Attention to carbon footprints in food choices and the crowding out effect of attention-leading nudges

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Attention to carbon footprints in food choices and the crowding out effect of attention-leading nudges

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Abstract

Consumer attention to carbon footprint labels may trigger efforts to adjust the agri-food sector toward more sustainable production. To assess attention levels, we used milk and bread products in an information display matrix (IDM), allowing consumers to direct attention or ignore various food product attributes. Our method improved upon previous IDM applications by introducing real-world complexity, featuring 25 attributes per product and multiple trade-offs. A randomizer ensured fairness by determining the order of attribute display. Results show that carbon footprints are not the primarily attended attributes. A salience nudge favoring carbon footprints directs attention to it but halves the attention paid to more holistic environmental footprints. We discuss strategies to promote environmental dimensions jointly and provide implications and recommendations for future labeling policies and marketing strategies.

KEYWORDS

choice-architecture, CO_2-labels, consumer attention, eco-score, food choices, environmental score

1 | INTRODUCTION

Information on food production's environmental impact can be a powerful tool for encouraging sustainable consumer choices. Environmental food labels can help bridge the information gap between supply (producers, retailers) and demand (consumers), promoting eco-friendly consumption (Czarnezki, 2011; Grunert et al., 2014). Currently, ecolabelindex.com lists 456 ecolabeling programs globally, with 147 related to food products. Major food companies like Unilever and Nestlé plan to label all products with CO2-equivalents, while the EU discusses adopting an 'Eco-score' (Pistorius & Foote, 2021). These labels aim to inform consumers about the environmental impact of their food choices (Annunziata & Mariani, 2019). Product carbon footprint labels, among various sustainability labels, have gained attention. Consumers are willing to pay a premium for products with carbon labels (Asioli et al., 2022; Edenbrandt & Lagerkvist, 2021). However, field studies suggest that carbon labels often have a null or limited effect on consumer behavior (Babakhani et al., 2020; Brunner et al., 2018; Kortelainen et al., 2016; Spaargaren et al., 2013).

For instance, in a student canteen, carbon labels yielded a 3.6% reduction in carbon emissions linked to food choices (Brunner et al., 2018). Raising the efficacy of environmental labels depends on a range of strategies. These strategies include enhancing label visibility and augmenting labels with supplementary information cues. Indeed, interventions designed to boost attention toward carbon labels are sometimes deemed necessary to observe any impact (Spaargaren et al., 2013). Similarly, other scholars have raised concerns regarding the limited impact of labels within the context of food selection,

Abbreviations: ANA, attribute non attendance; CO2, carbon dioxide; IDM, information display matrix; PEF, product environmental footprint; RQ, research question.

attributing this to their perceived lack of prominence (De Bauw et al., 2021, 2022). This challenge of capturing consumer attention is amplified by several factors, including the proliferation of food products, the utilization of credence product attributes for marketing purposes (Asioli et al., 2017), and the coexistence of hundreds of labeling approaches to food items (Lemken et al., 2021), often leading to information overload.

The importance of drawing attention to labels as a means to incentivize companies to enhance their production and processing methods has been well-established (WBAE, 2020). Anticipating heightened attention to a soon-to-be-introduced Nutri-Score has prompted substantial reformulation efforts among food suppliers in the past (Vermote et al., 2020), potentially also leading to future changes in consumer behavior. This supports the significance of research focused on attention and labeling beyond purchase decisions.

While there is existing research on how nutritional label designs (Gomes et al., 2014; Koenigstorfer et al., 2014; Lee, Stortz, Von Massow, et al., 2023; Werle et al., 2022) can effectively capture consumers' attention during supermarket shopping routines, similar attention-focused investigations specific to environmental labeling are still lacking, starting with an examination of the extent to which consumers genuinely pay attention. Previous studies investigating carbon labels on food products predominantly neglected to measure attention, with only a few exceptions.

For example, one study measured consumers' attention while shopping for asparagus using an information display matrix (IDM) and found that carbon information received less attention compared to other product attributes like price, organic labels, and country of origin (Lampert et al., 2017). Another field study that employed eye-tracking to evaluate attention to labels on restaurant menus found that the carbon label and a social label highlighting local community benefits attracted little attention, resulting in limited behavioral change (Babakhani et al., 2020). A study combining eye-tracking and a choice experiment measured attribute non-attendance (ANA) and revealed that 41% to 56% of participants ignored sustainability labels, including the carbon footprint, whereas price received significant attention (Van Loo et al., 2018). It's worth noting that such studies simplify consumer decision-making, as only a few product attributes are accessible to consumers compared to real online or physical food retail environments. This brings us to our pre-registered research question (RQ1): How much attention do consumers pay to carbon labels relative to other product attributes when faced with a complex choice task [https://osf.io/z3cnd].

Given the salience challenge, previous studies have recommended marketers to make environmental labels more prominent to the consumer, akin to employ a nudge (De Bauw et al., 2022). We propose the use of attention-leading nudges (Ozturk et al., 2020; van Rookhuijzen & de Vet, 2021). These nudges are known to influence attention and subsequent behavior (Vlaev et al., 2016). However, with the increasing number of stimuli in consumer markets, it remains unclear how to effectively position environmental information on food product packaging to compete for consumers' attention. The competition in food choice environments is fierce, and consumer policy and forward-thinking marketers should be guided on how to communicate sustainability attributes in a consumer-friendly design (Lemken et al., 2021; Rondoni & Grasso, 2021).

In this context, theoretical concerns arise regarding the potential impact of attention-leading nudges on consumers' focus on other choices (Nafziger, 2020). Given the limited capacity for information processing, directing attention toward one attribute can potentially divert attention away from other choices (Nafziger, 2020). These nudges may impose cognitive taxes (Sunstein, 2019), psychic costs (Jimenez-Gomez, 2018), and behavioral adaptation costs (Jimenez-Gomez, 2018), all of which have the potential to affect consumers' cognitive resources and behavior when evaluating other products and their attributes. There remains a lack of empirical evidence regarding the effects of nudging on non-nudged information relevant to many multi-dimensional challenges, leading us to the following pre-registered research question (RQ2): Will a nudge to increase salience for carbon information crowd out attention to other sustainability dimensions? [https://osf.io/z3cnd].

In pursuit of answering RQ1 and RQ2, we conducted a consumer study employing an information display matrix (IDM) methodology, selecting milk and bread as our focal products. The choice of milk and bread as our study products was deliberate, as these items represent staple foods in the country of investigation (Germany). Our study had a dual objective: first, to scrutinize the degree to which consumers allocate their attention to carbon footprints in relation to other product attributes, and second, to explore whether a nudge designed to heighten the visibility of carbon footprints inadvertently diverts attention away from environmental footprint information. This investigation gains particular relevance in light of the escalating complexity of contemporary food choices and the information overload faced by consumers.

Consequently, the contribution of this paper can be delineated along four significant dimensions. First, we extend the utilization of the IDM approach in measuring attribute attendance. IDM experiments traditionally involve a considerably reduced set of product attributes compared to real-world decision scenarios, potentially introducing bias into the assessment of attribute attendance. Our study, by randomizing attribute order across a broad spectrum of attributes, seeks to provide findings that enhance external validity, thereby enriching our understanding of how attribute attendance unfolds.

Second, our study demonstrates consumers' willingness to pay attention to the many product attributes, affording each piece of information an equitable chance of attention. Our findings identify key attributes that capture consumer attention. It underscores the limited capacity and interest that consumers generally have in product information for food products, which are typically low-stakes decisions. Thereby contributing to the general understanding of environmental labeling effects between field and laboratory settings.

Third, this study extends the discourse on consumer choice architecture by exploring the complex interplay between environmental sustainability and consumer decision-making. By examining how different nudge strategies, such as salience nudges and information framing, affect consumers' choices in an environmentally complex context, our research contributes to a nuanced understanding of how behavioral insights can be leveraged to promote sustainable consumption patterns.

Fourth, we contribute to the literature by offering the initial empirical evidence regarding the potential of attention-leading nudges to influence the allocation of attention to various product attributes. This insight is pivotal in shedding light on the challenges and potential pitfalls associated with promoting sustainability attributes independently.

The manuscript is organized as follows: First, a description of the methodology used in this study is provided including the experimental design, sample description, and statistical data analysis. Second, we will present the results of the analysis. Finally, a discussion of the results, followed by implications and recommendations as well as future research avenues are provided.

2 | METHODOLOGY

2.1 | Attention research

Under the umbrella of decision effort or cognitive effort, researchers investigate engagement in decision-making. This engagement, often involving the evaluation of alternatives, taps into cognitive resources—a measurement challenge due to its abstract nature. Fundamentally, "effort" involves the level of engagement in decision tasks. Increased engagement typically boosts task performance through heightened attention (Westbrook & Braver, 2015). However, attention, distinct from decision effort, serves merely as a proxy for it (Westbrook & Braver, 2015). The link between attention and decision-making is further underscored by studies showing how visual stimuli influence mental processing (Just & Carpenter, 1976) and how salient features drive decisions (Theeuwes, 2010). Metrics such as search time and eye-tracking data are valuable proxies for measuring attention in consumer behavior (Simonetti & Bigne, 2023). Search time encompasses the processes of information gathering and the specific exploration of product types and their attributes.

In the context of sustainability, attention may indicate awareness, such as recognition of environmental labels, which is crucial in low-involvement settings like grocery shopping where minimal cognitive effort is typical and may lead to uninformed consumer decisions (Cook et al., 2023). Contrary to assumptions, grocery shopping involves significant decision complexity due to the variety of products and marketing tactics (Cook et al., 2023). Increased attention in such contexts could help consumers make more informed choices that align better with their preferences. We will employ a methodology, detailed in the following section, that can track search times specific to product attributes and introduce considerable complexity to the choice task.

2.2 | Information display matrix

A useful and emerging tool to measure consumer attention is the so-called IDM, also called 'mouse-lab' (Johnson et al., 1989). In an IDM choice task, consumers are confronted with a decision-making task, while the researcher traces the information search on the screen. Practically, the IDM is a table where food attributes are presented in rows and food products are presented in columns, thus the table holds information on each attribute-product combination. Each information piece (i.e. food attributes) is hidden, and consumers can access the information by clicking on it if they wish (Zander & Schleenbecker, 2018). The IDM table can hold several trade-offs among the attributes and a bulk of information, thus consumers are faced with a complex choice task (illustration: https://postimg.cc/21XN6Phz).

Previous research suggests that the IDM causes less social desirability bias compared to other survey-based approaches because the product attribute 'price' achieved more relevance than ethical attributes in the IDM (Berekoven et al., 2009; Zander & Hamm, 2010). Surveys of this nature prompt inquiries such as "I usually pay attention to nutrition information?" (Jurado & Gracia, 2017), necessitating consumers to engage in significant self-reflection. This approach could introduce a bias, leading to a discrepancy between the information that is asserted and what is truly relevant for decision-making. There is a risk of incorrectly assuming relevance, particularly in cases where attributes are simultaneously visible and attention tracking, such as in an IDM, is not feasible.

A technical solution capable of tracking consumer attention beyond digital decision settings is eye-tracking. It has been implemented digitally and in brick-and-mortar stores to monitor attention to labels (Gomes et al., 2014; Lee, Stortz, Von Massow, et al., 2023; Werle et al., 2022). Conclusively, it allows precluding a bias between asserted and actually relevant information for decision-making, which can for example occur, when attributes are simultaneously visible and attention tracking is not possible. A main criticism of the IDM method discusses a perceived artificial information provision and therefore its relevance to real circumstances like, for example, a shopping environment (Kroeber-Riel & Weinberg, 1999). Through the rise of online shopping and product test platforms, nowadays consumers are more familiar with such a design (Aschemann-Witzel & Hamm, 2011) but some external validity concerns remain.

Information search strategies in reality are physically and mentally limited. For example, comparisons of more than two products may require remembering information from the back of a package. Hence, previous consumer research in the field of heuristics -cognitive efficient processes that ignore part of the information to save effort - suggests that consumers frequently limit their search to a few information criteria (i.e. attributes) (Gigerenzer & Gaissmaier, 2011; Zander & Schleenbecker, 2018). On the one hand, the IDM lowers the search costs for additional information, perhaps reducing the need for heuristics, which does not represent a search process in a retail store. On the other hand, the IDM tracks quantitatively whether additional information is actually accessed when given the opportunity. Thereby the method ensures that consumers are willing to cognitively process product information.

It's worth noting that our designed information display matrices (IDMs) do not incorporate graphics to introduce product attributes. While many product attributes, including environmental footprints, are commonly accompanied by graphical and colorful elements on food packaging, we deliberately opted for plain text presentation. This decision was made to prevent potential bias stemming from consumer preferences for specific graphic designs associated with certain attributes. Prior applications of IDM within the food domain have examined consumer attention regarding attributes, such as when purchasing organic products (Zander & Hamm, 2010) or evaluating carbon labels, as demonstrated in the context of asparagus purchases (Lampert et al., 2017).

2.3 | Study design

We used an IDM with a two-dimensional matrix of a list of either four milk products or four bread products, and twenty-five product attributes drawing on supplier websites and information available in the marketplace. This creates a matrix of 4×25 information pieces (see Appendix A Table A1). All the attributes are presented as a brief text with identical font, including carbon- and environmental footprint attributes. Then, consumers can freely choose to open and look at a specific product attribute by using a simple mouse click. Consumers can compare information across food products before making a potential purchase decision (Wille et al., 2017; Zander & Hamm, 2010). Specifically, carbon footprint information is basically a click away, and consumers are faced with the choice to consider or ignore it.

To measure unbiased attention for product attributes and in view of a large number of attributes (i.e. 25), it is a prerequisite to exercise control over the order of the attributes because in an IDM participants typically read from left to right and top to bottom, making the first and last attributes more salient (Zander & Schleenbecker, 2018). In this matter to test our research aims we included two treatments. Specifically, in the first treatment (CONTROL) we randomized the order of the attributes among participants and used the randomized IDM when assessing consumers' attention to attributes. In the second treatment (NUDGE), to investigate the nudging of carbon information, we created an IDM with a fixed order, placing the carbon information at the top of the list of attributes (following the order presented in Table A1), and underlining the carbon footprint attribute, thereby leading to a salience nudge (Dalrymple et al., 2020; Wilson et al., 2016).

The 'Nudge Theory,' popularized by Richard Thaler and Cass Sunstein (Thaler & Sunstein, 2008), posits that small and seemingly insignificant environmental cues can significantly influence human behavior in predictable ways. This concept is particularly relevant in the context of consumer behavior, where subtle changes in label design or placement can drastically impact consumer choices. For instance, using more prominent designs on eco-friendly product labels can nudge consumers toward making healthier or more environmentally conscious decisions without restricting their freedom of choice.

In the experiment, participants were exposed to three different IDM tasks: (i) a test IDM with placeholders to familiarize consumers with the presentation of products and attributes, (ii) a randomized IDM on either bread or milk products, and (iii) an ordered IDM (i.e., the salience nudge IDM) on either bread or milk products. Participants were randomly assigned to the two treatment groups: a randomized IDM for bread and an ordered IDM for milk products (group A) or vice-versa (i.e., a randomized IDM for milk and an ordered IDM for bread products) (group B). Before the food choice, participants could open full rows of the IDM to compare all the attributes, with a maximum of two rows that could be opened at the same time in order to allow repeated access to information. The IDM was limited to 50 attribute clicks to simulate some constraints of a shopping environment.

2.4 | Sample description

The data used in this study are drawn from an online experiment conducted in November 2022 in Germany involving 711 valid responses. The number exceeds the demanded sample size calculated within the pre-registration form. They were recruited by a market research firm to be representative of German consumers on quotas of age, gender, and income (Table 1). The difference between the sample and German consumers could be maintained at less than four percentage points for each class (Table 1). There are no significant differences between the treatment groups A and B based on the Chi^2-test.

The experiment was pre-tested among 30 participants not included in the final dataset. To minimize selection bias, participants received no information on the experiment content prior to participation. To ensure data quality, test questions were included, and participants who failed the test questions were unable to complete the experiment. In addition, participants' time per survey page was tracked. If participants repeatedly finished an experiment section faster than the page-specific threshold, they were dropped from the final dataset (52 participants). The final data set included 711 participants, 356 for treatment group A and 355 for treatment group B (Table 1). The median time to complete the experiment was 15 minutes. The evaluated food product categories are consumed frequently by many, except for oat-milk (Appendix A Figure A1). Upon completion of the choice tasks, the respondents were asked to complete a questionnaire to collect information about their sociodemographics, habits, and attitudes.

The experiment was written in XML (eXtensible Markup Language) and implemented with the methodological toolbox of dise-online (dynamic intelligent survey engine) (Schlereth & Skiera, 2012). We obtained informed consent from all the participants in the study. Our study was approved by a university ethical committee.

2.5 | Statistical data analysis

Data is analyzed in several steps. First, to measure the attention frequency (frequency) we counted the number of clicks participants did on each and second the length of time each participant spent on each attribute (attention intensity) before moving on to the next click. To deal with outliers that stopped clicking attributes for more than 20s, we limit the attention intensity per click to 20s if the threshold is exceeded. For readability, we excluded 'ignoring an attribute' from the analysis, but the attribute statistics on the measure can be accessed *[link omitted for blind review]*. The proposed IDM attention measures were previously

TABLE 1 Sample description.

Variable	Full sample (N = 711) Mean	Std. dev.	Population mean	Group A (N = 356) Mean	Std. dev.	Group B (N = 355) Mean	Std. dev.	A vs. B p-value
Gender Female	.533	.499	0.509	.534	.5	.532	.5	0.972
Male	.467	.499	0.491	.466	.5	.468	.5	0.972
Age 18–24 years	.084	.278	0.111	.098	.298	.070	.256	0.181
25–34 years	.198	.399	0.191	.202	.402	.194	.396	0.792
35–44 years	.181	.386	0.180	.166	.372	.197	.398	0.277
45–54 years	.203	.402	0.218	.222	.416	.183	.387	0.198
55–64 years	.222	.416	0.209	.211	.408	.234	.424	0.458
65–75 years	.111	.314	0.091	.101	.302	.121	.327	0.396
Net household income Less than 1,300 Euro	.153	.361	0.133	.163	.37	.144	.351	0.476
Between 1,300 and 2000 Euro	.159	.366	0.163	.163	.37	.155	.362	0.771
Between 2000 and 2,600 Euro	.132	.339	0.135	.138	.345	.127	.333	0.668
Between 2,600 and 3,600 Euro	.187	.390	0.178	.18	.385	.194	.396	0.618
3,600 or more	.368	.483	0.391	.357	.480	.380	.486	0.515

Income based on (BPB, 2018), age and gender based on (DESTATIS, 2021), group A was exposed to a randomized IDM for bread and an ordered one for milk, Group B was exposed to a randomized IDM for milk and an ordered one for bread. P-values (A vs. B) are based on chi2-Test.

suggested (Zander & Hamm, 2010; Zander & Schleenbecker, 2018), although the terminology can differ. In the following, attention is assessed with the frequency and intensity measure.

Specifically, to investigate the first aim of the study (RQ1), we compared the attention for all attributes graphically to assess whether carbon labels are among the top 10 attributes that consumers pay attention to.[1] Then, to investigate the second aim of the study (RQ2), the attention paid to carbon footprints and environmental footprints was compared between the randomized (control treatment) and ordered IDM (nudging treatment). We present the absolute attention to both attributes [in seconds and clicks] and the attention relative to the overall attention to all product attributes of each participant [in %]. Kruskal-Wallis tests were applied to evaluate if attention significantly differs between the treatments. Boxplots illustrate the distributional differences graphically. The analysis was conducted in STATA 17 and followed a preregistered plan formulated within the pre-registration [https://osf.io/z3cnd].

3 | RESULTS

3.1 | Consumer attention to carbon footprints and other product attributes

Consumer attention to carbon footprints was assessed through two metrics: the number of clicks (frequency) and the time spent (intensity) by participants on both, milk and bread product attributes. Figure 1 visually presents participants' attention to the 25 product attributes, represented by (1) the average number of clicks on each attribute and (2) the average time (in seconds) devoted to each attribute. Our findings yielded intriguing insights.

First, the top four attributes that garnered the most attention for both milk and bread were price, packaging size, shelf-life, and wholegrain content specific to bread, and animal welfare information specific to milk. Second, it's noteworthy that the carbon label did not rank among the top ten attributes in terms of attention. Instead, it shared a similar level of attention with the numerous other attributes, implying that participants allocated relatively equal focus to all attributes, with the exception of the four previously mentioned attributes. Third, it's evident that attention frequency and intensity metrics consistently reflect a similar level of focus, both on individual attributes and across different product categories. To illustrate, the total attention, as measured by the sum of attention frequency and intensity, displayed a strong correlation in both product categories ($r_{bread} = 0.72$, $r_{milk} = 0.73$).

3.2 | Nudging out attention for environmental footprints when nudging carbon footprints

Next, we test the effect of nudging carbon footprint information by comparing the two treatments (i.e., CONTROL vs. NUDGE). Table 2 presents the results related to attention using both absolute (frequency and intensity) and relative attention. The latter means the attention divided by the sum of attention paid by participants to all product attributes (in percentages). This allows for a comparison of attention to carbon and environmental footprints relative to

[1]The threshold of 10 was predefined in the pre-registration

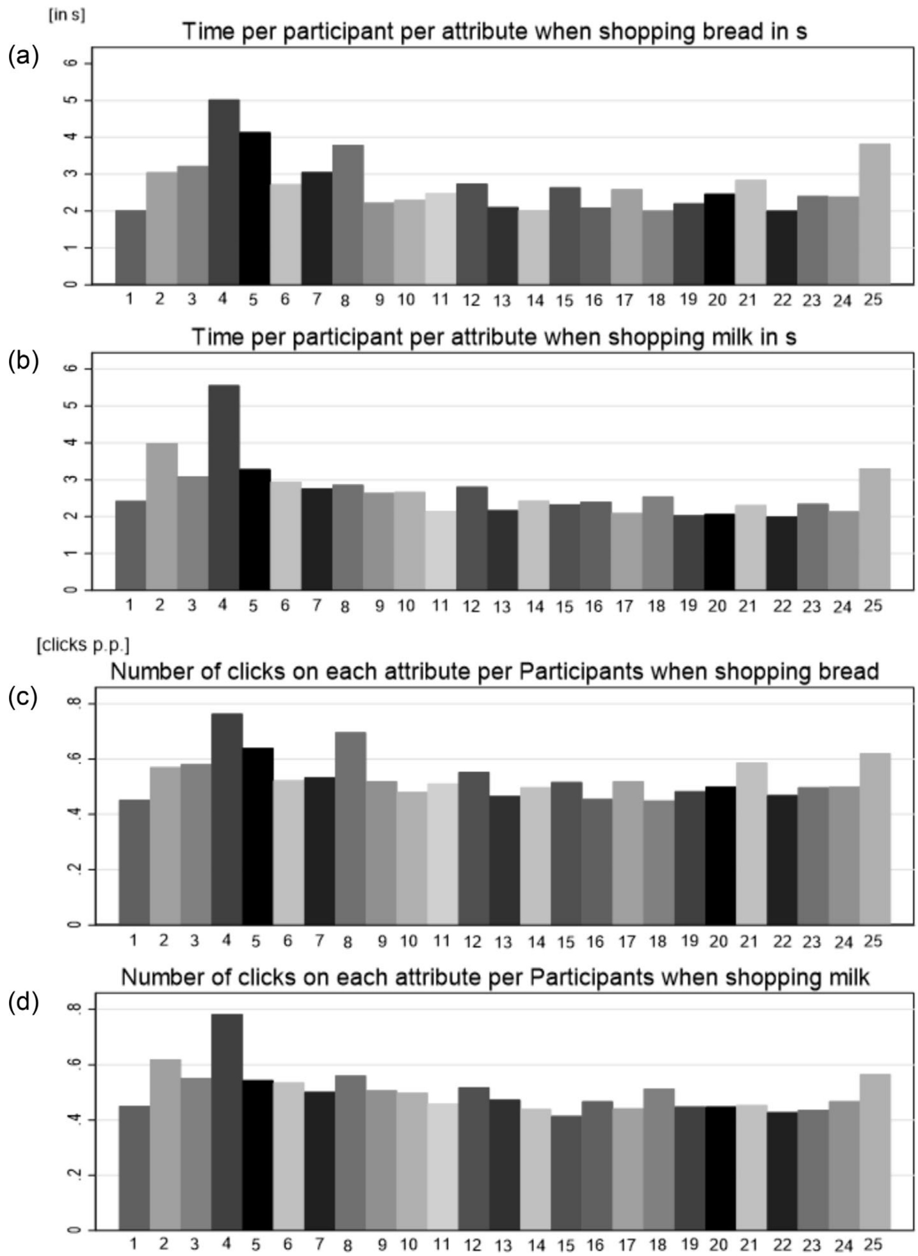

FIGURE 1 Attention intensity and frequency in a randomized IDM with 25 product attributes. THere was a fibure footer with the definition of the attributes 1 to 25 in this figure. PLease add close to this figure.

consumers' attention to all product attributes. Relative and absolute attention are compared for both the carbon and environmental footprint between treatments (i.e., CONTROL vs. NUDGE treatments). We conducted a Kruskal–Wallis significance test to evaluate if attention differed between the control and nudge treatments (Table 2).

Some interesting findings were found. First, the salience nudge increases the attention to carbon footprints in the nudge treatment vs. the control. There are exceptions because participants would predominantly pay more attention to the first rather than the second IDM they faced so here the Nudge just compensates for this order effect. The average time (intensity) across participants spent on the control treatment is 68 seconds and for the nudge, treatment is 36 seconds while the number of clicks (frequency) is 13 and 8 control and nudge treatments, respectively. Participants always evaluated the randomized IDM (control) first.

Second, the relative attention paid to the carbon footprint attribute in the nudged condition (i.e., nudges treatment) was 2–5 times greater than in the randomized condition (i.e., control). For example, the relative time spent with carbon information increased from 2.7% to 12.5% (.027 to .125, Table 2) in the bread purchase scenario. Thirdly, in regards to the environmental footprint attribute, both attention measures (i.e., frequency and intensity) for both products (i.e., milk and bread) indicate that the nudge aimed at promoting the carbon footprint reduced the absolute attention, and with more pronounced effect sizes, the relative attention allocated to the environmental footprint.

In addition, Figure 2 illustrates the differences graphically and displays the distribution of the attention measures. The horizontal line indicates the average effect of the salience nudge. This shows how the nudge typically increases the average intensity and frequency of

TABLE 2 Comparison of attention frequency and intensity between ordered and randomized IDM.

Attention frequency [in clicks]: clicks between randomized (control) and ordered (nudge) IDM.								
			Control CO2-info	Nudge CO2-info	KW	Control Enviro-info	Nudge Enviro-info	KW
Milk	Abs. Clicks	Mean	0.451	0.449	0.847	0.507	0.272	0.000
		SD	0.641	0.595		0.669	0.51	
	Rel. Clicks in %	Mean	0.029	0.072	0.073	0.038	0.019	0.000
		SD	0.053	0.157		0.069	0.049	
Bread	Abs. Clicks in s	Mean	0.452	0.482	0.324	0.52	0.279	0.000
		SD	0.609	0.583		0.668	0.485	
	Rel. Clicks in %	Mean	0.028	0.087	0.005	0.032	0.018	0.000
		SD	0.05	0.191		0.05	0.04	
Attention intensity [in s]: time between randomized (control) and ordered (nudge) IDM.								
			Control CO2-info	Nudge CO2-info	KW	Control Enviro-info	Nudge Enviro-info	KW
Milk	Abs. Time in s	Mean	2.427	3.693	0.056	2.641	0.994	0.000
		SD	5.243	5.849		4.984	2.961	
	Rel. Time in %	Mean	0.031	0.113	0.001	0.038	0.016	0.000
		SD	0.075	0.204		0.091	0.048	
Bread	Abs. Time in s	Mean	2.016	4.279	0.000	2.224	1.062	0.000
		SD	4.094	6.246		4.811	2.66	
	Rel. Time in %	Mean	0.027	0.125	0.000	0.028	0.016	0.000
		SD	0.065	0.221		0.055	0.041	

Kruskal Wallis (KW) Test chi2-statistic with ties is based on 711 observations, SD = standard deviation.

attending to the CO_2 footprint and vice-versa always reduces the attention to the environmental footprint.

4 | DISCUSSION

This study delved into consumer attention toward carbon and environmental footprints when presented in a text-format within an information display matrix (IDM) choice task. Our investigation aimed to discern whether carbon footprints can capture attention in competition with other product attributes and whether nudging can amplify the salience of carbon information while potentially reducing attention to broader environmental footprints. Key findings emerged as follows:

First, we observed that the attributes receiving the highest attention were price, package size, shelf-life, along with animal welfare for milk and wholegrain information for bread products. However, both carbon and environmental footprints did not rank among the most attended attributes. This finding aligns with prior IDM research, which similarly reported that carbon footprints garnered less attention compared to other product attributes (Lampert et al., 2017). Additionally, studies found that sustainability attributes, including carbon footprints, exhibited moderate relevance (Lusk & Briggeman, 2009) and carbon footprints failed to attract significant attention (Babakhani et al., 2020). Likewise, our findings are supported by the observation that even environmental labels have failed to impact decision-making (De Bauw et al., 2022). This suggests that environmental information should be integrated with other data that garners greater attention. Interestingly, from a health marketing perspective, environmental footprints generated a comparable level of attention as health-related information. A consumer survey in the same study context revealed that the proportion of consumers paying attention to sustainability-related concerns during food shopping has risen significantly over the last decade, reaching 43.5% (GFK, 2022). Nevertheless, more consumers remain committed to healthy and balanced diets, with 65.1% showing such commitment recently, compared to 62.3% a decade ago (GFK, 2022). This underscores the similarity in attention allocated to health and environmental attributes.

Next, our study unveiled that a salience nudge effectively directs attention to a previously disregarded attribute from the consumer's perspective, specifically carbon footprint information, even in situations characterized by information overload. The efficacy of attention-inducing salience nudges has also been demonstrated in various nutrition and health contexts (Vlaev et al., 2016), although the magnitude of their impact may vary across studies. This underscores the importance for brands seeking to promote their products through a sustainability lens to carefully consider label design and communication strategies (Koenigstorfer et al., 2014; Spaargaren et al., 2013; Werle et al., 2022). In brick-and-mortar stores, color coding and front-of-package placement were repeatedly identified as a key factor in improving the salience of nutrition labels (Koenigstorfer et al., 2014;

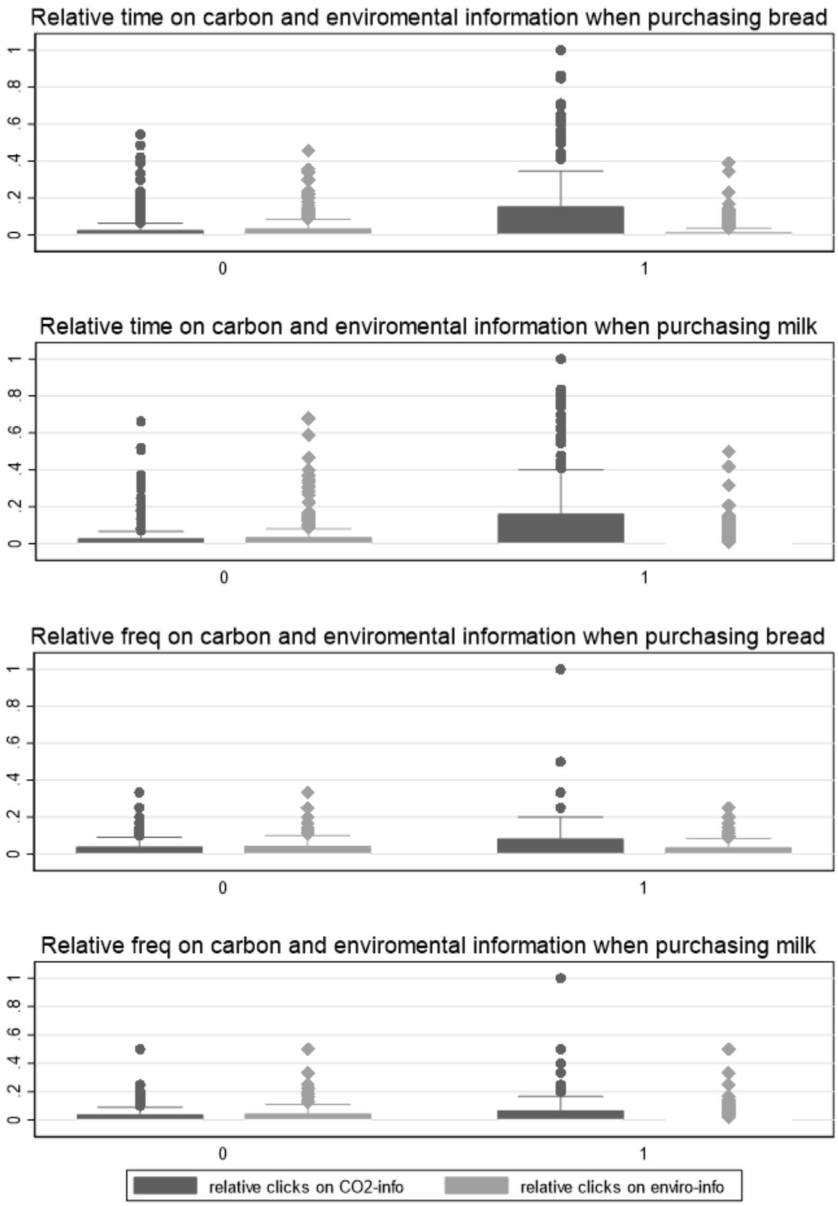

FIGURE 2 Boxplots on the attention paid to carbon and environmental information relative to overall attention to product attributes. The horizontal line indicates a mean, rectangles indicate a high density of observations, and circles or diamonds indicate a single observation. The mean change between the control group (0) and the treatment group (1) reveals a successful attention nudge for CO_2 information and an adverse effect on environmental information erse effect on environmental information.

Lee et al., 2023; Werle et al., 2022). In digital environments like online supermarkets, it is crucial to take into account consumers' search patterns and their utilization of filtering options when adjusting the prominence of choices (Michels et al., 2023). As demonstrated in this study, enhancing the visibility of an attribute in the top row of a product description will enhance its salience.

Conversely, the nudge exerts an influence on the attention afforded to other product attributes, including other sustainability attributes like environmental footprints. Importantly, our study is the first to empirically establish that attributes closely related to each other, such as carbon footprint information and general environmental footprint scores, do not receive equal attention when one of them is accentuated by a salience nudge. This attention-distorting effect is not confined to these two specific product attributes; rather, it may be attributed to the general limitations inherent in consumers' attention capacity. In the short term, consumers cannot augment their attention capacity or enhance their information processing skills, leading to inevitable competition for attention among sustainability-related product attributes when presented side by side. Furthermore, heuristic processing of carbon footprints may generate a halo effect, wherein consumers assume positive environmental sustainability, regardless of its veracity, which might lead to a misinterpretation of carbon footprints as a more comprehensive indicator of environmental sustainability (Feucht & Zander, 2018), potentially misguiding food choices.

4.1 | Limitations

The study presents valuable insights into the influence of environmental labeling on consumer behavior; however, it is subject to several limitations that affect its generalizability and external validity. For instance, the generalizability of the findings may be influenced by regional food culture and the environmental consciousness of consumers, as well as product-specific preferences. Milk and bread are staples in German diets and are also widely consumed in other countries; however, regional differences must be expected. While the experimental settings attempt to mimic the complexity of real-world scenarios, they do so within a digital context that maintains a high degree of experimental control. This setting limits the external validity of the findings, as food choices are typically made in physical, brick-and-mortar stores. Additionally, product attributes are often introduced to the market using images, shapes, and colors, exemplified by systems like the Nutri-Score. While a textual presentation provides an equal playing field for product attributes, it does not most accurately reflect the current market dynamics, where visual elements play a crucial role.

Another aspect concerns the long-term effects of labeling. Labels are more effectively utilized when they are widely recognized among consumers, a status that often requires significant time to achieve due to the slow process of market penetration. Consequently, consumer attention to such labels is likely to evolve as more people become aware of and understand their significance. This gradual increase in label recognition underscores the necessity for ongoing research into the dynamics of label effectiveness over time.

5 | IMPLICATIONS FOR POLICY-MAKERS, MARKETERS, AND FUTURE RESEARCH AVENUES

5.1 | Future research avenues

5.1.1 | Inefficiencies in labeling strategies

This study has illuminated several directions for future investigations and implications for researchers focusing on consumer behavior and labeling efficacy. One key finding suggests that when consumers focus on a particular attribute, such as CO_2 emissions, it often detracts from attention to a similar attribute, leading to possible misinterpretations—like equating CO_2 emissions directly with overall environmental impact. This phenomenon raises questions about whether this is driven by heuristic processing due to time constraints or limited cognitive capacity, a fundamental lack of understanding of the concepts, or the influence of strong biases like the halo effect. By pinpointing the underlying mechanisms, researchers can devise more effective labeling strategies that enhance comprehension and differentiation among similar attributes.

5.1.2 | Information search strategies of consumers

The success of the salience nudge in this study provides insights into why certain nudges work. The findings suggest that such nudges effectively capture attention and align with natural reading patterns, which typically flow from top to bottom. This strategy appears most effective at the onset of information processing when consumer fatigue is minimal. Understanding these dynamics can help refine theoretical assumptions about attention and processing in decision-making contexts.

5.1.3 | Refined methodological strategies

From a methodological standpoint, the use of an information display matrix (IDM) proved instrumental in measuring consumer attention and introducing complexity to the choice scenarios presented in the study. This approach not only helps in quantifying attention allocation across different label designs and placements but also facilitates the exploration of how consumers interact with product information. This methodological insight is vital for future studies aiming to dissect and manipulate the cognitive processes involved in consumer decision-making. Further enhancing the realism of information display matrices (IDMs) by incorporating font colors, shapes, and images helps to align IDMs more closely with actual visual communication methods in the market. Furthermore, future research could enhance understanding by analyzing label attention in various types of stores, extending beyond the preliminary investigations of attention in digital decision environments.

5.2 | Implications for policy-makers

5.2.1 | Generating consumer attention

For policymakers concerned with environmental issues, labeling represents a non-intrusive policy to address underlying issues (Ammann et al., 2023). The effectiveness of these labels in influencing consumer choices hinges significantly on their visibility and salience (Koenigstorfer et al., 2014; Werle et al., 2022). Simply mandating the presence of environmental information on packaging may not suffice; it's crucial to ensure these labels truly capture consumer attention. This study reveals that consumer attention to environmental labels is consistently not assured. Regarding front-of-pack labels, traffic light color codes, and warning labels have been found to receive significantly more attention in the marketplace(Argo & Main, 2004; Koenigstorfer et al., 2014; Purmehdi et al., 2017; Werle et al., 2022).

5.2.2 | Simplifying the food labeling market

Additionally, the complexity introduced by multiple competing labels, such as CO2 emissions versus general environmental impact, suggests a need for streamlined, single labels that consolidate crucial information, enhancing clarity and focus. Multiple approaches are available for combining carbon footprints and other environmental footprints into a single label, such as the Planet and Eco-Score, based on the life-cycle-assessment-based product environmental footprint (PEF) standard. There is also ongoing work on standardizing the presentation of sub-dimensions of environmental footprints within a single label (Lemken et al., 2021). A comprehensive environmental labeling framework is better suited to generate salience in food choice environments. It may also circumvent intra-sustainability trade-offs (Sonntag et al., 2023) when promoting sustainability attributes. We advise to feature a fully aggregated environmental score on the front of the packaging (FOP). Detailed sub-indicators can be provided on the back of packaging (BOP) to cater to highly involved consumers seeking more comprehensive information.

In alignment with this, the European Union's Farm to Fork strategy, released in May 2020, has proposed a 'Sustainable Food Labelling Framework' by 2024, emphasizing the need for clear labeling and accessible sustainability information (BEUC, 2021). Such a framework has the potential to consolidate a substantial amount of information currently dispersed across numerous public and private sustainability labels and claims. Such a framework would also help to prevent consumers from being overwhelmed by various different sustainability label designs.

5.3 | Implication for marketers

5.3.1 | Satisfying the increasing demand for environmental labels

Current policy debates suggest that manufacturers should proactively reformulate products and improve processes to achieve favorable environmental credentials not limited to CO_2 footprints in order to excel in more relevant environmental labels potentially coming up. This proactive approach not only complies with evolving regulations but also positions brands as sustainability leaders, enhancing market appeal and consumer trust. Consumers have even demanded policymakers and retailers to support suitable structures that facilitate environmentally friendly consumption (Feucht & Zander, 2018).

5.3.2 | Increasing the efficiency of label schemes

Marketers should critically assess the efficiency of current environmental and sustainability labeling schemes. The prevalence of multiple single-dimension labels on packaging can dilute consumer attention and contribute to information overload. Simplifying these labels into fewer, but more comprehensive, options may enhance their effectiveness. By reducing the number of labels and integrating essential environmental information into unified labels, producers can help ensure that key sustainability attributes are more noticeable and influential in consumer purchasing decisions.

6 | CONCLUSIONS

Our study revealed that carbon footprints and environmental footprints do not receive the highest attention among food attributes. However, when these attributes are presented to consumers using nudge strategies, they can enhance attention to sustainability dimensions, potentially fostering more sustainable purchasing behavior. An important result, since sustainability generally ranks lower in consumers hierarchy of attributes than others, e.g., price, taste, or animal welfare (De Bauw et al., 2021; Grunert et al., 2014). In the pursuit of directing attention toward food (environmental) sustainability, the use of a prominent, singular-dimensional label should be avoided, given its potential adverse impact on the attention directed toward other sustainability dimensions.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to declare.

CREDIT AUTHORS STATEMENTS

Dominic Lemken: Literature review, Conceptualization, Implementation, Formal analysis, Methodology, Writing—original draft, Writing—review & editing. **Daniele Asioli:** Literature review, Conceptualization, Writing—review & editing. **Frederick Schoppa:** Literature review, Methodology, Writing—review & editing.

TRANSPARENCY REPORTING

The research questions, hypotheses and study have been pre-registered via the open-science-framework (OSF): https://osf.io/z3cnd.

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APPENDIX A

TABLE A1 Food products and attribute levels in the IDM.

No.	Attribute name	Toast	Wheat-rye bread	Whole-grain Rye bread	Multi-grain bread
1	Brand name	Golden toast	Brotland	REWE bio	Harry
2	Production method: Bio or conventional	Non-organic	Non-organic	Organic	Non-organic
3	Price of product	1,69	1,79	2,19	1,69
4	Size of packaging kg	0,5 kg	1,0 kg	0,5 kg	0,5 kg
5	Packaging material	Plastic bag	Plastic bag	Plastic bag	Plastic bag
6	With or without genetically modified organisms	Not specified	Not specified	Not specified	Not specified
7	Best before date	27.11.2022	12.12.2022	12.12.2022	12.12.2022
8	Climate labeling: Climate-score	Class A, very good, 0,1 kg CO2-e/kg	Class A, very good, 0,2 kg CO2-e/kg	Class A, very good, 0,1 kg CO2-e/kg	Class A, very good, 0,1 kg CO2-e/kg
9	Environmental labeling: Enviro-score	Class B, good, 78/100 points	Class B, good, 75/100 points	Class B, good, 77/100 points	Class B, good, 62/100 points
10	Origin labeling	Germany	Germany	Germany	Germany
11	Processing: Sourdough	No	Yes	Yes	Yes
12	Processing: Preservatives	Yes	No	No	No
13	Information on containing lactose	Could contain lactose	Not specified	Not specified	Not specified
14	Information on containing gluten	Contains gluten	Contains gluten	Contains gluten	Contains gluten
15	Nutritional claims	Rich in fibre	Not specified	Not specified	Not specified
16	Nutritional labeling: Nutri-score	Not labelled	Class A, is very good	Class A, is very good	Class A, is very good
17	Nutritional value: Energy	1.129 kJ/268 kcal	933 kJ/221 kcal	924 kJ/220 kcal	229 kcal
18	Nutritional value: Total fat	5,3 g	2,5 g	5,1 g	4,9 g
19	Nutritional value: Saturated fats	0,5 g	0,5 g	0,5 g	0,8 g
20	Nutritional value: Total carbohydrates	43 g	40 g	33,0 g	35 g
21	Nutritional value: Sugar	4,3 g	1,9 g	2,9 g	2,3 g
22	Nutritional value: Fibre	6,5 g	Not specified	Not specified	6,9 g
23	Nutritional value: Protein	8,8 g	7,5 g	5,9 g	7,7 g
24	Nutritional value: Salt	1,1 g	1,0 g	1,1 g	1,0 g
25	Information on wholegrain-share	58,0%	0,0%	100,0%	0,0%
No.	**Attribute name**	**Oat Milk**	**UHT Milk**	**Medium-fat Milk (1.5%)**	**Whole Milk**
1	Brand name	Alpro	Dm	Alnatura	Landliebe
2	Production method: Organic or conventional	Non-organic	Organic	Organic	Non-organic
3	Price of product	1,49	1,35	1,69	1,19
4	Size of packaging ltr	1 ltr	1 ltr	1 ltr	1 ltr
5	Packaging material	Tetra Pak	Tetra Pak	Tetra Pak	Reusable glass-bottle
6	With or without genetically modified organisms	Not specified	Not specified	Not specified	Non-GMO
7	Best before date	05.02.2023	05.02.2023	26.11.2022	26.11.2022
8	Climate labeling: Climate-score	Class A, very good, 0,3 kg CO2-e jekg	Class D, bad, 1,6 kg CO2-e jekg	Class C, medium, 1,4 kg CO2-e jekg	Class C, medium, 1,4 kg CO2-e jekg

(Continues)

TABLE A1 (Continued)

No.	Attribute name	Toast	Wheat-rye bread	Whole-grain Rye bread	Multi-grain bread
9	Environmental labeling: Enviro-score	Class B, good, 79/100 points	Class B, good, 71/100 points	Class B, good, 64/100 points	Class B, good, 76/100 points
10	Origin labeling	Sweden	Germany	Germany	Germany
11	Processing: Pasteurized	No	UHT	Yes	Yes
12	Processing: Homogenized	No	Yes	Yes	Yes
13	Information on containing lactose	Lactose-free	Not lactose-free	Not lactose-free	Not lactose-free
14	Information on containing gluten	Not labelled	Gluten-free	Not specified	Not specified
15	Nutritional claims	Enriched with calcium and vitamins	Not specified	Not specified	Not specified
16	Nutritional labeling: Nutri-score	Class A, very good	Not labelled	Not labelled	Not labelled
17	Nutritional value: Energy	192 kJ/46 kcal	275 kJ/66 kcal	198 kJ/47 kcal	272 kJ/65 cal
18	Nutritional value: Total fat	1,5 g	3,6 g	1,5 g	3,8 g
19	Nutritional value: Saturated fats	0,2 g	2,4 g	1,0 g	2,6 g
20	Nutritional value: Total carbohydrates	6,6 g	5,0 g	4,9 g	4,4 g
21	Nutritional value: Sugar	3,3 g	5,0 g	4,9 g	4,4 g
22	Nutritional value: Fibre	1,4 g	0,0 g	0,0 g	Not mentioned
23	Nutritional value: Protein	0,8 g	3,3 g	3,5 g	3,3 g
24	Nutritional value: Salt	0,08 g	0,11 g	0,12 g	0,1 g
25	Animal welfare: Husbandry system	Not applicable	Not labelled	Not labelled	No GM technology and cows have access to open space

Animated screenshot from the survey via: https://postimg.cc/21XN6Phz, Translations of attributes and levels along with the IDM design are available via: https://github.com/dlemken/IDM/blob/main/IDM%20attributes%20and%20levels.xlsx

FIGURE A1 Consumption frequency of evaluated products in percent.