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Combining Geographical Indication Labels With Nutri-Scores: Preferences of German and Dutch Consumers

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Abstract: The introduction of a harmonised front-of-pack nutrition label remains a timely and contentious issue within EU policy debates. However, the effects of colour-coded candidates such as the Nutri-Score in combination with other prominent EU food labels such as Geographical Indications (GIs) remain underexplored – particularly, in northern European contexts and in a scenario of mandatory Nutri-Scores. To address this gap, we conduct a discrete choice experiment with over 800 German and Dutch respondents to quantify the willingness to pay for these labels. We find that consumers are willing to pay a premium of 72 cents for GI-labelled Parma ham and 48 cents for a Nutri-Score D rather than E. Consumers also prefer the combination of GI hams with a comparatively better Nutri-Score D but the interaction between the two labels is not significant, indicating no strong interplay between them in our experiment.

Keywords: Food Labelling, Geographical Indications, Protected Designation of Origin (PDO), Nutri-Score, Discrete Choice Experiment

1 Introduction

Food labelling has become a central tool to empower consumers through better information and to shape agri-food markets. Yet different label schemes may pull consumer evaluations in different directions. In the European Union (EU), Geographical Indications (GIs) aim to highlight origin, tradition and gustatory quality, whereas nutrition labels such as the Nutri-Score rank foods according to nutritional quality. However, many GI products, particularly cheeses and processed meats, receive poor Nutri-Scores (Höhn et al., 2023). This apparent contradiction raises concerns that these two label schemes may convey signals to consumers that are not complementary, but conflicting. Therefore, this paper analyses the effects of a new nutrition label on consumer evaluations of GIs, focusing on how the two labels are valued independently by consumers and whether a comparatively better Nutri-Score increases willingness to pay for a GI. In general, academic research on the interplay of GIs with additional (nutrition) labels has been limited.

The Farm to Fork Strategy originally envisioned a mandatory, EU-wide rollout of a front-of-pack nutrition label such as the Nutri-Score (EC, 2020). Yet, strong opposition from GI stakeholders and from Member States such as Italy, which argue that the Nutri-Score penalises

traditional GI foods, has effectively blocked this mandate at the EU level (Fortuna et al., 2022). This policy stalemate underlines the timeliness of investigating how consumers respond to the coexistence of GIs and the Nutri-Score, and whether these signals reinforce or undermine each other in consumer decision-making.

Nonetheless, the voluntary Nutri-Score, developed in France in 2017, has since been adopted by several Member States, including Germany and the Netherlands. In those countries, producers who adopt the Nutri-Score have to show it on all their products. Also, some retailers generally put pressure on producers to do so, in effect making it not necessarily completely optional (see e.g., BMLEH, 2025; Robinson, 2025). The Nutri-Score classifies foods into five colour-coded categories from green (A, healthier) to red (E, less healthy) based on a nutrient-profiling algorithm (Julia, Hercberg, 2017). Its purpose is to provide consumers with a simple but comparable indication of nutritional quality.

With a production above 80,000 tons per year, one of the economically most successful, high value and well-known GIs that receives unfavourable Nutri-Scores is Italian Parma ham (AND-International, 2020: 101; Höhn et al., 2023; Iotti et al., 2023). 38% of Parma ham production is exported, and about half of this share within the EU (Parma, 2025). While Parma ham enjoys a strong reputation, it faces the Nutri-Score in its key European export markets, namely, France, Germany, Belgium and the Netherlands (TESEO, 2025), where it is often found in shops with the Nutri-Score.[1] This makes Parma ham an ideal case for investigating how foreign consumers evaluate a GI product when confronted with a less favourable nutrition label. Germany and the Netherlands are especially relevant contexts, as they are major markets for Italian GIs, but remain underresearched in GI literature.

To address this gap, we determine with a discrete choice experiment (DCE) the willingness to pay (WTP) of German and Dutch consumers for GI-protected Parma ham and Nutri-Scores. First, we quantify the relative strength of the GI and comparatively better Nutri-Score labels in affecting consumer WTP, based on a sample of more than 800 German and Dutch respondents. To the best of our knowledge, this is the first experimental WTP study involving both German and Dutch consumers for a southern European GI product. Second, we investigate the combination of the Protected Designation of Origin (PDO) for Parma ham with a comparatively better Nutri-Score D. Overall, the experiment enables us to explore an important potential trade-off that consumers face: many GI products rooted in culinary tradition enjoy reputational value, but tend to perform poorly on Nutri-Scores. Hence, we examine whether consumers evaluate both labels independently in a scenario where the Nutri-Score would be mandatory and where consumers are at least somewhat familiar with it. A DCE allows us to simulate such an environment.

2 Background and Literature Review

2.1 Nutri-Score

The Nutri-Score attempts to evaluate nutritional quality, scoring foods and classifying them into five colour-coded categories A (green, best) to E (red, worst). The algorithm for solid foods, based on nutrient profiling of core macronutrients, results in a score ranging from -15 (best) to 40 (worst), which is then classified into five colour-coded categories: A (green) for -15 to -1, B (light green) for 0 to 2, C (yellow) for 3 to 10, D (orange) for 11 to 18 and E (red) for 19 to 40 (Julia, Hercberg, 2017). Its primary aim is to help consumers identify the healthier option within a product category, for example, raw hams.

[1] For instance, in the online shop of Albert Heijn, which is the largest retailer in the Netherlands (Reul, 2025), all available Parma hams display a Nutri-Score of either D or E. See https://www.ah.nl/.

Cheeses and meats, over a third of all GIs (eAmbrosia, 2023), tend to achieve higher economic value (AND-International, 2019), but typically receive unfavourable Nutri-Scores (D or E) (Höhn et al., 2023). This outcome has been strongly criticised by opponents like Italy and traditional food producers, who accuse the label of unfairly penalising their products (Fortuna et al., 2022; Borrillo, 2021; Qualivita, 2022; Roquefort, 2022). Italian authorities even restricted the use of Nutri-Scores unless accompanied by in-store consumer warnings (EFA, 2022), and recent constitutional debates sought to block any future adoption altogether (Fortuna, 2024).

Despite this opposition, seven countries endorsed the Nutri-Score.[2] Germany introduced the label in 2020 (BMEL, 2020), and during our data collection the Netherlands was in a so-called "pilot-phase" before the official introduction in 2024 (Rijksoverheid, 2023). The Nutri-Score is voluntary in both countries: the decision to display it lies with producers or distributors. Still, the Nutri-Score gained popularity due to the commitment of major retailers (Jumbo, 2022; REWE, 2022). Consequently, even producers that refuse the Nutri-Score, such as Roquefort (Roquefort, 2022), or emphasise health benefits, such as Parma or San Daniele ham (Parma, 2023b; San Daniele, 2022), may still bear a "red E" in main EU export markets (e.g. Parma, 2023a). Concretely, even if the Parma ham consortium chooses to oppose the Nutri-Score, the product will still be labelled in export countries where the distributor opts to implement it. In addition, the Nutri-Score or a similar label may still become binding in the future throughout the EU. Therefore, examining consumer preferences for GIs such as Parma ham with unfavourable Nutri-Scores remains essential.

2.2 Geographical Indications

First and foremost, GIs in the EU are meant to certify a specific origin and production method. GIs establish intellectual property rights for such products and are meant to signal authenticity and quality in the market, while also supporting producers in promotion and trade. Two main categories exist: Protected Designations of Origin (PDOs) and Protected Geographical Indications (PGIs). PDOs have the closest link to their place of origin, requiring that every step of production, processing and preparation occurs within a defined region. PGIs allow for a looser connection, with only one stage of production that must take place in the specified area.[3]

From an economic perspective, they aim to address information asymmetries related to origin and certain quality characteristics by providing a credible signal to consumers through a label (see e.g., Loureiro, McCluskey, 2000; Mérel, Sexton, 2012; Moschini et al., 2008). Although the EU asserts that GIs protect traditional products of high quality, superior (gustatory) quality itself must not be independently verified. Still, GIs do certify a certain origin, which is linked to the concept of "terroir" – the combination of natural factors (e.g., climate) and human factors (e.g., know-how) that can shape taste and quality characteristics (Huysmans et al., 2025).

Today, the GI label is getting company of labels certifying other product characteristics such as nutritional quality. Gracia and de-Magistris (2016) show in their ranking experiment of various food labels that the PDO label and the nutrition facts panel were the most important labels to consumers. Therefore, our paper addresses the important issue of the Nutri-Score's role in shaping consumer preferences for GI products.

2.3 Willingness to Pay for GIs and Nutri-Scores

A major enabler for sustainable economic success of GIs is the realisation of price premiums. GI hams tend to achieve rather high premiums compared to other categories (AND-International, 2019). Still, consumer responses may differ in northern Member States because GI recognition and awareness remain low there (AND-International, 2020). For example, in 2019/20, less than a quarter of German respondents knew about the GI logos and terms and

[2] Belgium, France, Germany, Luxembourg, Netherlands, Spain and Switzerland

[3] Regulation (EU) 2024/1143

not more than a tenth of Dutch respondents (AND-International, 2020). To the best of our knowledge, we contribute to the literature by conducting the first WTP analysis with German and Dutch consumers for a well-known foreign GI product.

Some DCEs confirm that higher WTP for GI products also exists in newer Member States such as Hungary (Török et al., 2022) and Slovenia (Kos Skubic et al., 2018), but major northern EU markets such as Germany and the Netherlands remain underexplored. In Germany, Teuber (2011) investigates consumer expectations towards Hessian apple wine and the study of van Ittersum et al. (2007) examines, amongst others, Dutch consumer appreciation and WTP for GI cheese and potatoes. A regional consumer study in Bavaria suggested some responsiveness to certification and origin cues, though it predates the formal GI status of Bavarian beef (Profeta et al., 2011). In general, all these studies consider domestic GI products.

Previous literature on the Nutri-Score focused on consumer understanding and appeal, highlighting the Nutri-Score as intuitive and easily recognisable (Becker et al., 2015; Egnell et al., 2020; Hagmann, Siegrist, 2020). Some research exists that investigates the WTP for Nutri-Scores. These studies find a higher WTP for better Nutri-Scores, but they tend to focus on relatively good Nutri-Scores, such as A versus B for yoghurt (Gassler et al., 2022) or B or D versus no Nutri-Score for whole milk and chicken breast (Sonntag et al., 2023). Thus, we quantify the difference in WTP between Nutri-Scores assigning low(er) nutritional value, namely categories D and E.

Critically, the interplay of the Nutri-Score with other quality-related labels such as GIs remains underinvestigated. Stiletto and Trestini (2022) provide first empirical evidence that the marginal WTP for PDO cheeses is higher than for the Nutri-Score. They investigate the WTP of Italian respondents for GIs and showing a Nutri-Score D in the case of two Italian PDO cheeses. Interestingly, they found that overall consumers had a higher WTP for the “unhealthy” Nutri-Score D, which was the only Nutri-Score category considered (Stiletto, Trestini, 2022).

Yet, focusing solely on the comparison of a Nutri-Score D to no Nutri-Score raises two important considerations. If the Nutri-Score becomes mandatory, the scenario without the Nutri-Score is no longer relevant. Although countries endorsing the Nutri-Score did not make it mandatory de jure, labels like the Nutri-Score may still become quasi required due to retailers’ commitment and bargaining power (Lemken et al., 2021). In fact, there are reports that some retailers exert pressure on suppliers to use the Nutri-Score (Robinson, 2025). Vandevijvere (2020) also observed that the high uptake by Belgian retailers could create additional pressure on food producers to follow suit. Secondly, if consumers lack an explanation or comparison to products with different Nutri-Scores in a certain category such as cheese, the implicit comparison may be the worse Nutri-Score E rather than better ones. The latter may explain why some Italian respondents were willing to pay a premium for the Nutri-Score D in the study of Stiletto and Trestini (2022). Thus, we consider varying Nutri-Scores on a PDO-labelled product which is sold in countries that endorse the Nutri-Score.

Willingness to Pay for Parma Ham

We focus specifically on PDO Parma ham because it represents one of the most well-known GI products (AND-International, 2020: 101). Its WTP has been analysed in several prior stated preference analyses. Garavaglia and Mariani (2017 unravel that overall Italian consumers are willing to pay a significant premium of more than 10% for Parma ham. Arfini and Mancini (2015) also find, using a contingent valuation method, that the PDO of Parma ham increases WTP among students at the University of Parma – on average 90 cents per pre-sliced package. Van Ittersum et al. (2007) analyse, amongst others, attitudes towards Parma ham of Italian consumers. Overall, a favourable image of the PDO label significantly influences WTP of consumers (van Ittersum et al., 2007). All these studies were conducted with Italian respondents and neglected nutrition labels. Therefore, our study extends this literature by estimating WTP of non-Italian consumers for Parma hams carrying Nutri-Scores.

In a recent study, Stiletto et al. (2024a) conducted a hedonic price analysis of retail data in France and find that Parma hams labelled with a Nutri-Score D or E have lower retail prices. This pattern also holds for non-GI hams in their study. The findings demonstrate how GIs may not shield products from Nutri-Score-related price penalties. However, their approach does not directly capture consumer preferences. To contribute to this emerging strand of research, our discrete choice experiment provides the first behavioural evidence on consumer WTP for Parma ham with varying Nutri-Scores in northern EU markets, where GI familiarity is relatively low and Nutri-Score awareness is rising.

2.4 Consumer Responses to Multiple Food Labels

Given the proliferation of sustainability-related labels, recent studies started exploring interaction effects of food labels (Drugova et al., 2020; Gassler et al., 2022; Sonntag et al., 2023). Combining labels, such as organic and animal welfare, can reduce marginal utility, i.e. the WTP for the combination is less than the WTP of each individual label together (Gerini et al., 2016). The reduction of marginal utility has also been described in the media as “label fatigue”, i.e. that more labels do not necessarily generate more value and are potentially ignored (Gunlock, 2015; von Massow, 2019). In our case, the GI label is assumed positive (GI versus a generic product), and the Nutri-Score to be relative: a score of D is comparatively positive for a ham product, which could also have a score of E.

Stiletto et al. (2024b) consider the interaction of GI labels and Nutri-Scores for three non-ham products. They find reduced WTP for low Nutri-Scores, and mostly non-significant interactions, suggesting consumers consider both labels in purchasing decisions. Their non-hypothetical experiment with 200 Italian consumers has more external validity than DCEs, but limited generalisability. Since the Nutri-Score is not endorsed in Italy, our focus on over 800 Dutch and German consumers has the benefit of involving consumers in countries where the Nutri-Score is observed. In addition, both countries are under-researched when it comes to GIs, despite being major EU markets, especially for Italian GIs (Qualivita, 2023).

2.5 Hypotheses

We aim to enrich the broader literature on consumer behaviour by empirically exploring the interplay of two prominent food labels. While the GI label leans towards signalling tradition, craftsmanship, and gustatory quality and is thus more related to hedonistic aspects, the Nutri-Score directly addresses health and nutritional quality. Our experiment intends to examine if consumers value both criteria independently and if a comparatively better Nutri-Score affects the price premium of a GI.

On the basis of the aforementioned literature we define our main hypotheses to test. To begin with, we expect a higher WTP for the PDO Parma ham certification versus no GI label than for the comparatively better Nutri-Score D versus Nutri-Score E. This expectation rests on the idea that nutritional quality represents only one credence attribute of the product. In contrast, GIs such as Parma ham follow product specifications that not only certify origin, but possibly also other relevant experience, credence or Potemkin attributes such as taste due to, e.g., minimum maturation time or authenticity by stipulating more traditional production techniques (Huysmans et al., 2025). We focus on Nutri-Score categories D and E because these represent the possible range for GI meats such as Parma ham (Höhn et al., 2023) based on the current algorithm. Hence, we aim to capture the realistic trade-off consumers face when evaluating GI products with consistently less favourable nutrition ratings.

Moreover, Parma ham represents a “vice product”. Vice products, or “wants”, are consumed primarily for immediate gustatory pleasure, rather than for long-term benefits such as healthiness (see e.g., van Doorn, Verhoef, 2011). For vice products, consumers typically place less importance on sustainability-related labels such as organic production or nutritional quality (Drugova et al., 2020; van Doorn, Verhoef, 2011). Therefore, our first hypothesis is:

(H1) Consumers have a stronger preference for PDO Parma ham than for a comparatively better Nutri-Score D relative to E.

Second, our paper examines whether a comparatively better Nutri-Score (D instead of E) changes consumer valuation of PDO Parma ham. While D represents an improvement over E, it is still considered a low nutritional score and hence, may not generate a strong positive premium when combined with the PDO. In general, abovementioned studies showed that combining different food labels often leads to diminishing marginal utility, rather than additive effects. Thus, the WTP for the combination of Parma ham with a Nutri-Score D could be less than the sum of the individual WTP values. Consequently, our second hypothesis reads:

(H2) The combined WTP for PDO Parma ham with a comparatively better Nutri-Score (D instead of E) is higher than the respective individual WTP, but smaller than their sum.

3 Method and Data

3.1 Data Collection and Experimental Design

3.1.1 Focus Product and Sample

We focus on Parma ham in our DCE as it is representative of popular GIs sold across the EU. Previous consumer experiments involving Parma ham have highlighted price premiums, but none have considered nutrition labels. Most importantly, Parma ham – and raw ham in general – does not fall into a single Nutri-Score category, but can receive either D (orange) or E (red). Hence, less healthy options are available.[4]

More than 70% of pre-sliced Parma ham is exported (Parma, 2025). Hence, rather than focusing on the Italian home market of Parma ham, we recruited respondents in Germany and the Netherlands, where the Nutri-Score is present and publicly endorsed. Both countries represent key export markets for Parma ham (Parma, 2023a) and Italian GIs (Qualivita, 2023). In 2023, Germany accounted for about 26% of all intra-EU exports and the Netherlands for about 6% (TESEO, 2025). German and Dutch consumers are also known to be price sensitive (Retailtrends, 2013; Statista, 2013) and show lower GI awareness (AND-International, 2020). These market conditions differ notably from those in Italy, underlining the importance of quantifying WTP in these contexts as well.

We administered the study in April and May 2023 via the service provider Prolific with gender-balanced samples of German and Dutch consumers.[5] The average completion time was approximately seven minutes, and respondents received a monetary reward of 1.25 £, i.e. about 11 £ per hour. We pre-screened respondents based on dietary habits. Those who avoid (terrestrial animal) meat, i.e. individuals following vegetarian, pescatarian, or vegan diets, were excluded.

In total, we received 980 completed responses to our questionnaire. We excluded 41 respondents who completed the survey in under two minutes – well below the average – indicating a lack of engagement. Additionally, 94 participants failed an attention check embedded in a ranking task, where selecting the same attribute as both most and least important signalled inattentiveness. To mitigate hypothetical bias, we further excluded 30 respondents who neither purchased ham in the past six months nor consumed ham in the past three. These exclusions

[4] This was double-checked in stores and databases such as Open Food Facts (see https://world.openfoodfacts.org/).

[5] Prolific (https://www.prolific.co/) is a platform tailored for researchers, offering online participant recruitment with a diverse pool of study participants from various countries. It upholds good standards in recruitment, ensuring participants are aware they are being engaged for research purposes (Palan, Schitter, 2018).

help ensure data quality and validity by focusing on attentive respondents familiar with the product. Please note that our main findings remain stable regardless of these exclusions. Appendix 1 gives more information on the final sample of 815 valid responses and how it is representative of the general population.

3.1.2 Experimental Design

In a DCE, consumers choose repeatedly between different hypothetical options of a product according to their preferences for defined product characteristics (Bliemer, Rose, 2024; Louviere, Woodworth, 1983). In our experiment, we consider three different product characteristics with differing levels (see Table 1).

Table 1. Product characteristics with given explanation and levels

Characteristic	Explanation (English translation)	Levels
Geographical Indication (GI)	Compared to *other raw hams*, traditional raw hams with a geographical indication such as *Parma ham* must be produced in a certain area (e.g. hills around Parma in Italy). In the EU, the label that stipulates a specific origin and production requirements is called *Protected Designation of Origin* or *PDO*:  In the survey, you will encounter *PDO Parma hams* and *raw hams*. The latter are not protected by a PDO label and hence, not limited in terms of origin and production.	I. Parma ham (PDO) II. Raw ham (generic)
Nutri-Score (NS)	The *Nutri-Score* intends to measure *the overall nutritional value* of a product and hence, to show *how healthy* the consumption is. Products are assigned to one of five colour-coded categories. Products bearing an A (green) are most likely to contribute to a healthy diet, while products with an E (red) are least likely:  Raw hams normally fall in the categories of *D (orange)* or *E (red)*. In the survey, you will encounter only these two categories.	I. D (orange) II. E (red)
Price / 100 grams (Price)	100 grams represent a regular package size of pre-sliced hams in supermarkets. Thus, *prices are given in euro per 100 grams*: **€/100gr** In the survey, prices will range from *3 €/100gr* over *4 €/100gr* to *5 €/100gr*.	I. 3 €/100gr (low) II. 4 €/100gr (medium) III. 5 €/100gr (high)

Source: authors` own elaboration

The first characteristic is *"Geographical Indication (GI)"* which has two levels. Respondents encounter either PDO Parma ham or generic raw ham without a GI. The second characteristic is *"Nutri-Score (NS)"*. The shown ham has either a Nutri-Score of D (orange) or E (red) because no better score would be possible for a raw ham based on the Nutri-Score metric. To determine WTP and test our hypotheses, the third attribute is *"Price/100 grams"*, which has three levels: 3€/100gr, 4€/100gr and 5€/100gr. The price levels were determined based on current in-store

and online store prices in major German and Dutch retailers. We rounded prices to decrease cognitive strain (Bliemer, Rose, 2024) and chose the price per 100 grams because 100 grams also represents a standard package size for raw hams sold in supermarkets.

Following related DCE studies, all characteristics were briefly explained to respondents so that they know the basic meanings (see Table 1). These explanations avoid confusion among respondents and ensure that characteristics are not misunderstood or ignored due to a respondent's possible lack of knowledge (cf. De Bauw et al., 2021, 2022; Mazzocchi et al., 2022).

Respondents had to choose their preferred ham out of two options differing with regard to the considered characteristics. We use a fractional factorial design because in total we have 66 possible comparisons in our full factorial design which is too much to show to each respondent. Based on the 66 possible comparisons we created a random design which allowed us to exclude undesirable dominant options (Bliemer, Rose, 2024; Walker et al., 2018).[6] In our case, a dominant option would represent, e.g., a ham that is GI-certified, healthier and cheaper compared to the other option. Our final random design includes 18 different choice situations that were randomly assigned into two blocks to reduce cognitive burden.[7] Hence, each respondent had to decide in 9 choice situations. Respondents were randomly assigned to each block via Qualtrics, while accounting for block balance.[8] See Appendix 2 for the complete matrix of attribute-level combinations of our fractional factorial design.

As we follow a stated preference approach, we also showed respondents a cheap-talk script to reduce hypothetical bias (Menapace, Raffaelli, 2020; Penn, Hu, 2018).[9] In addition, we added a "no-purchase" option to make the choice generally more realistic (Bliemer, Rose, 2024). Consequently, respondents could either choose "Option 1", "Option 2" or "None of them". We first created an English version of our DCE questionnaire in Qualtrics and conducted a pilot study (N=38).[10] See Appendix 3 for an exemplary choice situation shown to respondents. The DCE design was tested successfully and hence, not changed but we added and reformulated some explanations and questions concerning consumption behaviour and socio-demographics based on feedback from respondents and two fellow researchers. Finally, the questionnaire was translated in German and Dutch by native speakers and checked by the authors for accuracy.

3.2 Econometric Model

Preferences of respondent *i* for choosing option *k* in choice situation *n* based on certain characteristics can be modelled according to the well-established random-utility theory (Lancaster, 1966; McFadden, 1974; Train, 2009):

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6 Due to a lack of reliable priors, we employed a fractional random design and excluded dominant alternatives. Walker et al. (2018) showed that random designs can perform as well as efficient designs under such conditions.

7 The random design also exhibits desirable attribute level balance, i.e. that there is not a certain level of a characteristics predominantly shown (Bliemer, Rose, 2024). For instance, half of the options have a Nutri-Score D, while the other half have E.

8 The Qualtrics software ensures that an equal number of participants is allocated to each block. This practice prevents potential bias that could arise from an uneven distribution of participants across the blocks.

9 A cheap-talk script is a method often employed in discrete choice experiments to reduce hypothetical bias in estimating WTP. This technique involves informing respondents of the common tendency to overstate WTP in hypothetical scenarios and urging them to consider this when expressing their preferences (Cummings,Taylor, 1999).

10 Qualtrics is a widely-used online survey platform that allows researchers to design, distribute, and analyse complex online surveys and collect data for various research purposes (see https://www.qualtrics.com/). The link to the survey was shared with academic colleagues and peers in December 2022 to simulate the respondent experience and gather initial feedback.

$$U_{ikn} = \beta_0 ASC_{no-purchase} + \beta_1 Price_{ikn} + \beta_2 GI_{ikn} + \beta_3 NS_{ikn} + \beta_4 GI * NS_{ikn} + \varepsilon_{ikn}$$

$U = consumer\ utility, i = respondent, k = choice\ option, n = choice\ situation$

$ASC_{no\text{-}purchase}$ represents the alternative specific constant for the no-purchase option "None of them" and β_0 is its corresponding coefficient. β_1 represents the coefficient of *Price*, which is defined as a continuous variable. β_2 is the coefficient of the *GI* dummy, which takes the value of 1 if it is PDO Parma ham. β_3 is the coefficient of the *NS* dummy, which takes the value of 1 if the product has the better Nutri-Score D (orange). β_4 is the coefficient of the interaction effect of *GI* and *NS*. Finally, ε_{ikn} represents the error term.

In the past, the conditional logit model (CLM) represented the main tool for the analysis of DCE data. However, the CLM makes the often unrealistic assumption of preference homogeneity among consumers. In order to relax this strict assumption, we use a mixed logit model (MXL) for our data analysis to account for preference heterogeneity among consumers (Train, 2009). Due to the fact that the MXL accounts for preference heterogeneity, it emerged as a new standard in DCE analysis (Caputo, Scarpa, 2022; Lizin et al., 2022).

As in the case of the CLM, the dependent variable of our MXL is binary and takes the value of 1 if an option was chosen and 0 if otherwise. However, for the MXL we have to define the remaining parameters as either random or fixed. We assume that consumer preferences differ regarding GIs and Nutri-Scores. Hence, we define the coefficients of the dummies *GI* and *NS* as random based on a normal distribution. Using such random coefficients allows for the fact that some consumers in our sample favour the characteristic and others do not. Accordingly, we also estimate the coefficient of the interaction term *GI*NS* as random. Moreover, we introduce the continuous variable of *Price* as a fixed parameter, which is common practice due to the fact that rational consumers should generally prefer lower prices. Also, we include the alternative-specific constant (ASC) *No-Purchase* for the option "None of them". *No-Purchase* is also random as consumers may differ in their preference regarding the choice to "opt out". We run all our MXL specifications with 500 Halton draws.

In the end, we determine the marginal WTP for PDO Parma ham and a Nutri-Score D based on the negative ratio of the coefficient of *GI* and *NS* respectively to the coefficient of *Price.* For the interaction, we use the negative ratio of the sum of the coefficients *GI*, *NS* and *GI*NS* to the coefficient of *Price* (cf. Drugova et al., 2020). The marginal WTP represents the marginal amount in € per 100 grams that a consumer is willing to pay for a change in the corresponding product characteristic, i.e. a PDO Parma ham and/or having a better Nutri-Score D compared to E.[11]

4 Results

The regression results are presented in Table 2. In Model 1, we only include the main effects, all of which are statistically significant at the 1% level. German and Dutch consumers in our sample clearly prefer PDO Parma ham and a better Nutri-Score D. Generally, our respondents expectedly prefer lower prices because the coefficient of *Price* is negative. The realistic nature of the choice options is also underscored by the negative coefficient for the *No-purchase* option because respondents clearly prefer to make a purchase decision.

As discussed, the MXL model allows for heterogeneity across respondents. The standard deviations (SD) of all random coefficients are significant, indicating significant heterogeneity across consumers: some respondents value the attributes more than others. Appendix 4 explores this heterogeneity. For instance, it can be explained by age, nationality and gender.

[11] In general, note that since a Nutri-Score (D or E) was always present, the estimated WTP and interaction effects reflect comparisons between label combinations rather than absolute effects of displaying the Nutri-Score.

In addition, we asked respondents before the choice task: “did you know anything about the PDO label before this survey”, i.e. whether they were aware of the PDO label before our explanation. In fact, only 25% of respondents knew about the PDO label before the experiment. In our experiment, consumers with prior knowledge of the PDO label have a stronger preference for Parma ham and a weaker preference for the Nutri-Score D. This is consistent with *H1*: consumers who care about food quality labels appear to be more focused on the taste and gustatory quality of a product like ham, rather than on health.

In Model 2, the main effects remain highly significant and similar in magnitude once we add the interaction effect, which is negative but not significant. Thus, this finding does not indicate interaction effects from combining a GI with a better Nutri-Score as the marginal utility for each individual attribute is not significantly affected if both labels are combined.

Based on our main specification of Model 2 we calculate the marginal WTP in € per 100 grams for each of the considered product characteristics (see Figure 1). The marginal WTP for the PDO ham (72 cents) is higher than the 48 cents for the better Nutri-Score D, in line with *H1*. In addition to the economically significant difference between 72 cents and 48 cents, we conducted a post-estimation comparison between the GI and the Nutri-Score D coefficients. The difference between the coefficients is also statistically significant at the 1% level.

Adding the main coefficients with the interaction shows that the sum (1.13 €) is somewhat smaller than the addition of the two main effects only (1.20 €). As for the coefficient sign, the slight negative interaction of 7 cents is consistent with *H2*. However, the interaction *GI*NS* is not significant in Model 2, so we cannot reject the null hypothesis.

Table 2. Results of mixed logit regressions

	Model (1)	**SD of random coefficients**	**Model (2)**	**SD of random coefficients**
Price	-3.14***		-3.16***	
	(0.09)		(0.09)	
No-purchase (ASC)	-12.36***	3.28***	-12.35***	3.28***
	(0.34)	(0.16)	(0.35)	(0.17)
PDO Parma ham (GI)	2.22***	2.77***	2.27***	2.76***
(base level: generic)	(0.13)	(0.12)	(0.14)	(0.13)
Nutri-Score D (NS)	1.45***	2.52***	1.51***	2.51***
(base level: E)	(0.12)	(0.11)	(0.13)	(0.12)
*GI*NS*			-0.23	0.99***
(interaction)			(0.14)	(0.29)
Summary Statistics				
N	22,005		22,005	
Log-likelihood	-5080.31		-5078.09	
AIC	10174.61		10174.18	

Notes: *p < 0.1, **p < 0.05 and ***p < 0.01. Standard errors are shown in parentheses.
Source: authors` own elaboration

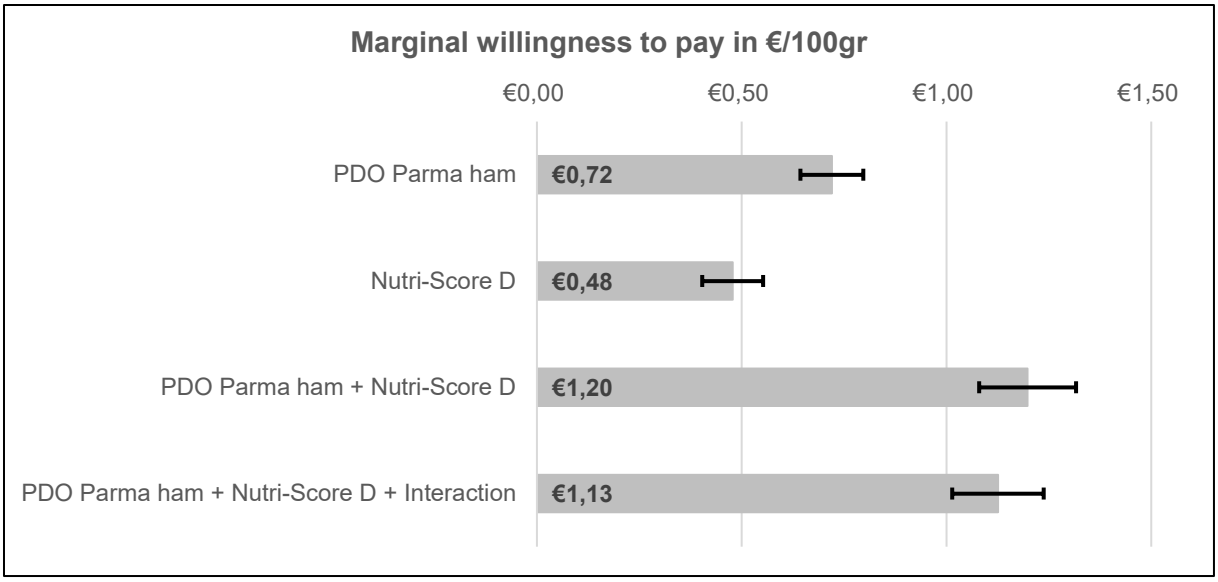

Figure 1. Marginal willingness to pay with 95% confidence intervals, based on Model 2

Source: authors` own elaboration

We also estimated the models directly in WTP space rather than estimating them in utility space and then dividing the coefficients of the attributes of interest by the coefficient of the price attribute.[12] The results are qualitatively similar. In particular, estimating the model in WTP space directly resulted in strongly significant WTP of €0.69 for the PDO (compared to €0.72), €0.51 for Nutri-Score D (compared to €0.48), and a non-significant interaction term of €-0.02 (compared to €-0.07).

To sum up, our findings support both hypotheses: first, consumers have a larger preference for PDO Parma ham than the Nutri-Score D (compared to E). Second, consumers are willing to pay more for a ham that has a PDO and a comparatively better Nutri-Score (D instead of E). However, the interaction when combining PDO-labelled ham and a better Nutri-Score D compared to E is negative as expected, but not significant.

5 Discussion and Limitations

5.1 Results and Implications

Our findings confirm previous studies that highlight higher WTP for GIs and better Nutri-Scores. In our study, the WTP for the PDO ham is considerably higher than for the Nutri-Score D versus E. Hence, consumers are willing to pay more for a PDO certification than for a comparatively better Nutri-Score. Even if some consumers might treat Parma ham as a vice product mainly consumed for pleasure rather than health reasons, the majority are willing to pay more for a comparatively better Nutri-Score. This suggests a relative valuation where consumers appreciate an improvement, albeit within an “unhealthy” range as neither a Nutri-Score D nor E is considered to inherently signal a healthy option.

Comparing our findings to previous literature, Gracia and de-Magistris (2016) show in their ranking experiment that the PDO label and the nutrition facts panel were the most important labels to consumers. We indeed find higher WTP for PDO Parma ham and a better Nutri-Score. In contrast, Grunert and Aachmann (2016) note that although GIs signal distinctiveness and quality, their influence on consumer decisions is likely low due to reliance on other cues.

[12] Note that the model did not converge with 500 Halton draws and we had to limit it to 50 Halton draws instead.

In our controlled setting, which intentionally limits products to three characteristics to isolate their effects, the PDO Parma ham emerged as a significant cue, both in comparison to the Nutri-Score D and in terms of WTP relative to average prices.

We find a negative but insignificant interaction effect of PDO Parma ham with the better Nutri-Score D, i.e. consumers are able to process the information of two labels independently. This aligns well with findings from previous studies such as the most recent one by Stiletto et al. (2024b). Sonntag et al. (2023) provide further evidence in a DCE considering several labels with varying levels including "bad" and "good" Nutri-Scores in the cases of chicken breast and whole milk. Regarding two-way interactions of positive attributes, such as organic production, lower climate impact, better Nutri-Scores and animal welfare, they find partial evidence for a reduction in marginal utility. Most of these interaction effects have indeed a negative sign, but are also insignificant. Our study echoes these findings because overall, our respondents do not receive significantly lower utility from the combination of labels but tend to value both independently. Still, there is also significant preference heterogeneity regarding the interaction term, suggesting that at least for some consumers there is a significant decrease in marginal utility.

With regard to policy implications of our results, a couple of key points merit consideration. GI cheeses and prepared meats typically receive lower Nutri-Score values compared to their generic counterparts (Höhn et al., 2023). Thus, GI producers might benefit from exploring healthier alternatives. To appeal to a more health-conscious demographic, introducing GIs with reduced salt and fat content could be advantageous, especially in products like ham where such reductions can enhance the Nutri-Score (Höhn et al., 2023). In fact, PDO San Daniele and Parma ham amended their specifications regarding minimum salt levels.[13] The recent GI reforms include the goal of simplifying the often lengthy amendment procedures, also encouraging GI producers to incorporate sustainability-related standards in their specifications (EP, 2024). More broadly, policymakers and producers should carefully consider new labels on food products. Weighing the cognitive load of multiple labels and potentially streamlining or simplifying the information presented might be pivotal, as further label proliferation could decrease consumers' utility.

5.2 Limitations and Generalisability

Several limitations should be acknowledged when interpreting our findings. First, the prominence of Parma ham. Second, the lack of a fully representative sample. Third, the absence of a "no Nutri-Score" condition. Fourth, the lack of additional labels such as Eco-Score or animal welfare labels in our design.

First, the prominence of Parma ham is a limitation of our study. In comparison, less well-known GI hams such as Croatian ham from Dalmatia or Belgian ham from the Ardennes may show lower premiums (Leufkens, 2018). In addition, Parma ham represents a PDO which comes with typically stricter production rules and higher price premiums (AND-International, 2019; Deselnicu et al., 2013). PGI hams, such as Black Forest ham from Germany or Tiroler ham from Austria, tend to show lower premiums (Höhn et al., 2024). Thus, our results may apply more to well-known and advertised PDOs and should be interpreted with caution regarding the WTP for GI labels in general.

Second, the sample is not exactly representative of the German and Dutch populations. However, it still represents major societal and consumer groups. By contrast to Parma ham's potential association with a relatively high GI premium, our sample of younger Dutch and German consumers may underestimate WTP. Dutch and German consumers are known to be price-

[13] See eAmbrosia database: https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/geographical-indications-register/ (status April 2023).

sensitive, which mirrors itself in the strong stance and growing market share of low-price discounters (Konrad, 2023; Retailtrends, 2022). This price sensitivity is likely to have contributed to an underestimation of WTP for a GI product and Nutri-Score, particularly considering our rather young sample. The estimate of 72 cents is comparable to, but notably lower than the average WTP of 90 cents among Italian students in the experiment by Arfini and Mancini (2015). Italian respondents may generally assign a higher value to their national food traditions than our German and Dutch respondents. While the potential cases of overestimation and underestimation in our experiment might partially offset each other, the overall impact remains uncertain due to the complex interplay of various demographic and product-related influences on WTP.

A further limitation of our study lies in our experimental design, specifically the absence of a "no Nutri-Score" condition. As a consequence, it is not possible to assess whether the Nutri-Score has an absolute independent effect, or a truly synergistic interaction with the PDO label. Accordingly, our analysis should be interpreted as a comparative evaluation of different label combinations. For example, PDO Parma ham with Nutri-Score D versus PDO Parma ham with Nutri-Score E. Nonetheless, the study's chosen hypothetical setup provides useful insights, as it simulates a market situation where a Nutri-Score label is mandatory, which may become reality in certain countries and ultimately, the EU. This approach allows us to explore potential consumer responses under a harmonised labelling regime, which cannot yet be observed in revealed preferences (e.g., scanner data). However, in real markets, many ham products in Germany and the Netherlands remain unlabelled, meaning the true counterfactual may be an unlabelled product rather than one rated E.

Finally, in real-world settings, the Nutri-Score is not the only label that accompanies GI labels on product packaging. With an increasing number of sustainability-related labels, there is potential for information overload and label fatigue, resulting in diminished attention to the GI. While we found no information overload in our setup, real-world settings with more label might still be too demanding on consumers. For example, the Eco-Score made headlines as a new label to asses environmental performance. In a Belgian experiment, consumers even found Eco-Scores more important than organic production in the context of vegetable choices (De Bauw et al., 2022). Moreover, recent animal welfare labels such as *Haltungsform* in Germany or *Beter Leven* in the Netherlands may influence consumer choices of GI products more than the Nutri-Score.

5.3 Future Research

Future research could further explore and validate several aspects highlighted by our results and limitations. First, future research could look into products beyond Parma ham. Second, further research with a more diverse and fully representative sample could provide more detailed insights into the extent to which the aforementioned effects of over- and underestimation based on the case of Parma ham as well as young Dutch and German consumers could actually offset each other.

Third, future research may extend the design by also considering more favourable Nutri-Scores for hams, such as a mid-range grade of C, particularly once such products are developed and available to consumers. More generally, products with a wider potential range of Nutri-Scores could be investigated. In addition, future research could examine further whether consumers indeed perceive unlabelled products as neutral or as implicitly "low-scoring", and how the presence of a front-of-pack nutrition label affects consumer choices independently of its rating.

Fourth, our design may be extended in future work by including more labels. This would shed further light on the phenomenon of label fatigue, by delving into the interaction effects of a broader array of labels, such as sustainability and animal welfare labels, on preferences for GIs. Controlled field experiments, revealed preference data, or eye-tracking studies, could

shed light on the real-world decision-making process of consumers when faced with multiple labels.

Finally, future work could further investigate and control for consumers' individual health perceptions and its corresponding importance in purchasing decisions. For example, a recent study found that in countries with high consumer familiarity with GIs such as Italy, a Nutri-Score D (the only grade considered) on hard cheese has almost no influence on purchase decisions. In contrast, in countries where GIs are less well known such as the Netherlands, the effect of a Nutri-Score D runs primarily through consumers' negative perceptions of healthiness (Stranieri et al., 2025).

6 Conclusion

In our study, we quantify jointly the WTP of German and Dutch consumers for raw hams with GI certification and comparatively better Nutri-Scores. Through an original discrete choice experiment where the Nutri-Score is mandatory on all products, we find that consumers in our sample prefer PDO Parma ham over generic ham and the Nutri-Score D over E. Our results align with prior findings that highlight higher WTP for GIs and better nutritional quality based on the Nutri-Score. In addition, our findings also clearly show that respondents are willing to pay considerably more for PDO Parma ham (72 cents) than the better Nutri-Score D (48 cents). Overall, combining PDO Parma ham with a better Nutri-Score D neither increases nor significantly decreases the marginal utility. Consumers in our study, on average, appear to value and cope well with both labels.

It must be highlighted that Parma ham is a prominent GI product with a strong brand. Hence, the estimated premium is likely to be higher than for other GI hams or the PDO label in general. Yet, our younger sample of Dutch and German respondents is likely to underestimate the premium for PDO Parma ham and the better Nutri-Score D in comparison to E. In general, our mixed logit regressions also underline that there is considerable preference heterogeneity among consumers. Partially, this can be explained by age, nationality, gender and prior PDO knowledge. Those who knew the PDO label before the experiment tend to value the PDO Parma ham more and the Nutri-Score less. This meshes well with findings about "vice" foods, which are mostly consumed for pleasure rather than for health (van Doorn, Verhoef, 2011).

Our study offers several business and policy implications. First, GI producers might consider making product specifications more flexible, such that better Nutri-Scores could be achieved within them (FAO, 2021). That would allow them to combine a GI premium with a premium for a better Nutri-Score. Second, with growing labelling initiatives highlighting various sustainability aspects, a more streamlined approach from policymakers may be essential. Overloading consumers with multiple labels can lead to confusion. One possible direction could be to introduce more encompassing labels that merge several concerns. Such an approach would minimise the need for numerous certifications, possibly striking a balance between informative clarity and consumer-friendly simplicity. However, informational labels by themselves may not have the desired behavioural effects (Delhomme, 2024). Other options are to establish elevated baseline standards for all products or to address the excess of unhealthy ingredients with reduction targets and potentially through harmonised taxation. Such initiatives would refrain from using more labels.

All in all, we hope that our study sheds light on the WTP for GIs and comparatively better Nutri-Scores as well as their interplay in a northern European context. Our findings suggest limited label fatigue in a dual-label scenario. However, future research should probe the effects of incorporating more than two labels evaluating their interplay on preferences and WTP across diverse food categories. One additional attribute could be private brands, which can be important, especially for high-price foods (Costanigro et al., 2010). Other attributes could be animal welfare or sustainability labels. As information labels continue to gain momentum, there

is a potential risk of overwhelming the consumer. Addressing this challenge is vital, and the highlighted avenues for future research may assist in shaping and navigating the evolving food label landscape.

Ethical Approval and Conflicts of Interest

The questionnaire used in this study was scientifically, GDPR and ethically approved by the Social and Societal Ethics Committee (SMEC) of KU Leuven with reference number "G-2022-5603-R2(MAR)" in February 2023.
The authors have no conflicts of interest to declare.

Data Availability

Replication data and code are available at
https://doi.org/10.15456/gjae.2026067.1558690378.

Credit Statement

GLH: conceptualisation, methodology, software, formal analysis, data curation, writing – original draft, writing – review & editing, visualization
MH: conceptualisation, validation, writing – review & editing, visualisation, supervision, funding acquisition
CC: supervision, project administration, funding acquisition

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Appendices

Appendix 1. Descriptive Statistics of Sample and Population

The sample (see Table A1) is not fully representative of the German or Dutch populations (see Table A2). It tends to overrepresent lower income groups, with about 60% of respondents reporting a below-average annual gross household income. In contrast, pensioners are underrepresented, with only 1% of respondents being retired. Although the proportion of participants with completed tertiary education is rather close to the general population, students are overrepresented at 33%. Younger age groups also see an overrepresentation, with 35% of respondents being under the age of 25. Nonetheless, our sample can still reveal useful insights because it covers respondents from major societal groups, is balanced regarding gender and all our respondents represent current consumers of ham.

Table A1. Descriptive statistics of sample

	Total (N=815)		**German (N=491)**		**Dutch (N=324)**	
Variable	**N**	**Share**	**N**	**Share**	**N**	**Share**
Age						
18-24 years	287	35%	163	33%	124	38%
25-49 years	485	60%	302	62%	183	56%
50-64 years	38	5%	24	5%	14	4%
>65 years	5	1%	2	0%	3	1%
Gender						
Male	403	49%	239	49%	164	51%
Female	404	50%	247	50%	157	48%
N/A	8	1%	5	1%	3	1%
Education level (completed)						
Non-tertiary	544	67%	319	65%	225	69%
Tertiary	262	32%	167	34%	95	29%
N/A	9	1%	5	1%	4	1%
Household income (gross)						
<50,000 p.a.	469	58%	293	60%	176	54%
≥50,000 p.a.	248	30%	150	31%	98	30%
N/A	98	12%	48	10%	50	15%
Employment						
Employed	475	58%	292	59%	183	56%
Unemployed	37	5%	20	4%	17	5%
Student	273	33%	161	33%	112	35%
Retired	7	1%	4	1%	3	1%
N/A	23	3%	14	3%	9	3%

Source: authors` own elaboration

Table A2. Descriptive statistics of German and Dutch population (2020)

Variables	Germany Population of 83,166,711	The Netherlands Population of 17,407,585
Age		
15-24 years	10%	12%
25-49 years	31%	32%
50-64 years	23%	21%
>65 years	22%	20%
Education level (completed)		
Non-tertiary	73%	63%
Tertiary	27%	37%
Household gross income (average)	56,580 €	75,200€
Employment		
Employment rate (share of ages 15-64)	74%	79%
Students (share of total population)	4%	5%
Retired (share of total population)	28%	25%

Source: authors` own elaboration based on Eurostat data

Appendix 2. Final Fractional Factorial Design

We employed a fractional factorial design, as the full factorial would have yielded 66 possible comparisons, which is too burdensome for respondents. Instead, we generated a random design from the full set of possibilities, which allowed us to exclude dominant alternatives (Bliemer, Rose, 2024; Walker et al., 2018). In our context, a dominant option would be, for example, a ham that is GI-certified, has a better Nutri-Score, and is cheaper than the alternative. The final design consists of 18 choice situations (see Table A3), randomly assigned into two blocks to reduce cognitive burden. The design also ensures attribute level balance, meaning no level is disproportionately represented (Bliemer, Rose, 2024). For example, half of the options display a Nutri-Score D, while the other half show E.

Table A3. Fractional factorial design of discrete choice experiment

Choice task	Block	Option 1			Option 2		
		GI	***NS***	***Price***	***GI***	***NS***	***Price***
1	1	PDO	D	5€	Generic	E	3€
2	1	Generic	E	3€	PDO	E	4€
3	1	PDO	E	3€	Generic	D	3€
4	1	Generic	D	4€	Generic	E	3€
5	1	Generic	D	5€	Generic	E	4€
6	1	PDO	E	4€	Generic	D	4€
7	1	PDO	D	4€	PDO	E	3€
8	1	Generic	D	5€	PDO	E	5€
9	1	Generic	D	4€	PDO	E	5€
10	2	PDO	E	5€	Generic	E	3€
11	2	Generic	E	3€	PDO	D	4€
12	2	PDO	D	5€	Generic	D	3€
13	2	Generic	D	4€	PDO	E	3€
14	2	PDO	D	5€	PDO	E	4€
15	2	Generic	D	4€	PDO	D	5€
16	2	PDO	E	3€	Generic	D	3€
17	2	Generic	D	5€	Generic	E	3€
18	2	PDO	D	5€	Generic	E	4€

Notes: PDO = PDO Parma ham; Generic = generic raw ham; NS = Nutri-Score; Price = price/100gr.
Source: authors` own elaboration

Appendix 3. Exemplary Choice Set

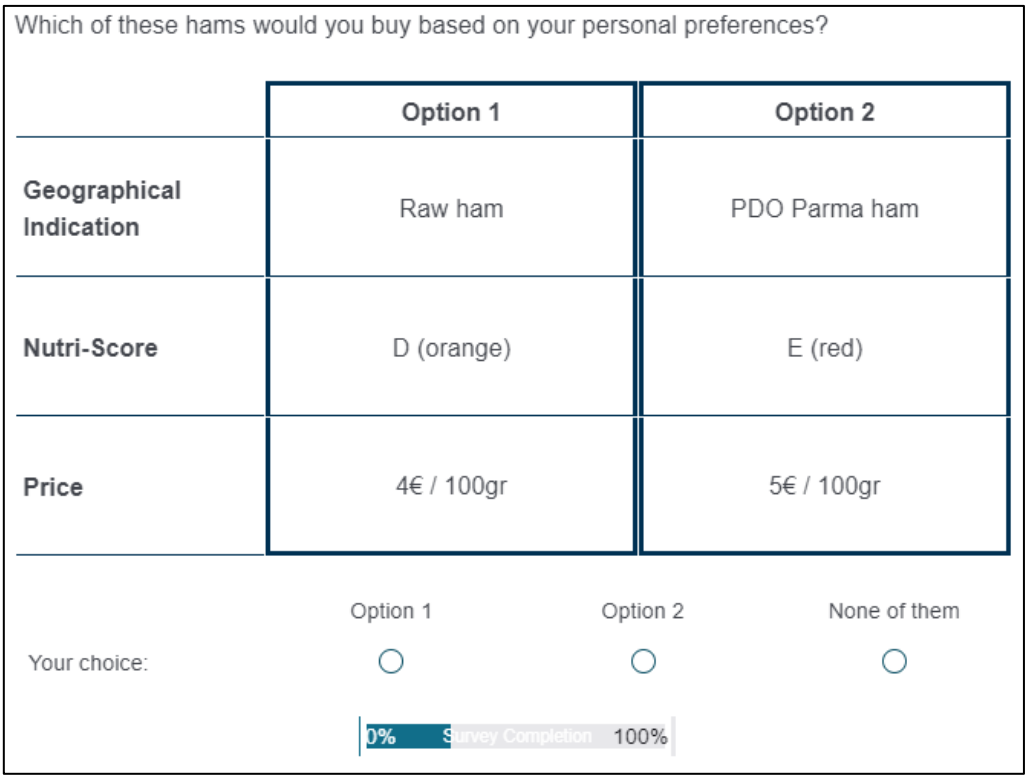

Figure A1. Exemplary choice set shown to our respondents (English translation)
Source: authors` own elaboration

Appendix 4. Preference Heterogeneity Among Consumers

There is a clear indication of preference for the PDO and better Nutri-Score on average. However, the significant standard deviations of all our random coefficients in Models 1 and 2 reveal that there is indeed heterogeneity regarding preferences in our sample, i.e. some respondents value the characteristic more than others.

Given the observed preference heterogeneity in our sample we control for socio-demographic variables by interacting them with the *GI* and *NS* variables in Models 3, 4, 5 and 6 (see Table A4). First, there may be a difference between male and female respondents as some research highlighted gender differences regarding diet purchases. For example, some studies find that women are more likely to avoid unhealthy foods (Wardle et al., 2004). Traditionally, women also tend to be responsible for household tasks such as grocery shopping in Germany and the Netherlands (ErUm, 2013; SCP, 2019). Thus, while our sample is representative in terms of gender, women's preferences may matter more regarding the actual purchases and premiums. Hence, we introduce interactions in Model 3 with the dummy *Male* that takes the value of 1 if the respondent is male. On the one hand, we do not find that males are significantly less likely to value a better Nutri-Score compared to females. On the other hand, males seem to be more prone to label fatigue and are more likely to value PDO Parma ham. Thus, our estimations may overestimate the premium for Parma ham as women tend to indicate lower WTP.

In contrast, our analysis may underestimate the premium for PDO Parma ham or a Nutri-Score due to the overrepresentation of respondents in the youngest age group. Hence, we use the variable *Young*, which takes the value of 1 if the respondent is 24 or younger, for the interactions in Model 4. While there is a slight indication for lower WTP for PDO Parma ham, there is no statistical difference concerning WTP for the Nutri-Score D or the interaction effect. Nonetheless, the premium for PDO Parma ham may be underestimated given the overrepresentation of younger respondents and students.

Next, as we have a bi-national sample, we control for potential differences between German and Dutch consumers by interacting in Model 5 with the dummy variable *Dutch*, which takes the value 1 if the respondent is Dutch. German and Dutch consumers tend to be price sensitive regarding foods, which may have been amplified by higher inflation (Marnik et al., 2023). Additionally, despite their economic strength, Germany and the Netherlands have relatively low consumer price levels (Eurostat, 2022). Thus, our estimations of marginal WTP probably represent an underestimation compared to other EU countries. In our sample, Dutch respondents have a lower WTP for PDO Parma ham and the better Nutri-Score D compared to German respondents. In addition, the Dutch respondents seem more prone to label fatigue, i.e. the combined effect of two positive labels is less than the sum of the labels separately, because the interaction of *Dutch* and *GI*NS* is negative and significant, but again at the 10% level only.

Finally, Stiletto and Trestini (2022) found that respondents with prior knowledge about the PDO label can differ in their preferences. In our sample, the awareness of the PDO label prior to our experiment was with 25% indeed low. Therefore, we include interactions in Model 6 with the variable "*GI-prior"* which takes the value of 1 if the respondent knew about the PDO label beforehand. The interaction of *GI-prior* and *GI* is positive while the interaction of *GI-prior* and *NS* is negative. As expected, consumers with prior knowledge of the PDO label have a stronger preference for Parma ham and a weaker preference for the Nutri-Score D. The three-way interaction of *GI-prior* with *GI* and *NS* is again negative and insignificant.

All in all, the preference heterogeneity in our sample is partially explained by gender, age, nationality and prior knowledge of the PDO label. Overall, the sample of rather young German and Dutch consumers that tend to be unaware of the PDO label is likely to underestimate the WTP for PDO Parma ham and a better Nutri-Score D. Nonetheless, our results are still insightful as the sample represents current consumers of ham in two major export markets of PDO Parma ham where the Nutri-Score was adopted or about to be adopted.

Table A4. Mixed logit regressions controlling for socio-demographics

	Model (3)	**Model (4)**	**Model (5)**	**Model (6)**
Price	-3.18*** (0.09)	-3.15*** (0.09)	-3.16*** (0.09)	-3.16*** (0.09)
No-purchase (ASC)	-12.48*** (0.35)	-12.35*** (0.35)	-12.36*** (0.35)	-12.39*** (0.35)
PDO Parma ham (GI) (base level: generic)	1.96*** (0.18)	2.43*** (0.17)	2.48*** (0.18)	2.12*** (0.15)
Nutri-Score D (NS) (base level: E)	1.72*** (0.18)	1.47*** (0.16)	1.66*** (0.17)	1.68*** (0.15)
*GI*NS (interaction)*	0.04 (0.18)	-0.31* (0.18)	-0.01 (0.17)	-0.29* (0.16)
*GI*Male*	0.60** (0.24)			
*NS*Male*	-0.44* (0.23)			
*GI*NS*Male*	-0.47* (0.26)			
*GI*Young*		-0.45* (0.26)		
*NS*Young*		0.10 (0.29)		
*GI*NS*Young*		0.25 (0.27)		
*GI*Dutch*			-0.52** (0.25)	
*NS*Dutch*			-0.40* (0.24)	
*GI*NS*Dutch*			-0.52* (0.27)	
*GI*Prior*				0.68** (0.30)
*NS*Prior*				-0.63** (0.27)
*GI*NS*Prior*				0.21 (0.31)
Summary Statistics				
N	21,789	22,005	22,005	22,005
Log-likelihood	-5010.91	-5075.85	-5068.89	-5066.57
AIC	10051.83	10181.7	10167.77	10163.14

Notes: *p < 0.1, **p < 0.05 and ***p < 0.01. Standard errors are shown in parentheses.
Source: authors` own elaboration

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