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RESEARCH ARTICLE

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Toward a differentiated understanding of the effect of Nutri-Score nutrition labeling on healthier food choices

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Abstract

By 2022, the European Commission seeks to introduce harmonized, mandatory front-of-pack (FOP) nutrition labeling. The color-graded Nutri-Score is at the heart of the European debate. Yet, little is known about how the information provided in back-of-pack (BOP) nutrition tables interacts with evaluative FOP labels, such as Nutri-Score, and if different consumer groups use both information cues differently when making food choices. Our objective is thus to identify segments of nutrition label users and contrast their choice behavior and use of FOP and BOP nutritional information. Therefore, this study builds on an attitude-based segmentation analysis and a survey-based discrete choice experiment among German consumers. We identify five segments of nutritional information users and significant interaction effects between FOP and BOP nutritional cues. Consumers use supplementary nutritional information differently: relying on BOP nutrition facts only (*label-resisters*) or combining both information cues (*majority*). For most, Nutri-Score reinforces the positive effect of a healthier nutrient profile on purchase likelihood,

Abbreviations: ASC, alternative specific constant; BOP, back-of-pack; DCE, discrete choice experiment; EU, European Union; F2F, Farm to Fork; FOP, front-of-pack; MFS, mean factor score; SD, standard deviation; WTP, willingness to pay.

while its use stigmatizes products of low nutritional quality. Overall, supplementary Nutri-Score labeling enables better alignment of food choices and health preferences, especially for consumers overwhelmed by technical BOP nutrition tables, and helps differentiate products with relatively unhealthy nutritional profiles. We discuss implications for food policy and business. [EconLit citations: D12, Q13, Q18].

KEYWORDS

back-of-pack nutrition table, choice experiment, consumer behavior, front-of-pack nutrition label, healthy food choice

1 | INTRODUCTION

The prevention of diet-related diseases has become a public health goal (World Health Organization, 2020). To encourage healthier diets, the European Commission seeks to introduce harmonized front-of-pack (FOP) nutrition labeling on prepacked food across the European Union (EU) by 2022. As laid out in its *Farm to Fork* (F2F) strategy, a mandatory FOP nutrition label should then supplement back-of-pack (BOP) nutrition tables (European Commission, 2020). A promising FOP label candidate is Nutri-Score, a five-step color-graded nutrition label developed by academic researchers. Nutri-Score provides an overall assessment of a food's health value. It weighs favorable against unfavorable nutrients and classifies prepacked food into one out of five categories, ranging from dark green (category A) to red (category E). Its purpose is to help consumers make better-informed choices by allowing for comparisons of the nutritional quality of foods. Nutri-Score has been adopted by several European countries, in the frame of national legislation, and several food companies label their products on a voluntary basis (Bundesministerium für Ernährung und Landwirtschaft BMEL, 2020; Julia & Hercberg, 2017).

Nevertheless, Nutri-Score has faced opposition from lobbying groups since its first proposition in France in early 2014 (Julia & Hercberg, 2016, 2018). The discussion continues, as food corporations try to push their own labels and influence public health policies and public opinions about the need for a harmonized nutrition label (Mialon et al., 2018). A frequent argument brought forward against a harmonized nutrition label is that nutritional information provided in BOP nutrition tables is sufficient to guide consumer food choices. In contrast, Crosetto et al. (2020) indicate that accessible nutritional information, provided via FOP labeling, crowds out other information cues like ingredient lists or nutrition tables and has thus a stronger effect on nutritional dietary quality. Given their importance in guiding consumers toward healthier choices, it is surprising how little is known about how the information provided in BOP nutrition tables interacts with evaluative FOP labels and if different consumer groups use both information cues differently when making food choices.

There has been ample research into the perception and effectiveness of Nutri-Score. First, there is evidence of evaluative FOP labels, such as Nutri-Score, being easier to understand than reductive labels, which include, for example, daily intake guidelines (Talati et al., 2016). Second, large-scale research across countries, comparing the color-graded Nutri-Score nutrition label to other FOP label formats, such as the Keyhole, Multiple Traffic Lights, or the Choices logo, conclude that Nutri-Score appears to be the preferred and most effective label. It is not only well understood by consumers, including those with low nutrition knowledge (De Temmerman et al., 2021; Ducrot et al., 2015a; Info GmbH Markt- und Meinungsforschung, 2019; Liljeberg & Krambeer, 2019; Sarda et al., 2020), but also highly effective for identifying healthier products (Ducrot et al., 2015b; Egnell et al., 2018, 2020).

Consequently, Nutri-Score has been found to promote healthier food choices and the overall nutritional quality of consumers' shopping carts (Crosetto et al., 2020; Dubois et al., 2021; Ducrot et al., 2016; Egnell et al., 2019; Julia & Hercberg, 2017; Sarda et al., 2020). However, we know little about how different consumer groups respond to supplementary Nutri-Score labeling and how they will use the new label alongside other packaging information when making food choices (Miller & Cassady, 2015; Storcksdieck genannt Bonsmann et al., 2020). Thus, there is still a need to separate the individual from the combined effects of the evaluative Nutri-Score labeling and the nutritional information provided in BOP nutrition tables on healthy food choices.

We fill these knowledge gaps by answering the following research questions: (i) How do consumers differ in their perception of and response to Nutri-Score? (ii) What are the individual and combined effects of nutritional information provided in BOP nutrition tables and evaluative FOP Nutri-Score labeling on food choice (i.e., the interaction effects between both informational cues), and how do these effects differ across consumers? Our objectives are (i) to segment food consumers based on their nutrition label attitudes and (ii) to assess differences in the individual and combined effects of evaluative nutrition labels and nutritional tables on purchase intention and willingness to pay (WTP) for healthier product variants across consumer segments.

To this end, we conducted a survey-based discrete choice experiment (DCE) among yogurt consumers in Germany. First, we identify segments of nutrition label users in an attitude-based two-step cluster analysis and assess differences in their motivational structure. Next, in a DCE with visual shelf-simulations, we study the effect of BOP nutritional tables and evaluative FOP nutritional labeling on preferences and WTP for healthier food choices across population subgroups. Finally, we conclude with practical implications. Marketers and food manufacturers can use our findings in strategic management decisions regarding product positioning and reformulation. Similarly, public health officials and policymakers can use our findings to promote supplementary nutrition labeling for healthier food consumption.

2 | LITERATURE REVIEW AND CONCEPTUAL APPROACH

2.1 | Motivational drivers of the use of nutritional information in healthier food choice

Evaluative nutrition labels allow consumers to incorporate health considerations into their food choice. That would still be possible by considering the nutritional information provided in nutrition tables—yet requires inferences from individual nutritional components. Consequently, while consumers need the opportunity to take nutrition labels into account (i.e., they need to be present on the packaging), consumers also need the motivation to use them when making food choices. "Use" in this sense then refers to consumers incorporating the nutrition label into their food choices when trading-off nutritional information and other product attributes (Grunert et al., 2014).

Previous studies acknowledge heterogeneous preferences for nutrition information on food and the use of such informational cues in food choice (e.g., Campos et al., 2011; Christoph et al., 2018; Cowburn & Stockley, 2005; Drichoutis et al., 2005; Liljeberg & Krambeer, 2019; Storcksdieck genannt Bonsmann et al., 2020). The current study presents a conceptual approach to capture this heterogeneity. It builds on Steinhauser and Hamm's (2018) determinants of consumer choice for foods with nutrition, health, and risk reduction claims and studies motivational drivers (consumer characteristics and product characteristics) of nutrition information use and their effect on the use of supplementary nutrition labels in food choice.

2.1.1 | Psychographic consumer characteristics

Consumers, in general, link food and health, and thus many are interested in nutritional information to guide their food choice (Grunert & Wills, 2007). The degree of use, however, differs between consumers because of varying

degrees of *health motivation*. Studies indicate that consumers who are more concerned about health issues or lead a healthier lifestyle are more likely to use FOP or BOP nutrition information and have higher purchase intentions toward healthy food (Bialkova et al., 2016; Cowburn & Stockley, 2005; Miller & Cassady, 2012; Steinhauser & Hamm, 2018).

Research suggests strong relationships between health motivation, nutrition knowledge, and the use of nutrition information. Consumers must be willing to apply their nutrition knowledge to make healthier choices, which will, in turn, depend on their health motivations or goals for dietary changes (Grunert & Wills, 2007). Different levels of *nutrition knowledge* are another reason why some consumers rely more on nutritional information. Nutrition knowledge is linked to how well consumers *understand* and therefore *use* different types of nutritional information, such as BOP nutritional tables and FOP labels (Drichoutis et al., 2005; Grunert & Wills, 2007; Jacobs et al., 2011; Miller & Cassady, 2015; Steinhauser & Hamm, 2018). Research has further established that nutrition experts are more likely to use detailed information, such as ingredient lists, while less knowledgeable individuals prefer simpler nutrient information, such as color-graded nutrition labels (Méjean et al., 2013; Miller & Cassady, 2012; Walters & Long, 2012). Additionally, consumers' *interest in the nutritional composition of foods* affects their willingness to read nutritional tables and compare nutrient profiles. Individuals with a low likelihood of reading nutrient tables are often less skilled in identifying healthier foods. Consequently, these consumers like and are interested in accessible, evaluative nutrition labeling (Liljeberg & Krambeer, 2019). Moreover, their abilities to identify healthier foods and their intake of nutrients whose consumption should be limited are strongly affected by the presence of color-coded FOP nutrition labels (Ducrot et al., 2016).

2.1.2 | Sociodemographic consumer characteristics

Relationships between *sociodemographics* and nutrition label use are also frequently discussed. Nutrition label use is reportedly higher for women, individuals with higher education and income, healthier diets or an active lifestyle, and those overweight or managing their weight (Campos et al., 2011; Christoph et al., 2018; Cowburn & Stockley, 2005; Drichoutis et al., 2005; Liljeberg & Krambeer, 2019; Storcksdieck genannt Bonsmann et al., 2020). For Nutri-Score specifically, findings suggest that both genders and high and low-income groups are affected in their food choice (Sarda et al., 2020). Moreover, individuals with lower education levels, who are less skilled at assessing a food product's nutritional quality, are more likely to use Nutri-Score (Ducrot et al., 2015b). In contrast, those with a higher degree look at nutrient information more frequently (Cowburn & Stockley, 2005), but are less likely to use Nutri-Score (Sarda et al., 2020). Still, their diets are healthier, probably due to better nutritional knowledge and their use of nutrition facts tables (Grunert et al., 2012; Sarda et al., 2020). Findings on age and nutrition label use are ambivalent (Campos et al., 2011; Cowburn & Stockley, 2005; Drichoutis et al., 2005). While older people are more interested in nutrition (Grunert & Wills, 2007), younger adults are more likely to use nutrition labels (Campos et al., 2011). Moreover, recent findings suggest more pronounced effects of Nutri-Score on younger populations (Sarda et al., 2020). Many of these effects relate to differences in nutrition knowledge and are thus correlates of attitudinal measures instead of their determinants (Grunert & Wills, 2007).

2.1.3 | Product characteristics

Nutrition and health goals compete with other interests in food, notably good taste, credence attributes (e.g., organic production), or brand preferences. Choosing food is complex and consumers use different *product characteristics* such as labels and ingredient lists to make inferences about a food's taste or health value. Moreover, the price of food is frequently stated as an important determinant of choice, crowding out other consumption motives (Drichoutis et al., 2005; Gassler et al., 2018; Grunert & Wills, 2007; Jacobs et al., 2011). Even the product

category itself is influential—thus, a food category that is perceived as less healthy is less likely to be selected by highly health-conscious individuals (Bialkova et al., 2016). In contrast, perceived healthier products may be rated less tasty, forcing consumers into trade-off decisions (Lee et al., 2013). Still, a positive match-up effect is reported, in which the presence of health claims or the Nutri-Score on perceived healthier products results in even higher purchase intentions (De Temmerman et al., 2021; Steinhauser & Hamm, 2018).

2.2 | Adopter segments for Nutri-Score labeled foods

Previous studies, as reviewed above, have identified consumers that would use Nutri-Score in guiding their food choice and also explored the label's effect on healthier diets. However, none have tried to profile consumer groups based on their nutritional information use in general and assess interaction effects between BOP and FOP nutritional information in healthier food choices across population subgroups, in particular. There is thus a lack of actionable information to allow policymakers to assess the value of supplementary nutrition labeling across consumer segments. The empirical research presented in the following sections, therefore, aims to capture consumer heterogeneity in three steps (Figure 1): First, we classify segments of nutritional information users based on *psychographic characteristics* (phase I). Second, we profile these consumer segments and identify potential Nutri-Score users based on their characteristics and Nutri-Score assessment (phase II). Third, we assess preferences and purchase intentions for Nutri-Score labeled products in a simulated purchase situation and assess the use of the label alongside other packaging information in food choice by consumer segments (phase III).

3 | EMPIRICAL STUDY AND DATA ANALYSIS

3.1 | Data collection, survey instrument, and measures

In December 2019, we conducted a self-administered online survey in Germany. We recruited respondents via university mailing lists (students and employees) and social media to participate in a survey about their "food shopping behavior." The survey targeted yogurt consumers. Thus, the survey ended early for participants who neither buy nor eat yogurt or other plant-based alternatives and were below 16. Individuals gave informed consent to take part in the study and to the privacy statement. 888 individuals followed the link to the survey;

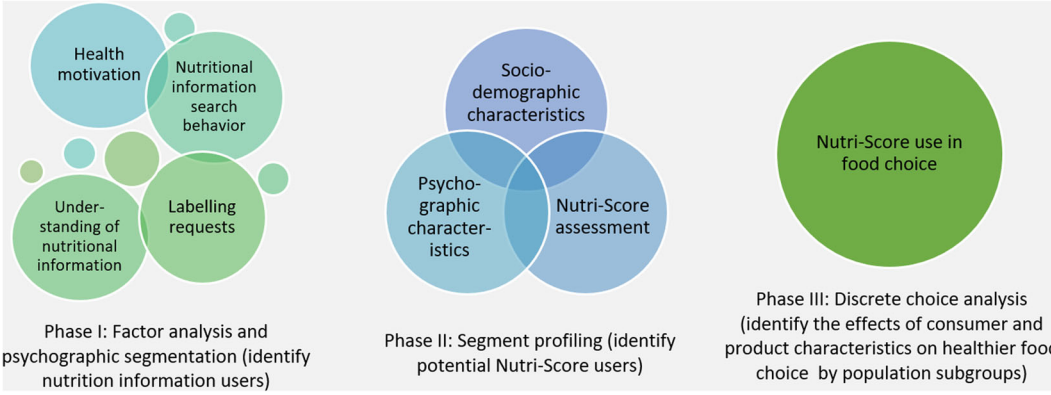

FIGURE 1 Identification strategy on the effect of consumer and product characteristics on preferences and purchase intentions for Nutri-Score labeled products

507 started, and 473 finished it (53.3% completion rate). We removed respondents from the dataset if they speeded or provided contradictory information in the quality check questions—445 interviews remained for further analysis.

The first section of the questionnaire inquired about respondents' purchasing and consumption behavior for yogurt products. The second section included attitudinal measurement scales for the segmentation analysis. Respondents indicated their attitudes toward health and nutrition and their food-related shopping and information behavior, including knowledge and usage of different FOP labels (items were based on Desai and Ratneshwar (2003), Grunert et al. (1993), and Roininen et al. (1999) and measured on 5-point scales). Section three introduced the DCE and asked respondents repeatedly to select from different yogurts the one that they would most likely buy. DCEs are preference elicitation methods common in consumer choice settings and well-grounded in economic theory. Their aim is to derive a utility function from observed choices of product alternatives (Louviere et al., 2000; Train, 2012). Section 3.3 presents details on the DCE. Next, respondents evaluated the Nutri-Score nutrition label on several bipolar rating scales (e.g., indicating if they perceive it as trustworthy or not trustworthy). Finally, sociodemographic information and respondents' height and weight were collected.

3.2 | Consumer segmentation

For our first objective, we used attitude-based cluster analysis to segment nutrition label users. Data were analyzed using the software R, version 3.5.2 (R Core Team, 2018) and the psych package (Revelle, 2020).

First, we assessed all survey items, which captured respondents' attitudes via exploratory factor analysis. Due to high cross-loadings and small factor loadings (<0.5), we discarded several items from the analysis and finally performed the factor analysis (varimax rotation) on eight items. The analysis detected four factors: Factor 1 (Health awareness) describes one's personal striving for a healthy lifestyle and diet. Factor 2 (Information search behavior) captures consumers' use of nutrition information on food packaging, whereas factor 3 (Understanding of packaging information) describes how well consumers understand this information. Factor 4 (Labeling request) describes consumers' expectancies regarding the labeling of healthy foods. Cronbach's αs for all factors are >0.70. (Supporting Information: Appendix A reports the factor structure and factor loadings.) Next, we predicted individual factor scores (Bartlett), which served as input variables for the cluster analysis.

Second, we performed a two-step clustering procedure. Before, we removed five outliers from the data, which we identified with hierarchical cluster analysis using squared Euclidean distance measures (single-linkage). In the first step, we performed Ward's hierarchical clustering method to identify an initial classification of five segments. In a second step, we refined this classification in k-means cluster analysis (Backhaus et al., 2018). We report mean factor scores and use analysis of variance (Kruskal–Wallis) and post hoc tests to identify significant attitudinal differences between the five segments. We further profile the segments regarding age, gender, food-related attitudes, and Nutri-Score perceptions using bivariate analyses.

3.3 | Choice experiment: attributes, design, and framing

Concerning the second objective, we assessed differences in the purchase intention and WTP for Nutri-Score labeled products across the identified consumer segments using a DCE. We chose yogurt as the base product for our analysis for two reasons: (i) it is widely consumed and (ii) even though it is commonly perceived as a healthy product, its nutrient content can vary widely (Miklavec et al., 2015).

In the DCE, yogurt products were described by five attributes with either two or four levels (Table 1). First, the *price* attribute reflects the price of a 150-g yogurt cup, which is the traditional serving size in Germany. The price range of €0.39–€0.99 was based on actual retail prices in November 2019 and determined in a store check. Second,

TABLE 1 Attributes and levels used for the choice experiment

Attributes	Levels							
Price (in €)	0.39		0.59		0.79		0.99	
Brand	Retailer's brand (e.g., Gut & Günstig, Ja!, Tip)		Manufacturer's brand (e.g., Bauer, Ehrmann, Landliebe)					
Nutritional value/ nutrient profile	Reflecting Nutri-Score category A		Reflecting Nutri-Score category B		Reflecting Nutri-Score category C		Reflecting Nutri-Score category D	
	Nutritional Information per 100 g		Nutritional Information per 100 g		Nutritional Information per 100 g		Nutritional Information per 100 g	
	Energy	360 kJ/ 86 kcal	Energy	385 kJ/92 kcal	Energy	431 kJ/ 103 kcal	Energy	636 kJ/ 152 kcal
	Fat	2.0 g	Fat	2.9 g	Fat	4.1 g	Fat	9.2 g
	of which saturated	0.3 g	of which saturated	1.9 g	of which saturated	2.9 g	of which saturated	6.2 g
	Carbohydrate	8.3 g	Carbohydrate	12.6 g	Carbohydrate	13.7 g	Carbohydrate	13.7 g
	of which sugars	6.1 g	of which sugars	12.0 g	of which sugars	12.0 g	of which sugars	13.1 g
	Protein	7.9 g	Protein	3.4 g	Protein	2.9 g	Protein	2.6 g
	Salt	0.1 g	Salt	0.1 g	Salt	0.2 g	Salt	0.8 g
Nutri-Score label	Yes		No					
Organic label	Yes		No					

the two levels of the attribute *brand* reflect either a retailer's brand or a manufacturer's brand. Brand names were added for a richer illustration and easier recognition among respondents. Third, products may or may not carry an *organic* label. Finally, we used two attributes to convey the yogurt's nutritional quality. We displayed the *nutrition information in panel form for 100 g* following Regulation (EU) No 1169/2011 (European Parliament and Council of the European Union, 2011). In addition, the products either carried the corresponding *Nutri-Score nutrition label* or not. In the DCE, the nutritional information reflects average products identified in a store check. Therefore, we first classified the products from the store check into their respective Nutri-Score categories using an online Nutri-Score calculation tool (Mailänder, 2021). Next, we calculated the average nutrient profile in each Nutri-Score category and used those in the DCE. We were unable to identify category E (red) products and thus limit our analysis to Nutri-Score categories A to D. Using the nutrition facts table and the Nutri-Score label in the DCE allows us to study the interaction effects between FOP and BOP nutritional information.

We generated the experimental design for the product profiles in two steps using the software R, version 3.5.2 (R Core Team, 2018) and the packages AlgDesign (Wheeler, 2019) and DoE.wrapper (Groemping & Russ, 2019). We started with the full factorial design (i.e., all 128 possible attribute combinations), which served as the candidate design for a D-optimal design in 32 runs. This final selection of attribute combinations was chosen based on level balance, D- and A-efficiency criteria, thereby reducing the number of required choice tasks while minimizing information loss. To prevent fatigue and reduce the burden placed on the individual respondent, we divided the design into six blocks and randomly assigned respondents to one of these blocks.

We asked respondents four times to select their preferred choice from three different yogurt products that differed in their attribute combinations. Respondents should make their choice as if standing in front of the refrigerated shelf in their local supermarket and as if having to pay for the chosen product. They could also decide against a purchase by choosing the opt-out alternative. Figure 2 shows a sample choice set.

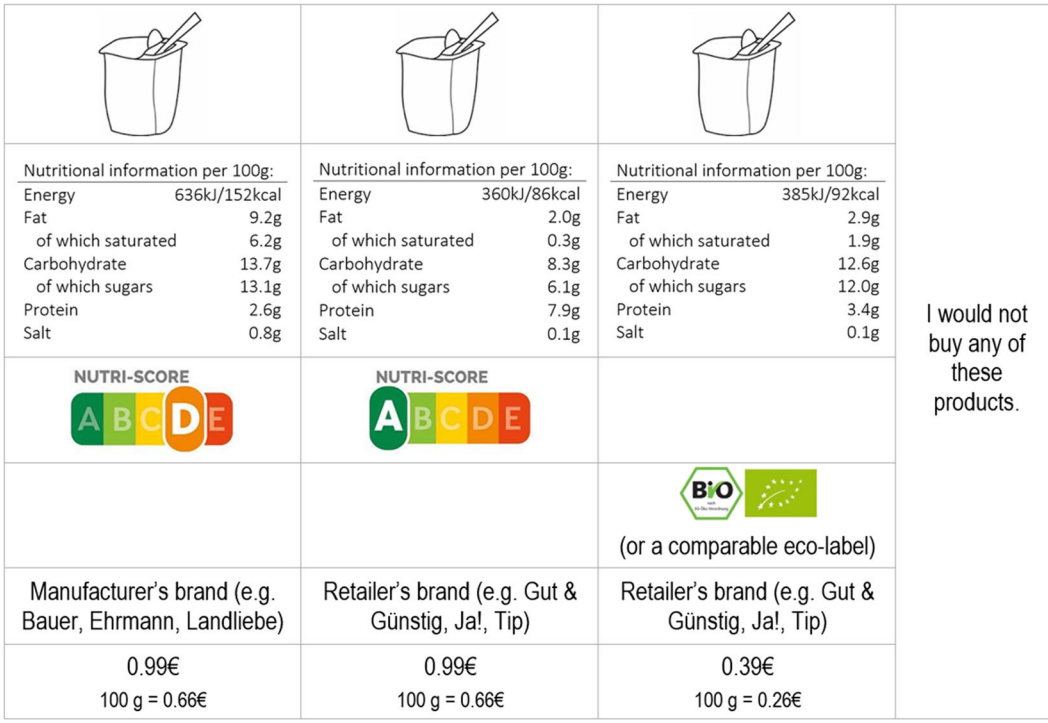

FIGURE 2 Sample choice set

Choice data were analyzed using the software R, version 3.5.2 (R Core Team, 2018) and the mlogit package (Croissant, 2020). We use a random parameters (or mixed) logit model, which allows the utility parameters to vary between individuals. Therefore, we assume individual preferences (the coefficients ß$_i$) to be random draws from a normal distribution whose parameters are estimated. We specify normal distributions for all coefficients except for price, which we treat as a nonrandom parameter. We take the panel data nature of our data into account (i.e., repeated choices of the same individual) and fix the random parameters of individuals to be the same across their choice situations (Croissant, 2020). We specify the observed utility V_{ij} for an individual i of choosing alternative j as:

$$V_{ij} = \alpha_i + \beta_i \,\text{price}_{ij} + \gamma_i' x_{ij}' + \delta_i' z_{ij}', \tag{1}$$

where α_i is an alternative specific constant (ASC), which takes a value of one if individual i chooses to buy a yogurt; and zero if the opt-out alternative is preferred. ß$_i$ and γ_i' are the part-worth utilities to be estimated for the price (ß$_i$) and other product characteristics (γ_i'), respectively. Price enters the utility specification as a continuous variable; all other variables are dummy coded and take a value of one if the characteristic is present in the alternative. To assess the interdependence of nutrition facts and evaluative nutrition labeling, we model a second-order effect (δ_i'). Therefore, we add interaction terms (z_i') that take a value of one if the nutritional facts table is accompanied by the corresponding Nutri-Score label. This allows the Nutri-Score premium to depend on the respective nutrient profile. A product with nutrient profile D, without Nutri-Score, acts as the base group for the analysis. Five models were estimated; one for each consumer segment.

Finally, we compare the effects of the Nutri-Score nutrition label on choice and assess the WTP for Nutri-Score labeled products across segments. For a utility specification with interaction terms, we work out the total derivative with respect to changes in the price and the relevant product characteristics [$dV_{ij} = \beta_i d\text{price}_{ij} + \gamma_i' dx_{ij}' + \delta_i' dz_{ij}' + \varepsilon_{ij}$]; the marginal WTP of segment c for a change in Nutri-Score related product attributes x_k and z_k is (Hensher et al., 2015):

$$WTP_{ck} = -\frac{1}{\beta_c}(\gamma_{ck} + \delta_{ck}), \tag{2}$$

where β_c is the fixed cost parameter, γ_{ck} is the parameter for the main effect of the Nutri-Score label, and δ_{ck} is the parameter for the interaction effect between Nutri-Score and the nutritional facts table. For the estimation, we use the delta method as implemented in the car package (version 3.0-10) for R (Fox & Weisberg, 2019).

4 | RESULTS

4.1 | Sample composition

Our data comprises 440 valid responses but leans toward the female, younger, and better-educated consumers (Table 2). While the sample closely mimics the middle-income brackets of the German population, the low-income group is overrepresented at the expense of the top earners. Findings and conclusions drawn from this sample are thus not necessarily representative of the general population. Nevertheless, our sample offers valuable insights into the nutrition label use behavior of those segments of the population that are at their final stages of education, are young professionals, or belong to the young and established middle class (Bürkl, 2018). Thirty-eight percent of respondents purchase yogurt at least once a week; 36% every 2nd or 3rd week. The sample, therefore, reflects important current and future buyer groups.

TABLE 2 Sample characteristics

Characteristic	Sample	German population[a]
Age (years), mean (SD) (%)	29.36 (11.34)	
18–21	20.7	3.8
22–25	32.7	5.3
26–40	30.9	22.7
41–60	13.9	34.8
>60	1.8	33.3
Female (%)	75.0	50.7
Income level (%)		
<900 €	37.5	4.9
900–1499 €	14.3	12.9
1500–1999 €	9.8	11.8
2000–2599€	11.4	13.5
>2600 €	17.7	56.9
General school leaving certificate (%)		
Lower secondary	6.1	54.8
Upper secondary	88.9	40.1
Other	5.0	

[a]German population data taken from Statistisches Bundesamt (2019).

4.2 | Segmentation results

The cluster analysis identified five segments, which differ in their potential use of nutritional information: "overstrained individuals," "ambivalent users," "detail-lovers," "uninterested consumers," and "label resisters." Table 3 introduces these consumer groups. We present summary and test statistics for the cluster forming variables (Supporting Information: see Appendix A and B for details), the variables used for profiling (i.e., items excluded from the factor analysis and sociodemographic variables), and Nutri-Score assessment.

Overstrained individuals strive to follow a healthy lifestyle. They are very health aware and interested in a healthy diet (mean factor score [MFS] health motivation = 0.73) but struggle with making healthy product choices (MFS understanding nutritional information = −1.14). These individuals report the lowest understanding of nutrition information currently provided on food packaging across the identified segments. Consequently, they only make limited use of nutrition facts tables to compare foods (MFS nutritional information search behavior = −0.61). They indicate interest in simple nutrition labels (MFS labeling request = 0.48) and assess Nutri-Score rather positively (e.g., as rather comprehensible, helpful, and influential). They may therefore be affected by Nutri-Score if disclosing relatively healthier products.

Ambivalent users of nutrition information are not particularly interested in a healthy diet (MFS health motivation = −0.92). Their health awareness, on average, is the lowest across segments. They also state a limited understanding of nutrition information on packaging (MFS understanding of nutritional information = −0.62). Nevertheless, they compare nutrients and read nutrition tables, especially for new products (MFS nutritional information search behavior = 0.80). In general, they favor having more information on food packaging (MFS

TABLE 3 Profiling nutrition information users

	C1: Overstrained individuals (*N* = 86; 20%)	C2: Ambivalent users (*N* = 100; 23%)	C3: Detail-lovers (*N* = 103; 23%)	C4: Uninterested consumers (*N* = 71; 16%)	C5: Label resisters (*N* = 80; 18%)
Mean factor scores (cluster forming variables)					
Health motivation***	0.731 (0.722)[2,3,4]	−0.920 (0.892)[1,3,4,5]	0.366 (0.691)[1,2,4]	−0.567 (1.07)[1,2,3,5]	0.544 (0.776)[2,4]
Nutritional information search behavior***	−0.608 (1.10)[2,3,4,5]	0.800 (0.633)[1,3,4,5]	0.591 (0.552)[1,2,4,5]	−1.414 (0.656)[1,2,3,5]	0.175 (0.966)[1,2,3,4]
Understanding nutritional information on packaging***	−1.142 (0.635)[2,3,4,5]	−0.619 (0.822)[1,3,4,5]	1.038 (0.699)[1,2,5]	0.798 (0.862)[1,2,3,5]	−0.076 (1.02)[1,2,3,4]
Labeling request***	0.480 (0.628)[2,3,5]	0.212 (0.738)[1,3,5]	0.749 (0.721)[1,2,4,5]	0.219 (0.868)[3,5]	−1.794 (0.896)[1,2,3,4]
Further cluster descriptive statistics					
Age (years) (SD)***	31.5 (13.3)[4]	33.5 (12.8)[3,4,5]	28.0 (10.7)[2]	24.7 (5.81)[1,2]	27.8 (9.54)[2]
Female (%)	72.09	68.00	78.64	74.65	82.50
Upper secondary education (%)	84.88	85.00	94.17	92.96	91.25
BMI (kg/m²)*	24.0 (3.87)[5]	24.0 (5.05)	22.9 (3.62)	23.2 (4.55)	22.3 (2.90)[1]
I can judge by the ingredients list whether food is rather healthy or unhealthy***	3.73 (1.12)[3,4,5]	3.72 (0.92)[3,4,5]	4.25 (0.79)[1,2,4]	3.28 (1.17)[1,2,3,5]	4.34 (0.73)[1,2,4]
I buy food that is not highly processed***	3.64 (0.85)[4]	3.33 (1.05)[3,5]	3.85 (1.13)[2,4]	2.97 (0.99)[1,3,5]	3.85 (0.89)[2,4]
The taste of food is more important to me than health aspects***	2.92 (0.91)[2,4]	3.24 (0.83)[1,3,5]	2.90 (0.90)[2,4]	3.55 (0.95)[1,3,5]	2.85 (1.01)[2,4]
Food packaging contains so much information that I feel overwhelmed***	2.85 (1.19)[3,5]	2.39 (1.12)	2.26 (1.13)[1]	2.55 (1.08)[5]	2.02 (1.02)[1,4]
I would like more information on food packaging***	4.00 (0.99)[4,5]	3.96 (0.97)[4,5]	4.00 (1.01)[4,5]	3.14 (1.09)[1,2,3]	2.91 (1.03)[1,2,3]

(Continues)

TABLE 3 (Continued)

	C1: Overstrained individuals (*N* = 86; 20%)	C2: Ambivalent users (*N* = 100; 23%)	C3: Detail-lovers (*N* = 103; 23%)	C4: Uninterested consumers (*N* = 71; 16%)	C5: Label resisters (*N* = 80; 18%)
Nutri-Score evaluation on bipolar scales					
Not trustworthy(−2)–Trustworthy(2)*	0.35 (0.99)[5]	0.24 (0.92)[5]	0.19 (0.99)	0.30 (0.98)	−0.14 (0.94)[1,2]
Not influencing my purchases(−2)–Influencing my purchases(2)***	0.56 (1.12)[5]	0.49 (1.15)[5]	0.41 (1.24)[5]	0.23 (1.21)[5]	−0.41 (1.14) [1,2,3,4]
Patronizing(−2)–Not patronizing(2)***	0.52 (1.13)[5]	0.52 (1.27)[5]	0.65 (1.19)[5]	0.47 (1.05)[5]	−0.13 (1.16)[1,2,3,4]
Not comprehensible(−2)–Comprehensible(2)	0.99 (1.21)	1.05 (1.12)	1.09 (1.10)	0.75 (1.23)	0.90 (1.09)
Not helpful(−2)–Helpful(2)***	0.83 (1.10)[5]	0.82 (1.04)[5]	0.83 (1.11)[5]	0.62 (1.01)[5]	0.11 (1.08)[1,2,3,4]
Not informative(−2)–Informative(2)***	0.40 (1.08)[5]	0.38 (1.27)[5]	0.46 (1.22)[5]	0.37 (1.12)[5]	−0.40 (1.15)[1,2,3,4]

Note: Scale: 1 = *strongly disagree* to 5 = *strongly agree*. −2 = not … to 2 = trustworthy. Values are means (standard deviations). Mean cluster differences were tested using analysis of variance/Kruskal–Wallis and posthoc tests.

Differences with ***$p \le 0.000$; **$p \le 0.01$; *$p \le 0.05$. [1,2,3,4,5]Significant differences ($p \le 0.05$) between clusters, For example, [1]indicates significant differences from Cluster 1 in this variable with $p \le 0.05$.

labeling request = 0.21), but they also admit to trade-off taste and health considerations in their food choices. Despite their positive assessment of Nutri-Score, they may use evaluative nutrition labeling in their food choices yet still buy less healthy products, depending on whether or not they prioritize health aspects.

Detail-lovers are not overly health-conscious (MFS health motivation = 0.37), but they study and compare nutrient profiles to some extent (MFS nutritional information search behavior = 0.59). They regard this information as simple and clearly displayed (MFS understanding nutritional information = 1.04). Accordingly, they feel well informed and confident in judging whether a product is healthy by the ingredients lists. These individuals are fond of nutritional information and demand additional nutrient declarations by manufacturers (MFS labeling request = 0.75). Therefore, and because of their favorable assessment of Nutri-Score, nutrition labeling can positively reinforce the healthy food choices of detail-lovers.

Uninterested consumers, similar to ambivalent users, are little health aware (MFS health motivation = −0.57). They are the youngest segment (24.7 years on average), and following a healthy diet and lifestyle is (yet) of little relevance for them. Even though they feel confident about their understanding of nutritional information provided on food packaging (MFS understanding nutritional information = 0.80), they show little interest in such information (MFS nutritional information search behavior = −1.41). Consequently, these consumers are the least likely to study and compare nutrient profiles. Further, this segment has the lowest rejection of highly processed foods and prioritizes taste over health aspects. As they see little need for additional information on the healthiness of food (mean labeling request = 0.22), they may be less likely to use Nutri-Score in their food choices, despite a rather positive assessment of the label.

Finally, *label resisters* are a contrast consumer group. They are moderately health aware (MFS health motivation = 0.54) and report an average understanding of nutritional information provided on food packaging (MFS understanding of nutritional information = −0.08). Yet, they are reluctant regarding nutrition labeling. These individuals have little interest in searching for nutritional information or comparing nutrient profiles to determine the healthiest product (MFS nutritional information search behavior = 0.18). Still, they are confident that they would be able to identify the healthiest product, should they choose to do so. They refuse more information on food packaging regarding high fat or sugar contents and a simple label indicating the overall healthiness of products (MFS labeling request = −1.79). Hence, their rather negative assessment of Nutri-Score, in stark contrast to all other segments, is not surprising. They perceive Nutri-Score as comparatively untrustworthy, uninformative, patronizing, and thus not relevant for their food choices. Consequently, this consumer segment may not use Nutri-Score in food choice.

4.3 | Choice experiment results

Table 4 reports the estimation results for the random parameters logit models for each consumer segment and for the pooled sample. We find several significant main and interaction effects with the expected signs. Some standard deviation parameters are also significant, indicating preference heterogeneity. It is interesting to note that the standard deviation parameters for Nutri-Score are not significant. We thus fully capture preference heterogeneity in FOP label preferences through the cluster approach and the interaction effects with the nutrient profile.

For four out of five segments, the mean parameter for ASC is positive and significant, indicating that consumers have a positive general attitude toward a purchase. The nonsignificant ASC coefficient for the *detail-lovers* suggests that they are indifferent between a purchase and the opt-out alternative—they may prefer more product information than those provided in the DCE. The negative and significant price coefficients are in line with economic theory; all segments are more likely to buy lower-priced than more expensive products, holding other product characteristics constant. Moreover, consumers across segments prefer organic over nonorganic yoghurt, which follows from the positive and statistically significant coefficients for the organic attribute. While *overstrained individuals* and *consumers uninterested in nutrition labels* have a higher choice probability for a manufacturer's brand,

TABLE 4 Utility estimates by cluster

	Pooled sample	C1: Overstrained individuals (20%)	C2: Ambivalent users (23%)	C3: Detail-lovers (23%)	C4: Uninterested consumers (16%)	C5: Label resisters (18%)
Coefficients						
ASC	3.141 (0.482)***	5.224 (2.258)*	4.162 (1.135)***	1.900 (1.077)	8.328 (2.999)**	1.988 (0.889)*
Product A	3.821 (0.345)***	5.900 (1.844)**	4.877 (0.998)***	4.805 (1.004)***	1.980 (0.884)*	4.797 (0.982)***
Product B	1.924 (0.267)***	5.186 (1.703)**	2.117 (0.661)**	1.911 (0.666)**	1.518 (0.852)	2.387 (0.721)***
Product C	0.944 (0.278)***	3.187 (1.556)*	0.451 (0.743)	1.170 (0.686)	1.520 (1.027)	1.789 (0.722)*
Nutri-Score:Prod. A	2.423 (0.375)***	6.240 (1.509)***	3.300 (1.107)**	3.617 (1.172)**	2.128 (0.933)*	1.142 (0.961)
Nutri-Score:Prod. B	2.059 (0.354)***	3.715 (1.283)**	3.289 (1.162)**	3.378 (1.109)**	2.100 (0.932)*	0.888 (0.878)
Nutri-Score:Prod. C	1.771 (0.465)***	2.308 (1.602)	3.615 (1.594)*	2.792 (1.346)**	0.120 (1.349)	0.528 (1.190)
Nutri-Score:Prod. D	−1.531 (0.300)***	−2.884 (1.120)*	−2.400 (1.002)*	−2.605 (1.075)*	−0.831 (0.684)	−0.865 (0.738)
Manufacturer's brand	0.515 (0.121)***	1.054 (0.447)*	0.377 (0.293)	0.329 (0.266)	2.047 (0.594)***	0.471 (0.350)
Organic	1.863 (0.159)***	3.923 (1.041)***	2.131 (0.444)***	2.011 (0.423)***	2.594 (0.667)***	1.861 (0.424)***
Price	−3.400 (0.334)***	−6.496 (1.825)***	−4.294 (1.002)***	−1.778 (0.662)**	−5.941 (1.486)***	−3.877 (0.888)***
Standard deviations						
sd.ASC	4.323 (0.477)***	5.806 (1.933)**	4.117 (0.909)***	5.459 (1.350)***	4.563 (1.627)**	4.194 (0.972)***
sd.Nutri-Score	0.265 (0.340)	1.063 (0.893)	0.730 (0.522)	0.418 (0.890)	1.080 (0.644)	0.759 (0.523)
sd.Product A	2.316 (0.281)***	1.780 (0.825)*	3.044 (0.734)***	3.125 (0.856)***	2.996 (0.965)**	2.997 (0.753)***
sd.Product B	0.895 (0.279)**	3.069 (1.240)*	1.147 (0.859)	1.037 (0.656)	2.702 (0.979)**	1.928 (0.720)**
sd.Product C	0.275 (0.453)	0.588 (1.098)	0.342 (1.192)	0.642 (0.759)	0.454 (1.127)	0.364 (0.800)

TABLE 4 (Continued)

	Pooled sample	C1: Overstrained individuals (20%)	C2: Ambivalent users (23%)	C3: Detail-lovers (23%)	C4: Uninterested consumers (16%)	C5: Label resisters (18%)
sd.Manufacturer's brand	1.285 (0.240)***	2.350 (0.917)*	0.712 (0.547)	0.760 (0.690)	1.834 (0.693)**	1.787 (0.618)**
sd.Organic	1.669 (0.212)***	4.033 (1.138)***	1.392 (0.477)**	2.410 (0.665)***	2.702 (0.895)**	1.616 (0.513)**
Log-likelihood:	−1,522.1	−251.1	−318.13	−349.8	−230.98	−291.74
#of choice observations	1,751	340	400	410	281	320

Notes: Values are means (std. errors); Signif. codes:***$p \leq 0.000$; **$p \leq 0.01$; and *$p \leq 0.05$. Base levels: Retailer's brand; No organic label; and following the interaction term (Nutri-Score Label*Nutrient Profile) we have a joint base level for these attributes: Product D (i.e., yoghurt with a nutrient profile reflecting Nutri-Score category D, but without the Nutri-Score label).

the other three segments are indifferent, as indicated by the nonstatistically significant coefficients for the manufacturer's brand for these three segments.

Regarding consumers' use of different types of nutritional information, we note several interesting findings. First, the coefficients for the attribute nutrient profile show a positive and significant effect on utility. We find that relatively healthier products are, on average, preferred across segments. For example, all segments prefer category A products to the base group of category D products. Note, however, that consumer segments assess nutrient profiles differently and do not differentiate between all nutrient profiles. Only *overstrained individuals* and *label resisters* show a significantly higher choice probability of category C products. Second, regarding interaction effects, we find both significant positive and negative effects between the nutritional information provided in nutrient tables and the Nutri-Score label. Again, effects differ across segments. For the majority, however, Nutri-Score reinforces the positive effect of a healthier product composition on purchase likelihood, as indicated by the significant positive interaction effects for category A and category B products in four consumer segments. For two segments, *ambivalent users* and *detail-lovers*, we find a positive interaction effect for category C products. While they are indifferent between category C and category D products if presented with the nutrient profile alone, they prefer category C products if Nutri-Score is present. Finally, we find significant negative interaction effects between the Nutri-Score label and the least healthy nutrient profiles (category D) for three consumer segments. In contrast, *uninterested consumers* and *label resisters* seem unaffected.

4.4 | Marginal WTP estimates

Table 5 presents marginal WTPs for yogurt products with different nutrient profiles in comparison to the reference group (i.e., a product with nutrient profile D, without Nutri-Score), holding all other attributes constant. Table 5 further provides the Nutri-Score mark-ups, given the respective nutrient profile. Values are means in € per standard serving size (150 g); lower and upper bounds of the 90% confidence interval are reported in brackets. We use color-coding for illustrative purposes.

TABLE 5 Marginal willingness to pay estimates by cluster and nutrient profile and for the Nutri-Score mark-up (in €/150g)

Nutrient profile	Nutri-Score	Pooled sample		Cluster 1: Overstrained individuals (20%)		Cluster 2: Ambivalent users (23%)		Cluster 3: Detail lovers (23%)		Cluster 4: Uninterested consumers (16%)		Cluster 5: Label resisters (18%)	
Product D		0.00 (Base)											
	+ Nutri-Score mark-up	-0.45***	[-0.60; -0.30]	-0.44**	[-0.79; -0.09]	-0.56***	[-0.91; -0.21]	-1.46*	[-2.72; -0.21]	-0.14n.s.	[-0.35; 0.07]	-0.22n.s.	[-0.54; 0.10]
Product C		0.28***	[0.14; 0.41]	0.49**	[0.13; 0.85]	0.10n.s.	[-0.18; 0.39]	0.66n.s.	[-0.08; 1.40]	0.26*	[0.01; 0.51]	0.46**	[0.14; 0.78]
	+ Nutri-Score mark-up	0.52***	[0.29; 0.75]	0.36n.s.	[-0.10; 0.81]	0.84**	[0.30; 1.38]	1.57*	[0.12; 3.02]	0.02n.s.	[-0.36; 0.40]	0.14n.s.	[-0.37; 0.64]
Product B		0.57***	[0.44; 0.70]	0.79***	[0.44; 1.15]	0.49***	[0.23; 0.75]	1.07**	[0.27; 1.88]	0.26**	[0.05; 0.47]	0.61***	[0.30; 0.93]
	+ Nutri-Score mark-up	0.61***	[0.42; 0.79]	0.57**	[0.20; 0.94]	0.77***	[0.35; 1.18]	1.90**	[0.43; 3.37]	0.35**	[0.08; 0.63]	0.23n.s.	[-0.14; 0.61]
Product A		1.12***	[0.95; 1.29]	0.91***	[0.55; 1.26]	1.14***	[0.80; 1.47]	2.70***	[1.12; 4.28]	0.33**	[0.11; 0.55]	1.24***	[0.85; 1.63]
	+ Nutri-Score mark-up	0.71***	[0.52; 0.90]	0.96***	[0.53; 1.39]	0.77***	[0.38; 1.16]	2.03**	[0.52; 3.55]	0.36**	[0.10; 0.62]	0.29n.s.	[-0.11; 0.70]

Note: values are means [90% confidence interval]; significance codes: ***p≤0.01; **p≤0.05; *p≤0.10; and 'n.s.' not significant; colour coding: non-significant estimates are white; significant estimates for each nutrient profile are greyish, those for the Nutri-Score mark-up in their respective colouring (orange, yellow, light green, and dark green) – with darker shades, the higher their absolute value.

We note several interesting results. First, turning to the estimates for the different nutrient profiles, we find that marginal WTP increases with a healthier nutrient profile across consumer groups. Further, the confidence intervals may be used to assess if the estimates for different nutrient profiles are statistically different from each other. This is the case, for example, for cluster 2. The confidence intervals for product A and product B do not overlap, which suggests a statistically significant difference in the WTP for both nutrient profiles (€1.14 and €0.49, respectively). Similarly, Cluster 5 exhibits a statistically significant difference in the WTP for product A and product C (€1.24 and €0.46, respectively). Second, turning to the Nutri-Score mark-ups, findings suggest a positive Nutri-Score premium for relatively healthier products and some consumer segments. For most consumers, we note negative marginal WTP values for category D (orange) products if they carry the Nutri-Score label. To assess if the Nutri-Score mark-ups statistically differ between nutrient profiles, we again consider the confidence intervals. We find no such differences between the mark-ups for both green Nutri-Scores (i.e., product A and product B). Third, turning to differences across consumer segments, we find the WTP of *label resisters* to be unresponsive to the Nutri-Score label (i.e., no statistically significant mark-ups for labeled products). Yet, they are generally willing to pay more for healthier product choices. In contrast, even though not particularly interested in nutrition labeling, *uninterested consumers* are positively influenced by green Nutri-Score labels, evidenced by the significant and positive Nutri-Score mark-up for category A (€0.35) and category B (€0.36) labeled products. Moreover, the *detail-lovers* show the highest marginal WTP for healthier products and the highest Nutri-Score mark-ups. They are willing to pay €2.70 for yogurt with a category A nutrient profile and are willing to pay a Nutri-Score mark-up of €2.03. These consumers, however, also react most negatively to less favorable (orange) Nutri-Score labeling (i.e., there is a negative Nutri-Score mark-up of €−1.46). *Detail-lovers* and *ambivalent users* are the only segments with positive Nutri-Score mark-ups for category C products.

5 | DISCUSSION

This paper investigates how individuals use and potentially benefit from supplementary, evaluative FOP nutrition information. The introduction of a mandatory FOP nutrition label, as proposed within the European F2F strategy, has become a contentious issue among policy-makers, researchers, and food lobby groups—with the color-graded Nutri-Score and the need for supplementary nutrition labeling at the heart of the European debate (European Commission, 2020; Julia & Hercberg, 2016, 2018). This paper contributes to the body of knowledge by being, to our best knowledge, among the first studies to empirically assess the combined use and effect of BOP nutrition facts tables and the FOP Nutri-Score nutrition label on healthier food choices.

Our objective was to identify segments of nutrition label users and contrast their choice behavior and use of FOP and BOP nutrition information. Therefore, this study was built on an attitude-based segmentation analysis and a survey-based DCE. Our findings show that healthier food choices are preferred by consumers across segments, holding other product characteristics constant. BOP nutrition facts tables guide consumers toward healthier food choices, and consumers correctly health-rank product variants based on this information in the DCE. However, these findings may be an artifact of our relatively health-conscious sample (Bialkova et al., 2016; Cowburn & Stockley, 2005; Miller & Cassady, 2012; Steinhauser & Hamm, 2018). Nevertheless, we identify four segments of label users who utilize the supplementary Nutri-Score in combination with BOP nutrient fact tables. The vast majority of consumers (*overstrained individuals*, *ambivalent users*, *and detail-lovers*) show interest in and preferences for supplementary Nutri-Score labeling—even initially *uninterested consumers* in healthy food. Only the *label resisters* (a fifth of the sample) prefer to infer nutritional and health values from the detailed nutrient facts tables only and are thus unaffected by Nutri-Score. The DCE findings resonate well with the psychographic consumer profiles and thus validate our cluster approach to explain consumer heterogeneity.

We find that Nutri-Score users apply different strategies for incorporating supplementary nutritional information in their food choices. Individual and combined effects of technical and evaluative nutritional cues thus vary across segments. First, the findings suggest an inverse relationship between perceived competent use of nutrient facts tables and the appreciation and adoption of evaluative labeling. O*verstrained individuals*, low in understanding and use of BOP nutrition information, voice preferences for more accessible and simple FOP nutrition labeling. Nutri-Score had a strong effect on this group's food choice. In contrast, competent users of technical nutrition information in our sample refrain from its use. That confirms Liljeberg and Krambeer (2019) and Ducrot et al. (2015b, 2016), who report low-competent nutrition facts users' abilities to identify and adopt healthier foods to be strongly affected by the presence of color-coded FOP nutrition labels.

Second, another important finding is that Nutri-Score reinforces the positive effect of a healthier food products composition on purchase intention and WTP among Nutri-Score adopters. De Temmerman et al. (2021) were the first to describe this positive match-up effect. We confirm their finding by showing a strong positive effect of Nutri-Score on purchase intentions and WTP for green-labeled products (categories A and B). Third, we detect a surprising effect for products with relatively unhealthier nutrient compositions (i.e., category C products). Take, for example, the group of *overstrained*, yet health-conscious individuals: Nutri-Score labeling of a category C-product reduces their WTP for this product, thus suggesting changes in individual utility levels and preference reversal to take place. Interestingly, for *ambivalent users* and *detail-lovers*, who initially do not differentiate between category C and D nutrient profiles, supplementary Nutri-Score labeling increases their purchase likelihood of category C products—relative to category D products. Overall, this suggests that Nutri-Score enables consumers' better alignment of food choices and health preferences and may be particularly helpful in differentiating products at the lower end of possible nutritional profiles. Conversely, our findings reveal that products labeled as of least favorable nutritional composition are stigmatized and less likely purchased by most consumers.

Overall, the findings of this study add to previous evidence in favor of supplementary Nutri-Score labeling and further establish evaluative nutrition labeling as an effective policy tool supporting consumers in identifying and making healthier food choices (e.g., Crosetto et al., 2020; De Temmerman et al., 2021; Dubois et al., 2021; Ducrot et al., 2016; Egnell et al., 2019; Julia & Hercberg, 2017).

5.1 | Policy and managerial implications

Our findings have potential public policy implications. First, the segmentation results point to particular consumer groups being overwhelmed by BOP nutrition facts (especially cluster A). They struggle with understanding nutrition tables, demand additional nutrition labeling, and have a positive attitude toward Nutri-Score. As we see from the DCE results, they incorporate the supplementary Nutri-Score label in their choice behavior. Overall, this implies that BOP nutrition tables are insufficient for guiding these consumer groups to make healthier dietary choices, and there is evidence that Nutri-Score labeling benefits these consumers. Thus, while we find that some groups do not need supplementary nutrition information to act on their health preferences, consumers overwhelmed by nutrient tables are currently put at a disadvantage. Mandatory nutrition labeling can thus serve as a vehicle for empowering consumers with low nutrition knowledge to select healthy foods. Second, the revealed interactions between FOP and BOP nutritional cues indicate that regulations governing food information, in particular food labeling, need to consider food packaging in its entirety. Consumers would ideally use nutrition labels to help interpret nutrition facts tables. Indeed, as indicated by our results, consumers understand how to use supplementary nutritional information in their best interest: relying on BOP nutrient facts only (*label resisters*) or combining both information cues (majority of consumers). That further brings evidence that concerns about information overload are negligible. Overall, findings establish Nutri-Score as an effective nutrition label supporting consumers in identifying and making healthier dietary choices, but that nutrition education, in general, is still necessary and helpful.

The results also indicate important managerial implications for food manufacturers and retailers. The findings that consumers prefer healthier product variants and, as also previously reported by De Temmerman et al. (2021), stigmatize products if labeled as relatively unhealthy, can motivate manufacturers to strive for healthier product variants. Reformulating relatively unhealthy products may make sense from a business perspective, as it will likely allow manufacturers to capture consumer surplus.

Moreover, we agree with De Temmerman et al. (2021) that the adoption of Nutri-Score offers potential for competitive advantage as it signals that food manufacturers or brands care about the well-being of their consumers. However, both advantages apply primarily for first-movers, who adopt the label voluntarily, and until Nutri-Score labeling is not mandatory and implemented across the board. And while businesses may wish to apply Nutri-Score on healthier products only, current German legislation requires all products of a brand to be labeled within 2 years of the initial adoption (Bundesministerium für Ernährung und Landwirtschaft BMEL, 2020). These terms may encourage food manufacturers to increase the availability of healthier product variants in the medium to long run.

5.2 | Limitations and avenues for future research

This study is not without limitations. First, we studied the interaction effect between FOP and BOP nutrition information for one product category and a single country. Our study is thus primarily exploratory. While the segmentation revealed diverse consumer groups, corresponding well with research on heterogeneous preferences for nutrition information use, future studies should corroborate our findings with representative samples to assess if the presented clusters are exhaustive and validate their respective sizes. Additional research is also needed to understand differences in the use of FOP and BOP nutrition information and their combined effects on food choice across product categories. Particular focus should be on the perceived healthiness and the vice versus virtue nature of a product category, which influences consumer responses to labeling (Bialkova et al., 2016; De Temmerman et al., 2021; Lee et al., 2013; van Doorn & Verhoef, 2011). Further studies could also include interferences between Nutri-Score and other product characteristics, such as organic claims or brands, which influence taste, health, and quality perceptions (De Temmerman et al., 2021; Gassler et al., 2019; Lee et al., 2013). Additionally, such work could consider interaction effects between price and Nutri-Score labeling to allow conclusions about pricing strategies.

Second, we excluded category E nutrient profiles from the chosen design, as no category E yogurt product was identified in the store check. Consequently, the reference category for the present analysis is an orange Nutri-Score (category D). One should thus be careful when transferring the results to other product categories, for which the full Nutri-Score range applies. While we expect the positive effects for green-labeled products to persist and the stigmatizing effect for red-labeled products to be even more pronounced among Nutri-Score responsive consumer groups, these issues require further examination. Moreover, one should note that we administered the DCE after the attitudinal measurement scales, and it is thus likely that respondents were primed toward choosing healthy products.

Finally, our framework and the subsequent empirical analysis consider several consumer-specific characteristics that influence the effect of Nutri-Score on consumer choice. The two-step cluster approach based on psychographic characteristics effectively captured preference heterogeneity for Nutri-Score in the DCE. Nevertheless, more theory building is needed, and future frameworks could include other attitudes or psychophysiological characteristics and multiple food categories.

6 | CONCLUSIONS

This study set out to assess how the information provided in BOP nutrition tables interacts with evaluative FOP nutrition labels in guiding healthier food choices and if different consumer groups react to and thus use both information cues differently. Findings from an attitude-based segmentation analysis and a survey-based DCE for

yogurt products with German consumers provide strong evidence in favor of supplementary, color-graded nutrition labels, such as Nutri-Score. Four major conclusions emerged. First, consumers prefer healthier product variants, but different consumers use nutritional cues differently. The vast majority of consumers show interest in and preferences for supplementary FOP Nutri-Score nutrition labeling. Only a small group of label resisters prefers to infer nutritional and health values from the technical BOP nutrient facts tables and is thus unaffected by Nutri-Score. Second, products with relatively healthier nutrient profiles experience a positive match-up effect, that is, the presence of a green Nutri-Score label (category A and B) further increases purchase intentions for healthier foods. This effect was present even among consumers initially uninterested in supplementary FOP labels. Third, products ranked as of lower nutritional quality are stigmatized by most consumers, except for those uninterested in nutrition labels. Fourth, preference reversal for products of lower health value indicates that Nutri-Score nutrition labeling enables consumers' better alignment of food choices and health preferences.

Possible limitations arise from the hypothetical choice setting for a perceived healthy product category, the Nutri-Score range considered, and the sample of mainly younger professionals. Nevertheless, several implications emerge from the findings. First, from a public health perspective, they support the introduction of Nutri-Score as a supplementary FOP nutrition label. Detailed BOP nutrient tables are not easily comprehensive for all consumers and thus not sufficient in promoting healthier food choices. Broad adoption of Nutri-Score is in the interest of consumers and public health officials alike, as it supports consumers who are currently struggling with making healthier food purchases. Second, communication strategies that accompany the introduction of Nutri-Score should take differences in consumers' health and labeling attitudes, use of nutrient information, and nutritional knowledge into account to promote healthier food choices and reduce possible prejudices. Finally, the identified positive match-up effects suggest that Nutri-Score adoption benefits healthier food products. Products of relatively low nutritional quality, however, will likely be stigmatized. Overall, these findings should encourage food businesses to formulate healthier product variants.

Future studies should corroborate our results with revealed preference data and different product categories. Moreover, examining household panel data or retailer loyalty card data could provide promising avenues for further research on changes in the nutritional quality of shopping carts or purchases within specific product categories across different consumer groups.

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DATA AVAILABILITY STATEMENT

The data are available from the corresponding author upon request.

ETHICS STATEMENT

The study was conducted in accordance with the ethical principles for research involving human subjects and in accordance with local statutory requirements. Informed consent was obtained from all individual participants involved in the study.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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