking studies, which provide detailed insights into visual processing and are less susceptible to conscious control by participants [71, 77]. These methodologies will enhance our understanding of the complex interplay between individual and environmental factors in color perception.

Another limitation of this study is the scope of the color experiment. While six packaging colors were tested to assess their influence on health perception and product choice, this number may not sufficiently capture the full spectrum of complex effects that color can have on consumer decision-making. Additionally, the study did not explore specific mechanisms underlying color perception, such as psychological associations, cultural influences, or potential interactions with other sensory attributes. Future research should incorporate a more extensive range of colors, along with variations in hue, brightness, and saturation, to uncover finer nuances in how consumers interpret packaging color. Combining these studies with psychophysical methods, such as eye-tracking or physiological measurements (e.g., EEG or fNIRS), could provide a more comprehensive understanding of color's impact on choice behavior.

5. Conclusions

This study highlights the nuanced impact of packaging color on consumer perceptions and choices, particularly in the context of healthy and unhealthy food products. While price emerged as the most influential factor in product choice, the role of packaging color, though less significant, varied across different consumer segments. Specifically, green packaging was associated with higher health perceptions, aligning with previous research that links cool colors to healthiness. Beige packaging, preferred overall, subtly enhanced health perception by harmonizing with the product contents.

However, several limitations must be acknowledged. First, the study sample primarily comprised students and young adults, limiting the generalizability of findings to other age groups or broader demographic populations. Second, the use of an online survey with digital renderings of packaging may not fully replicate real-world decision-making contexts, where physical interactions with products and environmental factors such as lighting may play a role. Additionally, while we included six packaging colors, this range may not capture the full spectrum of effects different hues, brightness, and saturation levels may have on consumer behavior. Lastly, the cultural specificity of the study, conducted in Germany, may limit the applicability of the findings to other cultural contexts with differing color associations.

The findings underscore the importance of considering both individual and environmental factors in color perception. Future research should delve deeper into the psychophysical aspects of color perception, incorporating methodologies such as eye-tracking and controlled lighting conditions to better understand the underlying mechanisms. Additionally, exploring the impact of packaging color on a broader range of food products and in different cultural contexts would provide more comprehensive insights.

CRediT authorship contribution statement

Saskia Buse: Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Stephan G.H. Meyerding:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

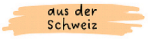
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

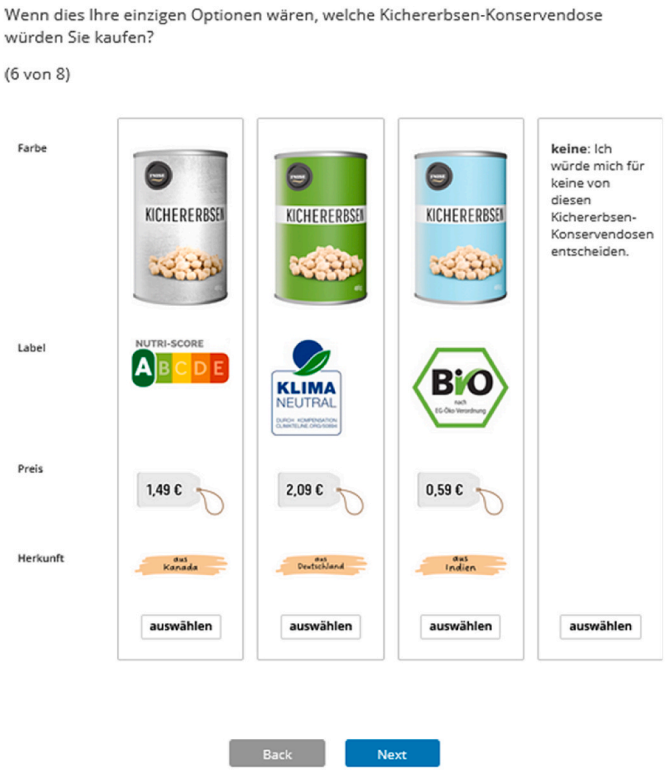
Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jafr.2025.101690.

Appendix

Table A1
Attributes and their levels used in the ravioli choice experiment.

Attributes	Levels					
Packaging color	Red	Green	Beige	Light blue	Silver	Black
						
Label	Nutri-Score B	Organic seal	Fairtrade	No label	Climate neutral	Vegan
						
Price	1,79 €	2,19 €	2,59 €	2,99 €	3,39 €	3,79 €
						
Origin	Argentina	Germany	France	Italy	Morocco	Switzerland
						



Note. This exemplary excerpt is taken from the original german questionnaire. For better understanding, translations of essential elements follow. The header "Wenn dies Ihre einzigen Optionen wären, welche Kichererbsen-Konservendose würden Sie kaufen?" means "If these were your only options, which can of chickpeas would you buy?" The elements on the left (top to bottom) have the following meanings: "Farbe" = "color", "Label" = "label", "Preis" = "price", "Herkunft" = "origin" The meanings of individual elements within the options to be selected are as follows: "Kichererbsen" = "chickpeas", "klimaneutral" = "climate neutral", "aus Kanada" = "from Canada", "aus Deutschland" = "from Germany", "aus Indien" = "from India", "auswählen" (button) = "select"

The option far right "keine: ich würde mich für keine von diesen Kichererbsen-Konservendosen entscheiden." means "none: I would not choose any of these canned chickpeas."

*Regarding prices: In German, decimal places are separated by commas.

Fig. A1. Example choice-set in the chickpea choice experiment.

Note. This exemplary excerpt is taken from the original german questionnaire. For better understanding, translations of essential elements follow. The header "Wenn dies Ihre einzigen Optionen wären, welche Ravioli-Konservendose würden Sie kaufen?" means "If these were your only options, which can of ravioli would you buy?" The elements on the left (top to bottom) have the following meanings: "Farbe" = "color", "Label" = "label", "Preis" = "price", "Herkunft" = "origin" The meanings of individual elements within the options to be selected are as follows: "Ravioli" = "ravioli", "klimaneutral" = "climate neutral", "aus Deutschland" = "from Germany", "aus Frankreich" = "from France", "aus der Schweiz" = "from Switzerland", "auswählen" (button) = "select"

The option far right "keine: ich würde mich für keine von diesen Ravioli-Konservendosen entscheiden." means "none: I would not choose any of these canned ravioli."

*Regarding prices: In German, decimal places are separated by commas.

Fig. A2. Example choice-set in the ravioli choice experiment.

Table A2
Part-worth utilities for the different consumer groups - Chickpea can (N = 222).

Attribute	Levels	Total Sample (100.0 %)	Group 1: Price-Conscious Consumers (57.2 %)	Group 2: Origin-Conscious Consumers (34.2 %)	Group 3: Health-Oriented Consumers (8.6 %)
Packaging color	Red	0.00	0.00	0.00	0.00
	Green	12.45	23.83	−3.51	0.18
	Beige	19.49	20.25	13.40	38.71
	Light blue	15.86	15.79	14.08	23.44
	Silver	7.65	6.33	5.00	27.03
	Black	9.31	13.02	−0.80	25.00
Label	Nutri-Score A	25.07	29.31	18.29	23.79
	Organic seal	59.02	52.65	70.66	55.02
	Fairtrade	39.43	35.02	51.56	20.44
	No label	0.00	0.00	0.00	0.00

(*continued on next page*)

Table A2 (*continued*)

Attribute	Levels	Total Sample (100.0 %)	Group 1: Price-Conscious Consumers (57.2 %)	Group 2: Origin-Conscious Consumers (34.2 %)	Group 3: Health-Oriented Consumers (8.6 %)
	Climate neutral	30.97	33.10	33.87	5.18
	Vegan	17.86	21.90	17.57	−7.98
Price	0.59 €	166.15	217.96	106.37	58.92
	0.89 €	131.30	170.07	82.48	67.34
	1.19 €	109.05	128.64	86.86	66.91
	1.49 €	76.58	87.21	64.33	54.50
	1.79 €	47.91	50.63	49.16	24.78
	2.09 €	0.00	0.00	0.00	0.00
Origin	Italy	67.65	41.15	111.37	69.91
	Argentina	20.22	7.77	35.71	41.51
	Canada	19.72	9.56	36.93	18.81
	Germany	112.91	71.04	177.13	135.88
	India	0.00	0.00	0.00	0.00
	Spain	62.86	39.78	99.87	69.03
None	No purchase	−42.64	−74.61	−19.78	79.62
Relative Importance (%)					
	Packaging color	9.54	9.28	8.26	16.39
	Label	17.75	16.40	19.08	21.50
	Price	42.88	54.52	28.31	23.30
	Origin	29.83	19.80	44.34	38.81

Table A3
Part-worth utilities for the different consumer groups - Ravioli can (N = 222).

Attribute	Levels	Total Sample (100.0 %)	Group 1: Price-Conscious Consumers (55.9 %)	Group 2: Origin-Conscious Consumers (31.5 %)	Group 3: Consumers with an interest in plant-based nutrition (12.6 %)
Packaging color	Red	0.00	0.00	0.00	0.00
	Green	−2.55	−8.20	8.03	−4.00
	Beige	−6.63	−12.43	−4.25	13.09
	Light blue	−11.18	−12.59	−11.24	−4.75
	Silver	−5.86	−6.12	−8.71	2.42
	Black	0.11	−3.47	8.65	−5.41
Label	Nutri-Score B	21.62	19.32	24.44	24.75
	Organic seal	57.35	52.52	72.77	40.15
	Fairtrade	29.04	28.59	37.17	10.69
	No label	0.00	0.00	0.00	0.00
	Climate neutral	25.47	25.51	34.16	3.55
	Vegan	35.02	18.72	30.49	118.54
Price	1.79 €	156.03	207.35	97.08	76.12
	2.19 €	127.01	157.42	87.93	90.05
	2.59 €	90.37	112.24	67.36	51.09
	2.99 €	59.79	65.52	49.74	59.53
	3.39 €	17.01	16.87	20.28	9.47
	3.79 €	0.00	0.00	0.00	0.00
Origin	Argentina	5.27	13.46	−8.02	2.23
	Germany	93.91	65.62	133.68	119.77
	France	50.76	37.02	70.14	63.15
	Italy	61.83	53.20	72.03	74.55
	Morocco	0.00	0.00	0.00	0.00
	Switzerland	62.00	51.73	81.05	59.82
None	No purchase	−31.62	−55.74	−52.13	126.43
Relative importance (%)					
	Packaging color	8.59	7.74	10.04	8.69
	Label	24.86	21.07	27.12	35.95
	Price	40.43	52.13	26.21	24.12
	Origin	26.13	19.05	36.63	31.24

Table A4
Overview of sociodemographic attributes for latent class segments - Chickpea can (N = 222).

Variables	Description	Share (%) Total Sample	Share (%) Group 1: Price-Conscious Consumers	Share (%) Group 2: Origin-Conscious Consumers	Share (%) Group 3: Health-Oriented Consumers
Gender	Female	49.5	51.2	48.7	42.1
	Male	49.1	48.0	48.7	57.9
	Diverse	1.4	0.8	2.6	0.0
Current situation	Apprentice	1.8	0.8	3.9	0
	Student	60.4	59.8	64.5	47.4
	Employed	34.7	35.4	28.9	52.6
	Other	3.2	3.9	2.6	0.0
Occupational field	Construction, architecture, surveying	4.5	5.6	4.0	0.0
	Services	5.0	5.6	1.3	15.8
	Electrical	0.9	0.8	0.0	5.3
	Health	16.4	17.5	17.3	5.3
	IT, computers	7.3	6.3	9.3	5.3
	Art, culture, design	0.9	0.8	1.3	0.0
	Agriculture, nature, environment	3.6	2.4	5.3	5.3
	Media	1.8	2.4	0.0	5.3
	Metal, mechanical engineering	3.2	4.0	2.7	0.0
	Natural sciences	20.0	19.0	24.0	10.5
	Production, manufacturing	4.1	4.0	4.0	5.3
	Social work, education	5.5	4.0	6.7	10.5
	Technology, technology fields	7.3	6.3	8.0	10.5
	Transportation, logistics	1.4	1.6	0.0	5.3
	Economy, administration	11.8	14.3	8.0	10.5
	Other	6.4	5.6	8.0	5.3
Diet	Omnivorous (all-eaters)	42.3	48.0	31.6	47.4
	Pescetarian (fish-eating vegetarian)	6.3	6.3	6.6	5.3
	Flexitarian (occasional meat eater)	24.3	18.9	30.3	36.8
	Vegetarian (no meat or fish, but honey, eggs, milk, etc.)	15.8	15.0	19.7	5.3
	Vegan (no animal products)	9.9	11.0	10.5	0
	Other type of diet	1.4	0.8	1.3	5.3
Migration background	None	76.1	87.0	75.0	68.4
	Asia	8.1	7.1	6.6	21.1
	Africa	0.9	1.6	0.0	0.0
	Europe	17.1	16.5	18.4	15.8
	Latin America, Caribbean	2.7	2.4	3.9	0.0
	North America	1.4	2.4	0.0	0.0
	Australia, Oceania	0.9	1.6	0.0	0.0

Variables	Unit of measurement	Mean			
		Total Sample	Group 1: Price-Conscious Consumers	Group 2: Origin-Conscious Consumers	Group 3: Health-Oriented Consumers
Age	Years	25.90	25.52	26.12	27.53
Height (women)	Meter	1.70	1.71	1.68	1.70
Height (men)	Meter	1.84	1.85	1.83	1.81
Weight (women)	Kilogram	64.34	65.78	62.08	62.86
Weight (men)	Kilogram	84.46	86.71	81.06	83.55
BMI (women)	Kilogram per meter squared	222772.10	225257.53	219041.32	218599.56
BMI (men)	Kilogram per meter squared	249323.04	252720.36	242256.94	253993.38
I use packaging colors in the supermarket to assess the health value of food.	5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5)	2.23	2.24	2.18	2.37
I go to the supermarket regularly (1 or more times a week) to buy food.	5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5)	4.18	4.17	4.26	3.95
I have comprehensive, healthy nutritional knowledge.	5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5)	3.59	3.59	3.68	3.26

Table A5
Overview of sociodemographic attributes for latent class segments - Ravioli can (N = 222).

Variables	Description	Share (%) Total Sample	Share (%) Group 1: Price-Conscious Consumers	Share (%) Group 2: Origin-Conscious Consumers	Share (%) Group 3: Consumers with an interest in plant-based nutrition
Gender	Female	49.5	41.1	61.4	57.1
	Male	49.1	56.5	38.6	42.9
	Diverse	1.4	2.4	0.0	0.0
Current situation	Apprentice	1.8	2.4	1.4	0.0
	Student	60.4	58.1	65.7	57.1
	Employed	34.7	36.3	31.4	35.7
	Other	3.2	3.2	1.4	7.1
Occupational field	Construction, architecture, surveying	4.5	4.8	5.9	0.0
	Services	5.0	6.5	2.9	3.6
	Electrical	0.9	0.8	0.0	3.6
	Health	16.4	13.7	16.2	28.6
	IT, computers	7.3	9.7	4.4	3.6
	Art, culture, design	0.9	0.0	1.5	3.6
	Agriculture, nature, environment	3.6	4.8	1.5	3.6
	Media	1.8	2.4	0.0	3.6
	Metal, mechanical engineering	3.2	4.0	2.9	0.0
	Natural sciences	20.0	16.9	26.5	17.9
	Production, manufacturing	4.1	3.2	5.9	3.6
	Social work, education	5.5	4.0	7.4	7.1
	Technology, technology fields	7.3	8.1	4.4	10.7
	Transportation, logistics	1.4	1.6	1.5	0.0
	Economy, administration	11.8	12.9	13.2	3.6
	Other	6.4	6.5	5.9	7.1
Diet	Omnivorous (all-eaters)	42.3	47.6	42.9	17.9
	Pescetarian (fish-eating vegetarian)	6.3	6.5	7.1	3.6
	Flexitarian (occasional meat eater)	24.3	21.8	24.3	35.7
	Vegetarian (no meat or fish, but honey, eggs, milk, etc.)	15.8	17.7	15.7	7.1
	Vegan (no animal products)	9.9	5.6	7.1	35.7
	Other type of diet	1.4	0.8	2.9	0.0
Migration background	None	76.1	73.4	80.0	78.6
	Asia	8.1	7.3	8.6	10.7
	Africa	0.9	1.6	0.0	0.0
	Europe	17.1	21.0	14.3	7.1
	Latin America, Caribbean	2.7	4.0	0.0	3.6
	North America	1.4	2.4	0.0	0.0
	Australia, Oceania	0.9	1.6	0.0	0.0

Variables	Unit of measurement	Mean			
		Total Sample	Group 1: Price-Conscious Consumers	Group 2: Origin-Conscious Consumers	Group 3: Consumers with an interest in plant-based nutrition
Age	Years	25.90	25.65	25.61	27.71
Height (women)	Meter	1.70	1.71	1.69	1.70
Height (men)	Meter	1.84	1.84	1.83	1.84
Weight (women)	Kilogram	64.34	67.29	61.43	62.56
Weight (men)	Kilogram	84.46	84.60	81.74	89.83
BMI (women)	Kilogram per meter squared	222772.10	230083.40	215685.81	217437.46
BMI (men)	Kilogram per meter squared	249323.04	248639.44	243983.59	265099.30
I use packaging colors in the supermarket to assess the health value of food.	5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5)	2.23	2.15	2.44	2.11
I go to the supermarket regularly (1 or more times a week) to buy food.	5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5)	4.18	4.19	4.20	4.11
I have comprehensive, healthy nutritional knowledge.	5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5)	3.59	3.44	3.80	3.75

Table A6
Results of the factor analysis (N = 222).

Factors and the Corresponding Variables	Mean	SD	Factor Loading
Pleasure [1] **(Cronbach's alpha: 0.781)** *			
I believe that food should always be source of pleasure.	3.62	1.040	0.783
It is important for me to eat delicious food on weekdays as well as weekends.	3.98	0.884	0.779
An essential part of my weekend is eating delicious food.	3.58	1.108	0.770
When I eat, I concentrate on enjoying the taste of food.	3.64	0.897	0.759
Quality aspects [2] **(Cronbach's alpha: 0.711)** *			
I prefer to buy foods that were traditionally made.	3.24	0.958	0.740
I like to buy foods that have hand-crafted production.	3.34	0.938	0.710
I prefer to buy food from my region.	4.05	0.854	0.706
For me the naturalness of the food is an important factor.	3.75	0.918	0.700
I would like to pay more money for animal welfare approved meat and eggs.	3.80	1.152	0.544
Social desirability [3] **(Cronbach's alpha: 0.586)** *			
I'm usually calm when I don't get my way.	3.11	1.003	0.722
There have never been situations when I took advantage of someone.	2.96	1.053	0.670
There were hardly any times when I was quite jealous of the good fortune of others.	3.25	1.127	0.661
I rarely try to get revenge rather than forgive and forget.	3.81	0.971	0.580
Environmental consciousness - responsibilty feeling [4] **(Cronbach's alpha: 0.863)** **			
Even though my personal contribution is very small, I feel responsible for air pollution.	3.26	1.129	0.872
I feel at least co-responsible for environmental problems occurring now.	3.58	1.052	0.846
I feel responsible for the greenhouse effect.	3.02	1.143	0.815
I feel responsible for the condition of the air.	2.98	1.051	0.809
Because I drive an automobile - even though rarely - I contribute to, and am responsible for, air pollution.	3.47	1.154	0.670
Visual product aesthetics - value [5] **(Cronbach's alpha: 0.832)** **			
Beautiful product designs make our world a better place to live.	2.47	1.142	0.824
A product's design is a source of pleasure for me.	2.84	1.176	0.817
Owning products that have superior designs makes me feel good about myself.	2.99	1.142	0.805
I enjoy seeing displays of products that have superior designs.	3.14	1.148	0.614
Visual product aesthetics - response [5] **(Cronbach's alpha: 0.836)** **			
When I see a product that has a really great design, I feel a strong a strong urge to buy it.	3.04	1.175	0.872
If a product's design really "speaks" to me, I feel that I must buy it.	2.89	1.138	0.861
Sometimes the way a product looks seems to reach out and grab me.	2.93	1.134	0.758
Price consciousness [6] **(Cronbach's alpha: 0.507)** **			
I compare food prices from different brands.	4.19	0.824	0.754
I attempt to purchase food goods that have discounts.	4.10	0.842	0.741
The price of organic foods is relatively high.	3.63	0.868	0.615
Weight-controlling eating behavior [7] **(Cronbach's alpha: 0.895)** ***			
I purposely hold back on eating to avoid gaining weight.	2.08	1.029	0.895
I purposely eat less to avoid weight gain.	2.15	1.077	0.873
I often refuse food or drinks because I am worried about my weight.	2.05	1.061	0.839
If I have gained weight, I eat less than usual afterwards.	2.50	1.116	0.790
I eat products that are preferably low in calories.	2.13	0.952	0.776
Motivation for health prevention and promotion [8] **(Cronbach's alpha: 0.836)** ***			
I am strongly motivated to devote time and effort to my physical health.	3.47	1.074	0.844
It's really important to me that I keep myself in proper physical health.	4.01	0.797	0.841
I have a strong desire to keep myself physically healthy.	4.01	0.852	0.800
I try to avoid engaging in behaviors that undermine my physical health.	3.58	0.959	0.688
I really want to prevent myself from getting out of shape.	3.57	1.106	0.661
Health-conscious eating behavior [7] **(Cronbach's alpha: 0.761)** ***			
I choose food from local farming.	3.66	0.873	0.757
I prefer seasonal food.	3.59	0.952	0.749
I eat a lot of vegetables.	3.83	1.029	0.697
I prefer organic food.	3.47	1.064	0.667
My nutrition is varied and diverse.	3.67	1.007	0.637

Note. 5-point Likert-scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5). $N = 222$.
* = Factor analysis 1, ** = Factor analysis 2, *** = Factor analysis 3.
[1]Source: Roininen, K., Lähteenmäki, L., & Tuorila, H. (1999). Quantification of consumer attitudes to health and hedonic characteristics of foods. Appetite, 33(1), 71–88. https://doi.org/10.1006/appe.1999.0232.
[2]Source: Meyerding, S. G. H., Kürzdörfer, A., & Gassler, B. (2018). Consumer preferences for superfood ingredients - The case of bread in Germany. Sustainability, 10 (12), 4667–4687. https://doi.org/10.3390/su10124667.
[3]Source: Reynolds, W. M [45]. Development of reliable and valid short forms of the Marlowe-Crowne Social Desirability Scale. Journal of Clinical Psychology, 38(1), 119–125. https://doi.org/10.1002/1097-4679(19820138:1 < 119::AID-JCLP2270380118 > 3.0.CO;2-I).
[4]Source: Kaiser, F. G., & Shimoda, T. A. (1999). Responsibility as a predictor of ecological behavior. Journal of Environmental Psychology, 19(3), 243–253. https://doi.org/10.1006/jevp.1998.9123.
[5]Source: Mumcu, Y. & Kimzan, H. S [41]. The effect of visual product aesthetics on consumers' price sensitivity. Procedia Economics and Finance, 26, 528–534. https://doi.org/10.1016/S2212-5671(1500883-7).
[6]Source: Zheng, G.-W., Akter, N., Siddik, A. B., & Masukujjaman, M. (2021). Organic foods purchase behavior among generation Y of Bangladesh: The moderation effect of trust and price consciousness. Foods, 10(10), 2278. https://doi.org/10.3390/foods10102278.
[7]Source: Wurst, R., Brame, J., Ramsenthaler, C., König, D., & Fuchs, R [46]. A questionnaire to assess eating behavior: Structure, validity and responsiveness of a new German eating behavior scale (SEV). Appetite, 168(3), 105668. https://doi.org/10.1016/j.appet.2021.105668.
[8]Source: Masiero, M., Oliveri, S., Cutica, I., Monzani, D., Faccio, F., Mazzocco, K., & Pravettoni, G [47]. The psychometric properties of the Italian adaptation of the Health Orientation Scale (HOS). Health and Quality of Life Outcomes, 18(1), 1–15. https://doi.org/10.1186/s12955-020-01298-z.

Table A7
Profiling the latent consumer segments - Chickpea can (N = 222).

Factors	Sample Groups		
	Group 1: Price-Conscious Consumers	Group 2: Origin-Conscious Consumers	Group 3: Health-Oriented Consumers
Pleasure	−0.068 (1.019)[a]	0.118 (0.998)[a]	−0.015 (0.878)[a]
Quality aspects	−0.259 (0.998)[a]	0.410 (0.883)[b]	0.098 (0.928)[a,b]
Social desirability	−0.029 (1.034)[a]	0.023 (0.989)[a]	0.101 (0.835)[a]
Environmental consciousness - responsibility feeling	−0.093 (1.020)[a,b]	0.264 (0.912)[b]	−0.407 (1.000)[a]
Visual product aesthetics - value	0.045 (0.973)[a]	0.025 (1.026)[a]	−0.396 (1.045)[a]
Visual product aesthetics - response	−0.041 (1.049)[a]	0.004 (0.957)[a]	0.260 (0.818)[a]
Price consciousness	0.203 (0.983)[b]	−0.180 (0.902)[a,b]	−0.647 (1.112)[a]
Weight-controlling eating behavior	0.066 (1.051)[a,b]	−0.233 (0.878)[a]	0.498 (0.910)[b]
Motivation for health prevention and promotion	0.008 (1.029)[a]	−0.009 (0.999)[a]	−0.016 (0.843)[a]
Health-conscious eating behavior	−0.217 (0.981)[a]	0.332 (0.863)[b]	0.102 (1.278)[a,b]

Note. The values represent the mean values (standard deviation) for the extracted factors measured. Superscript lower case letters stand for significant mean differences at the 0.05 level based on Tukey testing.

Table A8
Profiling the latent consumer segments - Ravioli can (N = 222).

Factors	Sample Groups		
	Group 1: Price-Conscious Consumers	Group 2: Origin-Conscious Consumers	Group 3: Consumers with an interest in plant-based nutrition
Pleasure	−0.162 (1.005)[a]	0.138 (0.979)[a,b]	0.373 (0.906)[b]
Quality aspects	−0.205 (1.005)[a]	0.357 (0.897)[b]	0.023 (0.999)[a,b]
Social desirability	0.021 (1.025)[a]	0.029 (0.922)[a]	−0.162 (1.092)[a]
Environmental consciousness - responsibility feeling	−0.116 (0.951)[a]	0.194 (1.001)[a]	0.036 (1.159)[a]
Visual product aesthetics - value	0.085 (0.974)[a]	−0.014 (1.027)[a]	−0.338 (1.010)[a]
Visual product aesthetics - response	−0.145 (0.962)[a]	0.208 (1.008)[a]	0.131 (1.074)[a]
Price consciousness	0.163 (1.043)[a]	−0.215 (0.861)[a]	−0.195 (1.023)[a]
Weight-controlling eating behavior	0.018 (1.023)[a]	−0.065 (0.981)[a]	0.079 (0.968)[a]
Motivation for health prevention and promotion	−0.061 (1.078)[a]	0.100 (0.917)[a]	0.022 (0.833)[a]
Health-conscious eating behavior	−0.301 (0.985)[a]	0.313 (0.846)[b]	0.552 (0.971)[b]

Note. The values represent the mean values (standard deviation) for the extracted factors measured. Superscript lower case letters stand for significant mean differences at the 0.05 level based on Tukey testing.

Imageabfrage membership 1 = price-conscious consumers

Items	Red	Green	Beige	Light blue	Silver	Black
The tin can contains healthy food.	3.57	3.99	3.47	3.31	3.10	3.27
I associate the color of the product with healthy food.	2.20	3.92	2.94	2.54	2.28	2.47
The color of the can conveys the health value of the food to me.	2.14	3.52	2.77	2.38	2.17	2.34
The design of the product really appeals to me.	2.18	3.01	3.05	2.58	2.45	3.19
I like the color of the product.	2.61	3.52	3.20	3.09	2.52	3.30
I think the product is of high quality.	2.59	3.10	3.27	2.72	2.80	3.65
The product looks classy.	2.20	2.60	3.14	2.55	2.87	3.70
The packaging color promises an environmentally friendly product.	2.00	3.77	2.79	2.52	2.18	2.19
I associate the color of the product with sustainability.	1.86	3.97	2.69	2.47	2.13	2.12
I associate positive emotions with the color of the product.	2.45	3.63	2.91	3.22	2.32	2.60
The product seems expensive to me.	2.41	2.81	3.09	2.67	2.93	3.70
I associate the packaging with food without artificial additives.	2.38	3.63	3.10	2.50	2.43	2.42
For me, the color of the packaging reflects the contents of the can.	2.20	3.03	3.65	2.17	2.35	2.35
The packaging promises me a good tasting product.	2.84	3.16	3.09	2.90	2.62	3.06

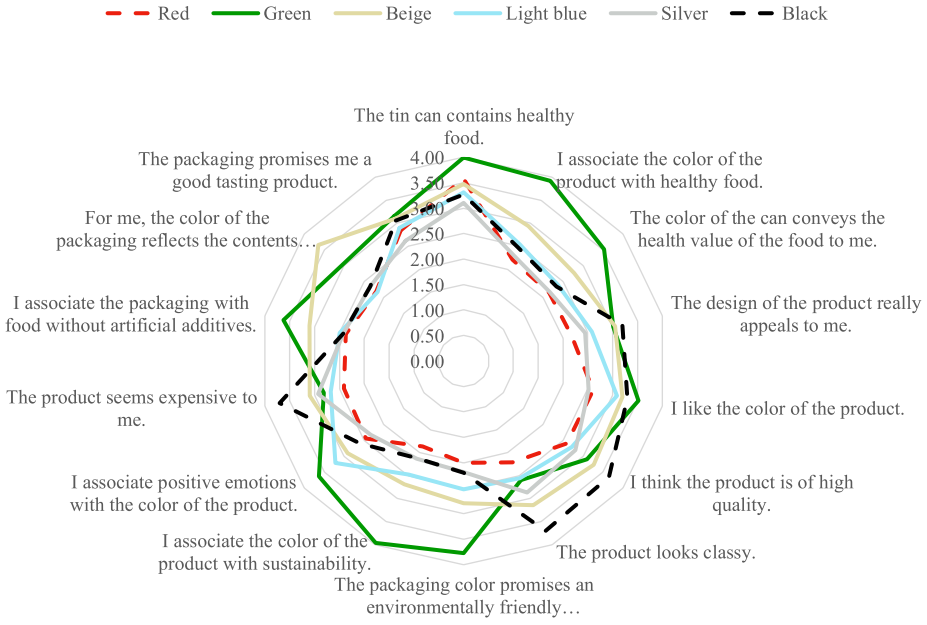


Fig. A3. Results image query 'price-conscious consumers' – Chickpea can.
Note. The six differently colored (red, green, beige, light blue, silver, black) chickpea cans from the choice experiment were each to be rated on the items shown. This was measured using a 5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5). The graphic illustrates the mean values of the results for the individual colors.

Imageabfrage membership 3 = origin-conscious consumers

Items	Red	Green	Beige	Light blue	Silver	Black
The tin can contains healthy food.	3.32	3.93	3.51	3.45	3.47	3.31
I associate the color of the product with healthy food.	2.14	3.85	3.00	2.59	2.33	2.56
The color of the can conveys the health value of the food to me.	2.11	3.45	2.77	2.47	2.23	2.20
The design of the product really appeals to me.	2.25	2.91	3.04	2.59	2.81	3.35
I like the color of the product.	2.32	3.43	3.25	2.95	2.88	3.44
I think the product is of high quality.	2.49	3.00	3.22	2.68	3.08	3.67
The product looks classy.	2.16	2.44	3.08	2.39	3.15	3.95
The packaging color promises an environmentally friendly product.	2.07	3.67	2.68	2.43	2.07	2.21
I associate the color of the product with sustainability.	1.84	3.88	2.71	2.43	1.89	2.15
I associate positive emotions with the color of the product.	2.37	3.53	2.93	3.13	2.41	2.63
The product seems expensive to me.	2.24	2.47	3.01	2.45	3.07	3.78
I associate the packaging with food without artificial additives.	2.38	3.51	3.20	2.76	2.60	2.56
For me, the color of the packaging reflects the contents of the can.	2.33	2.99	3.55	2.15	2.49	2.27
The packaging promises me a good tasting product.	2.79	3.15	3.12	2.91	2.83	2.97

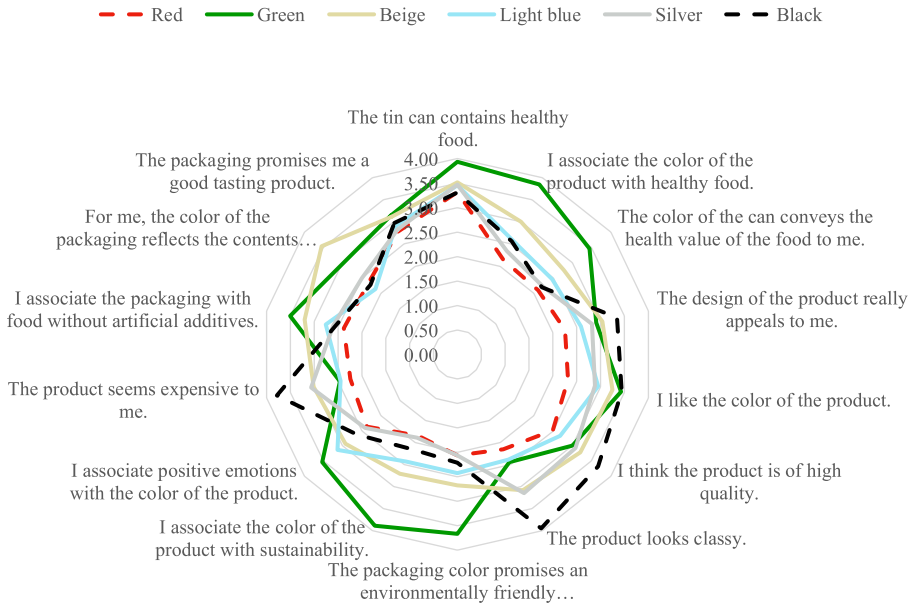


Fig. A4. Results image query 'origin-conscious consumers' – Chickpea can.

Note. The six differently colored (red, green, beige, light blue, silver, black) chickpea cans from the choice experiment were each to be rated on the items shown. This was measured using a 5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5). The graphic illustrates the mean values of the results for the individual colors.

Imageabfrage membership 3 = origin-conscious consumers

Items	Red	Green	Beige	Light blue	Silver	Black
The tin can contains healthy food.	3.32	3.93	3.51	3.45	3.47	3.31
I associate the color of the product with healthy food.	2.14	3.85	3.00	2.59	2.33	2.56
The color of the can conveys the health value of the food to me.	2.11	3.45	2.77	2.47	2.23	2.20
The design of the product really appeals to me.	2.25	2.91	3.04	2.59	2.81	3.35
I like the color of the product.	2.32	3.43	3.25	2.95	2.88	3.44
I think the product is of high quality.	2.49	3.00	3.22	2.68	3.08	3.67
The product looks classy.	2.16	2.44	3.08	2.39	3.15	3.95
The packaging color promises an environmentally friendly product.	2.07	3.67	2.68	2.43	2.07	2.21
I associate the color of the product with sustainability.	1.84	3.88	2.71	2.43	1.89	2.15
I associate positive emotions with the color of the product.	2.37	3.53	2.93	3.13	2.41	2.63
The product seems expensive to me.	2.24	2.47	3.01	2.45	3.07	3.78
I associate the packaging with food without artificial additives.	2.38	3.51	3.20	2.76	2.60	2.56
For me, the color of the packaging reflects the contents of the can.	2.33	2.99	3.55	2.15	2.49	2.27
The packaging promises me a good tasting product.	2.79	3.15	3.12	2.91	2.83	2.97

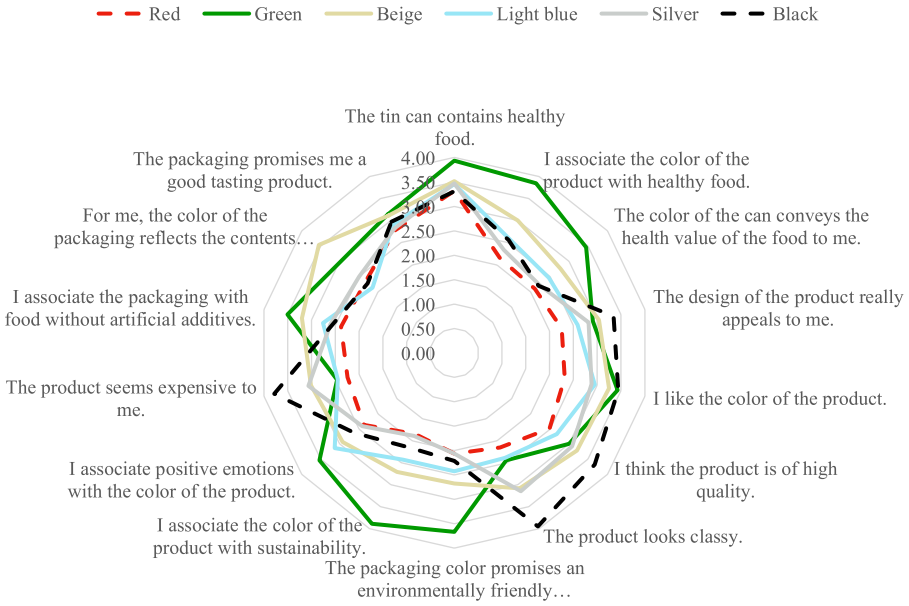


Fig. A5. Results image query 'health-oriented consumers' – Chickpea can.
Note. The six differently colored (red, green, beige, light blue, silver, black) chickpea cans from the choice experiment were each to be rated on the items shown. This was measured using a 5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5). The graphic illustrates the mean values of the results for the individual colors.

Table A9
Results image query all consumer segments - Chickpea can.

	Red			Green			Beige			Light blue			Silver			Black		
Items	**PCC**	**HOC**	**OCC**	**PCC**	**HOC**	**OCC**	**PCC**	**HOC**	**OCC**	**PCC**	**HOC**	**OCC**	**PCC**	**HOC**	**OCC**	**PCC**	**HOC**	**OCC**
The tin can contains healthy food.	3.6	2.7	3.3	4.0	3.2	3.9	3.5	3.1	3.5	3.3	2.1	3.5	3.1	2.5	3.5	3.3	2.1	3.3
I associate the color of the product with healthy food.	2.2	2.5	2.1	3.9	3.2	3.9	2.9	3.1	3.0	2.5	2.0	2.6	2.3	2.2	2.3	2.5	2.3	2.6
The color of the can conveys the health value of the food to me.	2.1	2.5	2.1	3.5	3.0	3.5	2.8	2.9	2.8	2.4	2.3	2.5	2.2	2.3	2.2	2.3	2.3	2.2
The design of the product really appeals to me.	2.2	2.2	2.3	3.0	2.8	2.9	3.0	3.1	3.0	2.6	2.3	2.6	2.4	2.4	2.8	3.2	2.5	3.3
I like the color of the product.	2.6	2.7	2.3	3.5	3.3	3.4	3.2	3.2	3.2	3.1	2.6	2.9	2.5	2.5	2.9	3.3	2.5	3.4
I think the product is of high quality.	2.6	2.3	2.5	3.1	2.9	3.0	3.3	3.2	3.2	2.7	2.4	2.7	2.8	2.3	3.1	3.6	2.6	3.7
The product looks classy.	2.2	2.5	2.2	2.6	2.5	2.4	3.1	2.9	3.1	2.6	2.5	2.4	2.9	2.5	3.1	3.7	2.7	3.9
The packaging color promises an environmentally friendly product.	2.0	2.4	2.1	3.8	3.2	3.7	2.8	2.7	2.7	2.5	2.2	2.4	2.2	2.1	2.1	2.2	1.8	2.2
I associate the color of the product with sustainability.	1.9	2.2	1.8	4.0	3.1	3.9	2.7	2.8	2.7	2.5	2.3	2.4	2.1	2.0	1.9	2.1	2.0	2.1
I associate positive emotions with the color of the product.	2.4	2.4	2.4	3.6	3.3	3.5	2.9	3.1	2.9	3.2	2.4	3.1	2.3	2.3	2.4	2.6	2.2	2.6
The product seems expensive to me.	2.4	2.4	2.2	2.8	2.5	2.5	3.1	2.6	3.0	2.7	2.6	2.5	2.9	2.6	3.1	3.7	2.9	3.8
I associate the packaging with food without artificial additives.	2.4	2.3	2.4	3.6	2.8	3.5	3.1	2.9	3.2	2.5	1.9	2.8	2.4	2.3	2.6	2.4	2.0	2.6
For me, the color of the packaging reflects the contents of the can.	2.2	2.8	2.3	3.0	2.8	3.0	3.6	3.2	3.5	2.2	2.4	2.1	2.3	2.2	2.5	2.4	2.1	2.3
The packaging promises me a good tasting product.	2.8	2.4	2.8	3.2	2.7	3.1	3.1	2.9	3.1	2.9	2.3	2.9	2.6	2.3	2.8	3.1	2.2	3.0

Note. Price-conscious consumers (PCC), health-oriented consumers (HOC), origin-conscious consumers (OCC). The six differently colored (red, green, beige, light blue, silver, black) chickpea cans from the choice experiment were each to be rated on the items shown. This was measured using a 5-point Likert scale (Do not agree at all = 1, Do not agree = 2, Neither agree nor disagree = 3, Agree = 4, Strongly agree = 5). The table illustrates the mean values of the results for the individual colors.

Data availability

Data will be made available on request.

References

[1] B. Renner, U. Arens-Azevêdo, B. Watzl, M. Richter, K. Virmani, J. Linseisen, DGE position statement on a more sustainable diet, Ernahrungs Umsch. 68 (7) (2021) 144–154, https://doi.org/10.4455/eu.2021.030.

[2] A. Schienkiewitz, G.B. Mensink, R. Kuhnert, C. Lange, Overweight and obesity among adults in Germany, Journal of Health Monitoring 2 (2) (2017) 20–27, https://doi.org/10.17886/RKI-GBE-2017-038.

[3] WHO, WHO European Regional Obesity Report 2022, 2022. Copenhagen.

[4] X. Chen, Z. Gao, L. House, Y. Gao, Do color-coded Nutrition Facts Panels nudge the use of nutrition information? Food Policy 129 (2024) 102730 https://doi.org/10.1016/j.foodpol.2024.102730.

[5] K. Steiner, A. Florack, The influence of packaging color on consumer perceptions of healthfulness: a systematic review and theoretical framework, Foods 12 (21) (2023) 3911, https://doi.org/10.3390/foods12213911.

[6] B. Plasek, Z. Lakner, Á. Temesi, I believe it is healthy - impact of extrinsic product attributes in demonstrating healthiness of functional food products, Nutrients 3518 (2021), https://doi.org/10.3390/nu13103518.

[7] L. Hallez, H. Vansteenbeeck, F. Boen, T. Smits, Persuasive packaging? The impact of packaging color and claims on young consumers' perceptions of product healthiness, sustainability and tastiness, Appetite 182 (2023) 106433, https://doi.org/10.1016/j.appet.2022.106433.

[8] D. Sucapane, C. Roux, K. Sobol, Exploring how product descriptors and packaging colors impact consumers' perceptions of plant-based meat alternative products, Appetite 167 (2021) 105590, https://doi.org/10.1016/j.appet.2021.105590.

[9] V. Marques da Rosa, C. Spence, L. Miletto Tonetto, Influences of visual attributes of food packaging on consumer preference and associations with taste and healthiness, Int. J. Consum. Stud. 43 (2) (2019) 210–217, https://doi.org/10.1111/ijcs.12500.

[10] G. Wąsowicz, M. Styśko-Kunkowska, K.G. Grunert, The meaning of colours in nutrition labelling in the context of expert and consumer criteria of evaluating food product healthfulness, J. Health Psychol. 20 (6) (2015) 907–920, https://doi.org/10.1177/1359105315580251.

[11] L. Huang, J. Lu, The impact of package color and the nutrition content labels on the perception of food healthiness and purchase intention, J. Food Prod. Market. 22 (2) (2016) 191–218, https://doi.org/10.1080/10454446.2014.1000434.

[12] J. Su, S. Wang, Influence of food packaging color and food type on consumer purchase intention: the mediating role of perceived fluency, Front. Nutr. 10 (2024) 1344237, https://doi.org/10.3389/fnut.2023.1344237.

[13] S. Singh, Impact of color on marketing, Manag. Decis. 44 (6) (2006) 783–789, https://doi.org/10.1108/00251740610673332.

[14] P. Silayoi, M. Speece, Packaging and purchase decisions: an exploratory study on the impact of involvement level and time pressure, Br. Food J. 106 (8) (2004) 607–628, https://doi.org/10.1108/00070700410553602.

[15] L.L. Garber, E.M. Hyatt, R.G. Starr, The effects of food color on perceived flavor and acceptability, J. Market. Theor. Pract. 8 (4) (2000) 59–72. http://www.jstor.org/stable/40470017.

[16] K.J. Emery, M.A. Webster, Individual differences and their implications for color perception, Current Opinion in Behavioral Sciences 30 (2019) 28–33, https://doi.org/10.1016/j.cobeha.2019.05.002.

[17] Y. Lin, W. Xu, Q. Liu, Advances in color science: from color perception to color metrics and its applications in illuminated environments, Front. Psychol. 14 (2023) 1142153, https://doi.org/10.3389/fpsyg.2023.1142153.

[18] Y. Xiong, G. Wu, X. Li, X. Wang, Optimized clustering method for spectral reflectance recovery, Front. Psychol. 13 (2022) 1051286, https://doi.org/10.3389/fpsyg.2022.1051286.

[19] W. Tantanatewin, V. Inkarojrit, Effects of color and lighting on retail impression and identity, J. Environ. Psychol. 46 (2016) 197–205, https://doi.org/10.1016/j.jenvp.2016.04.015.

[20] M. Pfeuffer, H. Erbersdobler, G. Jahreis, Legumes in human nutrition. Health aspects - part 1, Ernahrungs Umsch. 67 (9) (2020) 160–165, https://doi.org/10.4455/eu.2020.045.

[21] BMEL, Deutschland, wie es isst, Der BMEL-Ernährungsreport (2022) 2022.

[22] Max-Rubner-Institut, Nationale Verzehrsstudie II. Ergebnisbericht, Teil 2: Die bundesweite Befragung zur Ernährung von Jugendlichen und Erwachsenen, MRI, 2008.

[23] A. Dittmann, L. Werner, S. Storcksdieck, I. Hoffmann, What percentage of people adhere to vegetarian and vegan diets in Germany? An exploration of the research situation, Ernahrungs Umsch. 70 (7) (2023) 80–93, https://doi.org/10.4455/eu.2023.012.

[24] H.F. Erbersdobler, C.A. Barth, G. Jahreis, Legumes in human nutrition. Nutrient content and protein quality of pulses, Ernahrungs Umsch. 64 (9) (2017) 134–139, https://doi.org/10.4455/eu.2017.034.

[25] N. Begum, Q.U. Khan, L.G. Liu, W. Li, D. Liu, I.U. Haq, Nutritional composition, health benefits and bio-active compounds of chickpea (*Cicer arietinum* L.), Front. Nutr. 10 (2023) 1218468, https://doi.org/10.3389/fnut.2023.1218468.

[26] S. Nájera Espinosa, G. Hadida, A.J. Sietsma, C. Alae-Carew, G. Turner, R. Green, S. Pastorino, R. Picetti, P. Scheelbeek, Mapping the evidence of novel plant-based foods: a systematic review of nutritional, health, and environmental impacts in high-income countries, Nutr. Rev. (2024), https://doi.org/10.1093/nutrit/nuae031.

[27] C. Ringuette, J. Finley, W. Prinyawiwatkul, J.M. King, Development of reduced glycemic load/high fiber ravioli using bean flour, J. Culin. Sci. Technol. 16 (4) (2018) 336–356, https://doi.org/10.1080/15428052.2017.1391147.
[28] German Food Database, Nutritional profiles of packaged foods, Retrieved from Bundeslebensmittelschlüssel, https://blsdb.de/bls, 2025.
[29] USDA FoodData Central, Chickpeas, canned, Retrieved March 15, 2024, from, https://fdc.nal.usda.gov/, 2023.
[30] E. Lancsar, J. Swait, Reconceptualising the external validity of discrete choice experiments, Pharmacoeconomics 32 (2014) 951–965, https://doi.org/10.1007/s40273-014-0181-7.
[31] S. Selka, D. Baier, P. Kurz, The validity of conjoint analysis: an investigation of commercial studies over time, in: Data Analysis, Machine Learning and Knowledge Discovery, Springer International Publishing, Cham, 2013, pp. 227–234, https://doi.org/10.1007/978-3-319-01595-8_25.
[32] P.E. Green, V. Srinivasan, Conjoint analysis in marketing: new developments with implications for research and practice, J. Market. 54 (4) (1990) 3–19, https://doi.org/10.1177/002224299005400402.
[33] Sawtooth Software, The CBC/HB system for hierarchical bayes estimation, Retrieved April 19, 2024, from Sawtooth Software:, Version 5.6, 2021. https://sawtoothsoftware.com/resources/technical-papers/cbc-hb-technical-paper.
[34] A.E. Oltman, S.M. Jervis, M.A. Drake, Consumer attitudes and preferences for fresh market tomatoes, J. Food Sci. 79 (10) (2014) S2091–S2097, https://doi.org/10.1111/1750-3841.12638.
[35] L.J. Sant'anna, C.I. Araújo, M.C. de Paula, E.d. da Moreira, S.M. Lucia, T.L. Filho, How to inform about sodium reduction on food labels? J. Sensory Stud. 37 (5) (2022) e12768 https://doi.org/10.1111/joss.12768.
[36] Sawtooth Software, How to use time statistics to improve your results (Sawtooth Software) Retrieved April 4, 2024, from Sawtooth Software: https://sawtoothsoftware.com/resources/knowledge-base/design-and-methodology-issues/how-to-use-time-statistics-to-improve-your-results, 2018.
[37] F.R. Johnson, E. Lancsar, D. Marshall, V. Kilambi, A. Mühlbacher, D.A. Regier, J.F. P. Bridges, Constructing experimental designs for discrete-choice experiments: report of the ISPOR conjoint analysis experimental design good research practices task force, Value Health 16 (1) (2013) 3–13, https://doi.org/10.1016/j.jval.2012.08.2223.
[38] J.F.P. Bridges, A.B. Hauber, D. Marshall, A. Lloyd, L.A. Prosser, D.A. Regier, J. Mauskopf, Conjoint analysis applications in health—a checklist: a report of the ISPOR good research practices for conjoint analysis task Force, Value Health 14 (4) (2011) 403–413, https://doi.org/10.1016/j.jval.2010.11.013.
[39] A. Field, Discovering Statistics Using SPSS: and Sex and Drugs and Rock 'n' Roll, third ed., Sage, Los Angeles, London, New Delhi, Singapore, Washington DC, 2009.
[40] K. Roininen, L. Lähteenmäki, H. Tuorila, Quantification of consumer attitudes to health and hedonic characteristics of foods, Appetite 33 (1) (1999) 71–88, https://doi.org/10.1006/appe.1999.0232.
[41] Y. Mumcu, H.S. Kimzan, The effect of visual product aesthetics on consumers' price sensitivity, Procedia Econ. Finance 26 (2015) 528–534, https://doi.org/10.1016/S2212-5671(15)00883-7.
[42] F.G. Kaiser, T.A. Shimoda, Responsibility as a predictor of ecological behavior, J. Environ. Psychol. 19 (3) (1999) 243–253, https://doi.org/10.1006/jevp.1998.9123.
[43] S.G. Meyerding, A. Kürzdörfer, B. Gassler, Consumer preferences for superfood ingredients - the case of bread in Germany, Sustainability 10 (12) (2018) 4667, https://doi.org/10.3390/su10124667.
[44] P. Grimm, Social desirability bias, Wiley International Encyclopedia of Marketing (2010), https://doi.org/10.1002/9781444316568.wiem02057.
[45] W.M. Reynolds, Development of reliable and valid short forms of the marlowe-crowne social desirability scale, J. Clin. Psychol. 38 (1) (1982) 119–125, https://doi.org/10.1002/1097-4679(198201)38:1<119::AID-JCLP2270380118>3.0.CO;2-I.
[46] R. Wurst, J. Brame, C. Ramsenthaler, D. König, R. Fuchs, A questionnaire to assess eating behavior: structure, validity and responsiveness of a new German eating behavior scale (SEV), Appetite 168 (3) (2022) 105668, https://doi.org/10.1016/j.appet.2021.105668.
[47] M. Masiero, S. Oliveri, I. Cutica, D. Monzani, F. Faccio, K. Mazzocco, G. Pravettoni, The psychometric properties of the Italian adaptation of the Health Orientation Scale (HOS), Health Qual. Life Outcome 18 (69) (2020), https://doi.org/10.1186/s12955-020-01298-z.
[48] J. Howell, CBC/HB for beginners, from Sawtooth Software, https://sawtoothsoftware.com/resources/technical-papers/cbc-hb-for-beginners, 2009. (Accessed 18 April 2024).
[49] B.E. Weller, N.K. Bowen, S.J. Faubert, Latent class analysis: a guide to best practice, J. Black Psychol. 46 (4) (2020) 287–311, https://doi.org/10.1177/0095798420930932journals.sagepub.com/home/jbp.
[50] K. Nylund-Gibson, A.Y. Choi, Ten frequently asked questions about latent class analysis, Translational Issues in Psychological Science 4 (4) (2018) 440–461, https://doi.org/10.1037/tps0000176.
[51] Sawtooth Software, The latent class technical paper, Retrieved April 24, 2024, from Sawtooth Software:, Version 4.8, 2021. https://sawtoothsoftware.com/resources/technical-papers/latent-class-technical-paper.
[52] N.E. Benni, H. Stolz, R. Home, H. Kendall, S. Kuznesof, B. Clark, M. Stolze, Product attributes and consumer attitudes affecting the preferences for infant milk formula in China – a latent class approach, Food Qual. Prefer. 71 (2019) 25–33, https://doi.org/10.1016/j.foodqual.2018.05.006.
[53] A.G. Yong, S. Pearce, A beginner's guide to factor analysis: focusing on exploratory factor analysis, Tutorials in Quantitative Methods for Psychology 9 (2) (2013) 79–94, https://doi.org/10.20982/tqmp.09.2.p079.
[54] D.M. Lane, Tukey's honestly significant difference (HSD), in: N.J. Salkind, B. B. Frey, D.M. Dougherty (Eds.), Encyclopedia of Research Design, 1 ed., SAGE Publications Inc, Thousand Oaks, 2010, pp. 1565–1570.
[55] I. Tijssen, E.H. Zandstra, C. de Graaf, G. Jager, Why a 'light' product package should not be light blue: effects of package colour on perceived healthiness and attractiveness of sugar- and fat-reduced products, Food Qual. Prefer. 59 (2017) 46–58, https://doi.org/10.1016/j.foodqual.2017.01.019.
[56] World Health Organization, A Healthy Lifestyle - WHO Recommendations, World Health Organization, 2010. Retrieved April 4, 2024, from World Health Organization Europe: https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle—who-recommendations.
[57] J.M. Brix, B. Andersen, K. Aydinkoc-Tuzcu, P. Beckerhinn, A. Brossard-Eitzinger, A. Cavini, D. Weghuber, Overweight and obesity in adults: general principles of treatment and conservative management, Wien. Klin. Wochenschr. 135 (6) (2023) 706–720, https://doi.org/10.1007/s00508-023-02270-9.
[58] Federal Statistical Office. (n.d.). Bevölkerungsstand. Wie wird mit den Daten von Personen mit den Geschlechtsausprägungen 'unbekannt' oder 'divers' verfahren? (Federal Statistical Office) Retrieved April 4, 2024, from Destatis: https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Bevoelkerungsstand/Methoden/Erlauterungen/geschlechtsauspraegungen.html.
[59] K.L. Nylund, T. Asparouhov, B.O. Muthén, Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study, Struct. Equ. Model. (2007) 535–569, https://doi.org/10.1080/10705510701575396.
[60] P. Sinha, C.S. Calfee, K.L. Delucchi, Practioner's guide to latent class analysis: methodological considerations and common pitfalls, Crit. Care Med. 49 (1) (2021) e63–e79, https://doi.org/10.1097/CCM.0000000000004710.
[61] S. Ahrens, Aus welchen Gründen ernähren Sie sich vegan? (POSpulse), Retrieved May 5, 2024, from Statista, https://de.statista.com/statistik/daten/studie/1192354/umfrage/befragung-gruende-vegane-ernaehrung/, 2024.
[62] S. Fromm, Faktoren- und Reliabilitätsanalyse, in: S. Fromm (Ed.), Datenanalyse mit SPSS für Fortgeschrittene 2: Multivariate Verfahren für Querschnittsdaten, VS Verlag für Sozialwissenschaften, Springer Fachmedien, Wiesbaden, 2012, https://doi.org/10.1007/978-3-531-18794-5_3.
[63] H.F. Kaiser, An index of factorial simplicity, Psychometrika 39 (1) (1974) 31–36, https://doi.org/10.1007/BF02291575.
[64] M. Tavakol, R. Dennick, Making sense of Cronbach's alpha, Int. J. Med. Educ. 2 (2011) 53–55, https://doi.org/10.5116/ijme.4dfb.8dfd.
[65] C. Kamrath, S. Bidkar, S. Bröring, Is food involvement in purchasing decisions always low? A consumer study from Germany, PharmaNutrition 9 (2019) 100157, https://doi.org/10.1016/j.phanu.2019.100157.
[66] J. Thøgersen, How does origin labelling on food packaging influence consumer product evaluation and choices? A systematic literature review, Food Policy 119 (2023) 102503, https://doi.org/10.1016/j.foodpol.2023.102503.
[67] S. Kushwah, A. Dhir, M. Sagar, B. Gupta, Determinants of organic food consumption. A systematic literature review on motives and barriers, Appetite 143 (2019) 104402, https://doi.org/10.1016/j.appet.2019.104402.
[68] B. Ellison, B.R. Duff, Z. Wang, T.B. White, Putting the organic label in context: examining the interactions between the organic label, product type, and retail outlet, Food Qual. Prefer. 49 (2016) 140–150, https://doi.org/10.1016/j.foodqual.2015.11.013.
[69] J.D. Temmerman, E. Heeremans, H. Slabbinck, I. Vermeir, The impact of the Nutri-Score nutrition label on perceived healthiness and purchase intentions, Appetite 157 (2021) 104995, https://doi.org/10.1016/j.appet.2020.104995.
[70] A. Grzybowski, K. Kupidura-Majewski, What is color and how it is perceived? Clin. Dermatol. 37 (5) (2019) 392–401, https://doi.org/10.1016/j.clindermatol.2019.07.008.
[71] S.G.H. Meyerding, N. Merz, Consumer preferences for organic labels in Germany using the example of apples–Combining choice-based conjoint analysis and eye-tracking measurements, J. Clean. Prod. 181 (2018) 772–783, https://doi.org/10.1016/j.jclepro.2018.01.224.
[72] E. Reutskaja, R. Nagel, C.F. Camerer, A. Rangel, Search dynamics in consumer choice under time pressure: an eye-tracking study, Am. Econ. Rev. 101 (2) (2011) 900–926, https://doi.org/10.1257/aer.101.2.900.
[73] J.L. Orquin, S.M. Loose, Attention and choice: a review on eye movements in decision making, Acta Psychol. 144 (1) (2013) 190–206, https://doi.org/10.1016/j.actpsy.2013.06.003.
[74] S.G.H. Meyerding, X. He, A. Bauer, Neuronal correlates of basic taste perception and hedonic evaluation using functional Near-Infrared Spectroscopy (fNIRS), Applied Food Research 4 (2) (2024) 100477, https://doi.org/10.1016/j.afres.2024.100477.
[75] S.G.H. Meyerding, C.M. Mehlhose, Can neuromarketing add value to the traditional marketing research? An exemplary experiment with functional near-infrared spectroscopy (fNIRS), J. Bus. Res. 107 (2020) 172–185, https://doi.org/10.1016/j.jbusres.2018.10.052.
[76] T.C. Rosenqvist, Seeing with color: psychophysics and the function of color vision, Synthese 202 (20) (2023), https://doi.org/10.1007/s11229-023-04226-y.
[77] B.R. Conway, S. Chatterjee, G.D. Field, G.D. Horwitz, E.N. Johnson, K. Koida, K. Mancuso, Advances in color science: from retina to behavior, J. Neurosci. 30 (45) (2010) 14955–14963, https://doi.org/10.1523/JNEUROSCI.4348-10.2010.
[78] C. Spence, C. Velasco, K. Knoeferle, A large sample study on the influence of the multisensory environment on the wine drinking experience, Flavour 3 (2014) 1–12, https://doi.org/10.1186/2044-7248-3-8.