Green Consumption Assistant

WORKING PAPER SERIES

#06

Increasing the effectiveness of sustainability tags

Empirical evidence from user tests and a field study on Ecosia Shopping

Jens Bergener, Maike Gossen, Marek Veneny, Zsofia Paszternak, Ruben Korenke

This Working Paper Series is published by the Green Consumption Assistant (GCA) Research Project.

The Green Consumption Assistant supports consumers in making more sustainable decisions during online shopping. The GCA displays green product alternatives on the search engine Ecosia and provides information about more sustainable alternatives, for example, references to repair, rental, or sharing options. In addition, sustainable websites will be highlighted on Ecosia and the climate commitments of the organisations and companies will be made transparent in a ranking. For the recommendations of the GCA, a comprehensive product database (Green Database) with ecological and social sustainability information is being built up using machine learning techniques.

The GCA is a collaboration project between the Technische Universität Berlin, the Berliner Hochschule für Technik, and the green search engine Ecosia and is funded by the Bundesumweltministerium as a lighthouse project for artificial intelligence in use for ecological challenges. The project embodies a new, interdisciplinary partnership that combines sustainable and behavioural research with machine learning, user-centered design, and digital product development.

In the project, we rely on cooperation and exchange with various sustainability actors, scientists, and label organisations or online shops, to ensure a reliable and comprehensive data set for the recommendations of the Green Consumption Assistant.

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Increasing the effectiveness of sustainability tags

Empirical evidence from user tests and a field study on Ecosia Shopping.

Working Paper for the GCA Research Project

December 2023

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Abstract

Sustainability tags offer a simple and efficient way to communicate the sustainability performance of products. Research has shown that generic sustainability tags can help consumers to choose more sustainable products. However, the effectiveness of different approaches to sustainability tags in online shopping still needs to be better understood. Using a sequential exploratory, mixed-methods research design, we investigate the perception and effectiveness of two sustainability tag approaches and their impact on consumer choices when shopping for electronic and fashion products via the online search engine Ecosia. The generic approach highlights sustainable products using a stand-alone "sustainable" tag. In contrast, the detailed sustainability tags provide contextual sustainability information based on specific product attributes, such as energy efficiency or fair labour conditions. Firstly, we employ qualitative user testing using a prototype to gather information on how search engine users perceive detailed sustainability tags for fashion and electronic products. Following this, we employ a field experiment using an A/B-test on Ecosia Shopping, measuring actual click behaviour to compare the performance of the generic and detailed sustainability tag approaches. The user tests reveal that detailed sustainability tags help online shoppers better understand the contextual aspects of product sustainability. Based on 244.000 product impressions, the field experiment indicates that detailed sustainability tags significantly increase the click-through rate for sustainable products compared to a generic approach. We conclude that online shopers benefit from detailed sustainability tags when searching for sustainable consumer electronics and fashion products. Our results have important implications for research on sustainability communication, particularly for online sustainability tags, and provide valuable guidance for marketers and policymakers.

Keywords

Sustainability labels, sustainability tags, mixed-methods design, consumer behaviour, online shopping, search engine

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INTRODUCTION

Sustainable consumption has become an urgent need given the ongoing climate crisis and the transgression of planetary boundaries. Studies show that many respondents are on the cusp of adopting more environmentally oriented behaviour (Umweltbundesamt, 2020). However, regarding sustainable consumption, there is a gap between what people say and what they do. At the same time, environmentally friendly behaviour is influenced by various rational factors such as knowledge, financial resources, social norms, habits, and emotions. In this context, product information plays an important role in informing consumers about the sustainability attributes of a product and enabling them to make a conscious purchase decision (Dendler, 2014). Research shows that providing sustainability information, such as eco labels, can positively influence the likelihood of purchasing sustainable products in online shops (Feuß et al., 2022; Majer et al., 2022). For example, easy-to-understand sustainability labels that are eye-catching and prominently placed can help make it easier for consumers to process and evaluate information about sustainable products (Donato & Adıgüzel, 2022). However, in online retail environments, consumers often lack sustainability information, or the presented information is untrustworthy (Gossen, et al., 2022). Thus, consumers need considerable support in understanding the socio-economic impact of their purchasing decisions to make informed, sustainable choices (Torma & Thøgersen, 2021).

In recent years, large parts of consumer activities, such as purchasing, comparing, and examining goods, have shifted online. Consumers evaluate product information and increasingly engage in what is often referred to as 'digital virtual consumption' (Molesworth & Denegri-Knott, 2013). Particularly, search engines are used for online shopping and have evolved from tools for comparing prices to tools for comparing nearly everything (Rennie et al., 2020). Today, around 65% of online shoppers start their product search on a marketplace or search engine (*The Future Shopper Report*, 2022). These websites can be understood as market devices that shape digital consumer behaviour (Cochoy et al., 2020). At the same time, there is an ongoing critical discourse about the digital 'devicification' of consumer culture (Cochoy et al., 2017). Scholars emphasise the manipulative power of these often large and hi-tech infrastructures on the one hand and their potential to empower marketers, intermediaries and local consumers, as well as their potential to change ethical consumption norms on the other hand (Cochoy et al., 2020; Fuentes & Sörum, 2019). Regarding the latter, online search engines and e-commerce platforms offer opportunities to promote sustainable products and ethical consumption (Fuentes & Sörum, 2019).

As part of the Green Consumption Assistant project, the search engine Ecosia displays four best-in-class products in a designated sustainable choices section at the top of the shopping results page, marked with a generic sustainability tag (Hoffmann, 2022). Studies have shown that these generic sustainability tags, such as a simple "sustainable" banner, can significantly increase consumers' decisions to purchase sustainable products (Bergener et al., 2023; Berger et al., 2020; Sigurdsson et al., 2020, 2022). In addition, studies show that this condensed form of sustainability information is easier to process, particularly for less motivated consumer groups (Sigurdsson et al., 2022) and that single sustainability tags are most effective when consumers trust the seller. At the same time, previous research has revealed that the influence of sustainability information on consumer choices varies depending on the topic, such as environmental or social information, product category, and type of information (O'Rourke & Ringer, 2016). Furthermore, there is a risk that generic sustainability tags are less reliable, as they

reduce a product's sustainability performance to a simple piece of information (Berger et al., 2020). Sustainability tags can be used as marketing techniques, often referred to as greenwashing, to highlight products with little or no sustainability performance and influence customer choice. These drawbacks of generic sustainability tags correspond to the goals of the Unfair Commercial Practice Directive at the EU level, which aims to curb unfair business practices such as marketing untrue sustainability information to consumers (European Commission, 2023).

Because consumers need contextual sustainability information that is easy to find and helpful, marketers and policymakers are working to remove some existing barriers to environmentally friendly behaviour. However, marketers need to understand which sustainability attributes consumers value most and which they associate with a particular product or product category. At the same time, there is a lack of research comparing the effectiveness of different approaches to sustainability communication and measuring actual shopping behaviour in field settings (Majer et al., 2022). Thus, we address the following research questions:

RQ 1: How do Ecosia users perceive a set of detailed sustainability tags for fashion and electronic products, and do they understand their meaning related to various sustainability dimensions?

RQ 2: Is there a difference in click behaviour when sustainable fashion and electronic products are enhanced with detailed sustainability tags compared to a generic sustainability tag on Ecosia Shopping?

To answer these research questions, we use a mixed-methods research design with a qualitative data collection phase preceding the primary quantitative phase (McBride et al., 2019; Schoonenboom & Johnson, 2017). First, we employ qualitative user tests with an Ecosia Shopping prototype to explore how consumers perceive and evaluate a set of detailed sustainability tags when searching for fashion and electronic products. Secondly, we refine and implement the set of detailed sustainability tags on Ecosia Shopping. Finally, we employ a field experiment using a randomised A/B-test to measure actual click behaviour on Ecosia Shopping and compare the effectiveness of the detailed tags with a generic, stand-alone sustainability tag approach.

This study contributes to the academic and practical discourse on the impact of sustainability cues, particularly sustainability tags, on e-commerce sites for consumer electronics and fashion products. We provide empirical evidence for marketers and policy-makers on the implementation of a detailed sustainability tag approach. The results show how marketers can promote sustainable behaviour change through sustainability tags. In addition, the study reveals untapped market potential for sustainable products. The remainder of this working paper is organised as follows. In the next section, we provide information on the methodological approach and present the results of the qualitative user tests and the field experiment. The final section integrates and discusses the results, derives practical implications, and outlines the study's limitations and avenues for future research.

RESEARCH DESIGN

This study was obtained in cooperation with the search engine Ecosia. The research setting of our study is Ecosia Shopping, a shopping section included in the main vertical of Ecosia's search engine. Ecosia Shopping is designed to enable environmentally-conscious online shopping and

allows users to search for and compare product information. Similar to other search engines, the website allows consumers to search for products or to navigate through multiple results pages with many different products following a respective search query. Rather than purchasing products directly through Ecosia, users are redirected to retailer sites when they click on a product. Hence, consumers in this study are understood as individuals who search, explore and evaluate product options on Ecosia Shopping. Users of Ecosia Shopping receive an overview of the four best-in-class offers next to conventional shopping results for their respective search queries. Based on their sustainability attributes, these best-in-class products are selected from a publicly available green product database. They are displayed in the "sustainable choices" section at the top of the shopping results page and marked with a generic sustainability tag with the product picture (see Figure 1). Below the picture, Ecosia provides information on the product name, price and name of the seller. To provide sustainability information in the database, sustainable product information is collected from various e-commerce websites using a web-scraping approach. This information is then automatically structured, assessed and stored. For detailed information on the web-scraping approach and the data set, see (Flick et al., 2023). By default, the ranking of product listings on Ecosia Shopping is based on relevance to a user's current search term. Sustainable choices are ranked based on sustainability label information and other sustainability indicators provided by credible third-party sources. For a detailed explanation of the current evaluation approach for sustainable products and the underlying conceptual considerations, see Hoffman (2022) and Gossen et al. (2022).

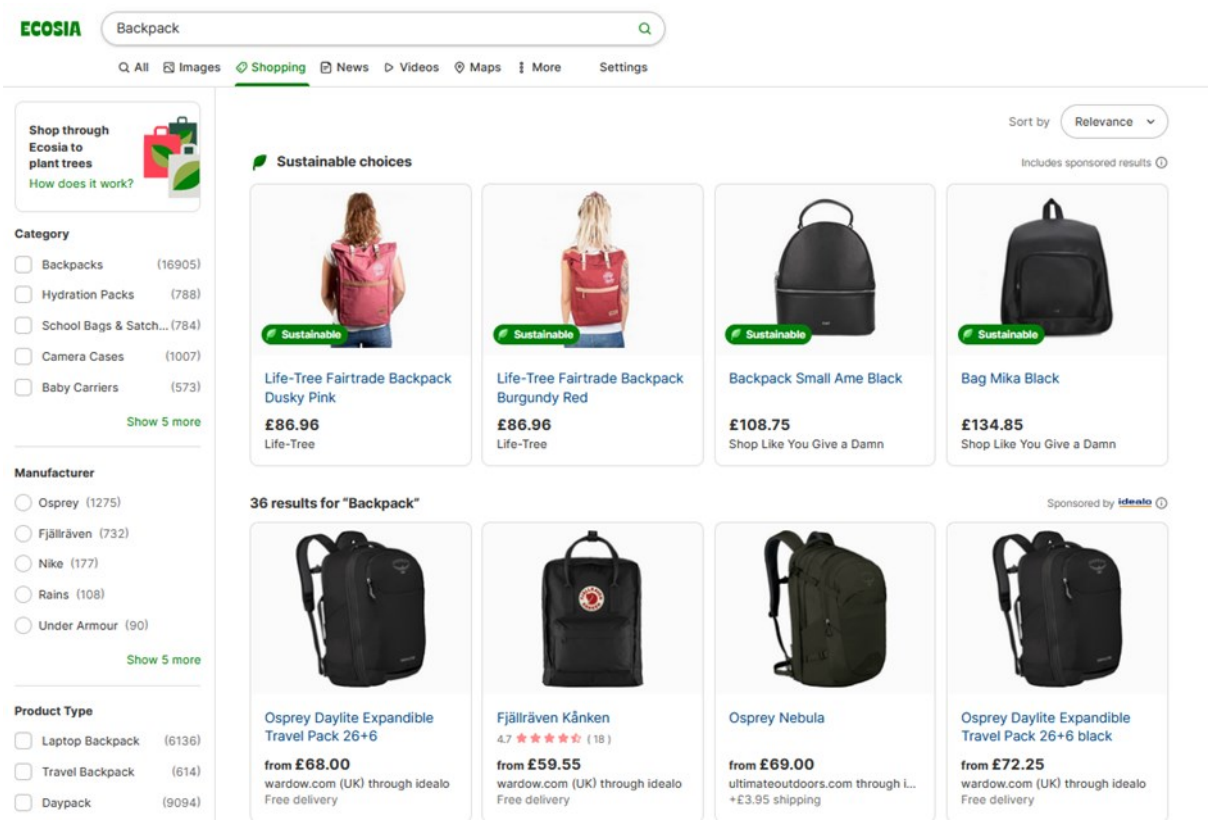

Figure 1: Screenshot of the currently implemented stand-alone sustainability tags in the sustainable choices section on Ecosia Shopping following the search term "Backpack" in the UK market.

To investigate the influence of sustainability tags on consumer preferences when shopping for consumer electronics and fashion products on Ecosia, this study employs a sequential, exploratory design (McBride et al., 2019; Schoonenboom & Johnson, 2017). A qualitative data

collection phase precedes the primary quantitative phase, with the latter building on the former (qual → QUANT). The two-study design utilises qualitative unmoderated user testing using a virtual prototype and a field study (see Figure 2). The points of integration are two-fold: First, we use the findings of the qualitative user tests to inform and redirect the design and hypothesis for the subsequent quantitative study (Bryman, 2006). Additionally, after presenting the results sequentially, the qualitative findings provide context for the quantitative results as part of an integrated discussion.

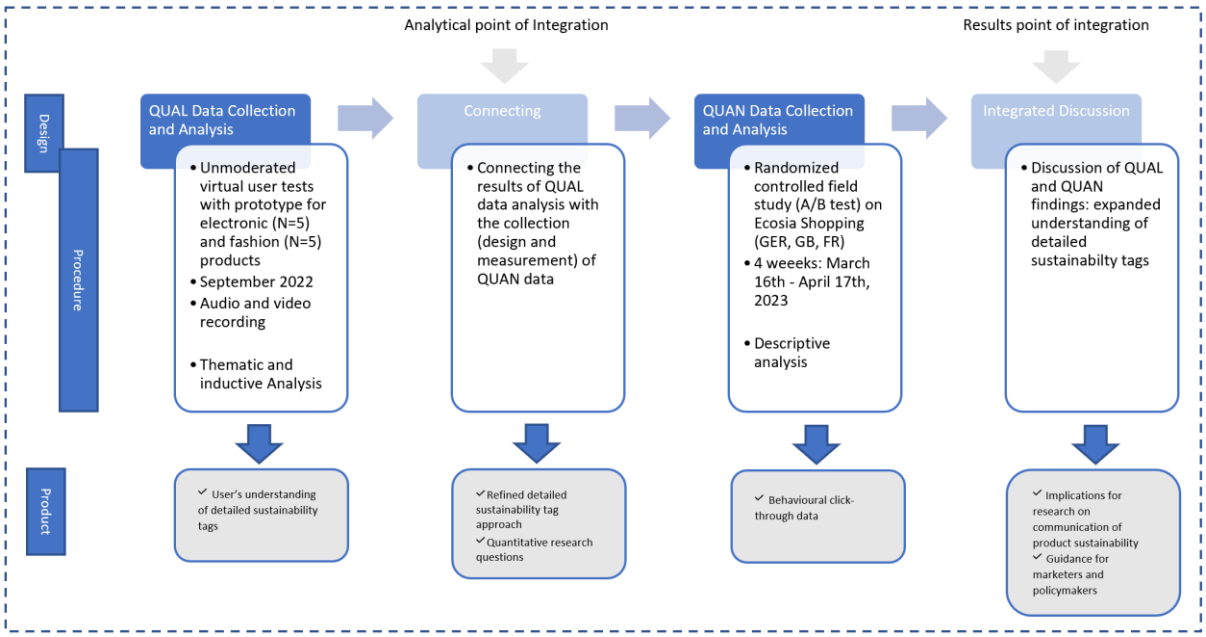

Figure 2: Procedural diagram of the mixed-methods study design.

STUDY 1: UNMODERATED QUALITATIVE USER TESTS

Method

We conducted unmoderated remote usability testing to investigate how Ecosia users interpret a set of detailed sustainability tags for fashion and electronic products (RQ1). Participants were recruited to complete shopping tasks. Their behaviour was recorded using screen capture technology as they talked about their behaviour and thought processes. This approach has been used in previous studies to observe user behaviour on search engines (Rennie et al., 2020). It offers the advantage of capturing participants' search and thought processes while shopping online. Thus, the unmoderated tests are used to test the usability of Ecocis Shopping and to gain insights into how users perceive a set of detailed sustainability tags on the shopping pages. After receiving written instructions, the users run the test session themselves, while their behaviour and verbalizations are video-recorded for subsequent analysis. This makes it a flexible and efficient method for user testing and has been shown to benefit usability studies (Hertzum et al., 2015).

Material

To obtain data on how consumers perceive a set of detailed sustainability tags, two prototypes of Ecosia 's shopping website were designed for a fashion and an electronic product. We asked participants to imagine shopping for a backpack or a TV and presented them with screenshots of

the results page after searching for "backpack" and "TV" on Ecosia Shopping (see Figures 3 and 4). These products represent the most frequently searched categories on Ecosia Shopping - fashion and electronics - and are associated with various risks, complexities, and emotional and financial investments that consumers make daily. The screenshots showed both the regular search results and sustainable product alternatives. The sustainable products were displayed in the “sustainable choice” section at the top of the results page and were marked with one or two sustainability tags on the product images. We tested six sustainability tags for both fashion and electronic products, covering relevant sustainability dimensions for each product category based on Siegelklarheit's label directory (see Tables 1 and 2). Due to space and design limitations and to increase readability on Ecosia Shopping, the length of the detailed sustainability tags did not exceed 20 characters.

Table 1: Detailed sustainability tags for different sustainability dimensions of consumer electronics

Sustainability dimension	**Short description of sustainability criteria based on Siegelklarheit**	**Detailed sustainability tag**
Energy & Climate	Criteria on power consumption and power management during the use phase.	Energy efficient
Lifetime	Criteria on the quality and durability of specific components, availability of spare parts, properties, quality of the battery, providing information concerning repairability, upgradeability and usage of the battery to the user, and an additional lifetime guarantee for the product beyond the legal obligations.	Resilient
Chemicals	Restriction of chemical use in the production process, such as chemicals listed on the REACH Candidate List as substances of very high concern, the use of flame retardants, and the use of specific harmful substances which have impact on human health and the environment such as mercury, cadmium, lead, chromiumVI and others.	Fewer toxins
Waste & Air pollution	Criteria on waste management in the production phase, a common external power supply, the recyclability of plastics used, the disassembly of the product for recycling, take back system for the product, and consumer information on the sustainable use and disposal of the product	Reduced waste
Labour rights and working conditions	Compliance with (at least) all ILO core labour standards for different suppliers along the supply chain and covers criteria on occupational health and safety of workers, working hours, the prohibition of	Fair labour

	child labour, paying wages sufficient to meet basic needs of the worker, compensating overtime, paid leave, freedom of association, the right to organize and the formation of workers representations, the payment of equal wages, the non-discrimination in the workplace, the standard's rights and benefits for other forms of work such as sub-contracted labour.	
Conflict Minerals	Restrictions on the use of conflict minerals (based on the OECD Due Diligence Guidance)	Conflict free

Table 2: Detailed sustainability tags for different sustainability dimensions of fashion products

Sustainability dimension	**Short description of sustainability criteria based on Siegelklarheit**	**Detailed sustainability tag**
Energy & Climate	Energy consumption and renewable energy use in the production phase	Energy efficient
Quality	Usability, durability, and quality of textiles (fabrics)	Durable
Chemicals	Restrictions in the use of harmful chemicals, testing the final product regarding residues of these chemicals, and handling hazardous substances in the production process.	No toxins
Wase & Air pollution	Water consumption in the production phase, wastewater quality, wastewater treatment, or wastewater volumes (per production unit).	Reduced waste
Water	Reduction and management of waste and air pollutants and immission in the production phase	Water efficient
Labour rights and working conditions	Basic workers' rights and working conditions, such as limited working hours, the prohibition of child labour, paying wages sufficient to meet basic needs of the worker, compensating overtime, freedom of association, the right to organize and the formation of workers representations, the payment of equal wages, the non-discrimination in the workplace, the same standards and benefits for sub-contracted labour, and the requirements on setting up policies or procedures to manage basic labour rights in the workplace	Fair labour

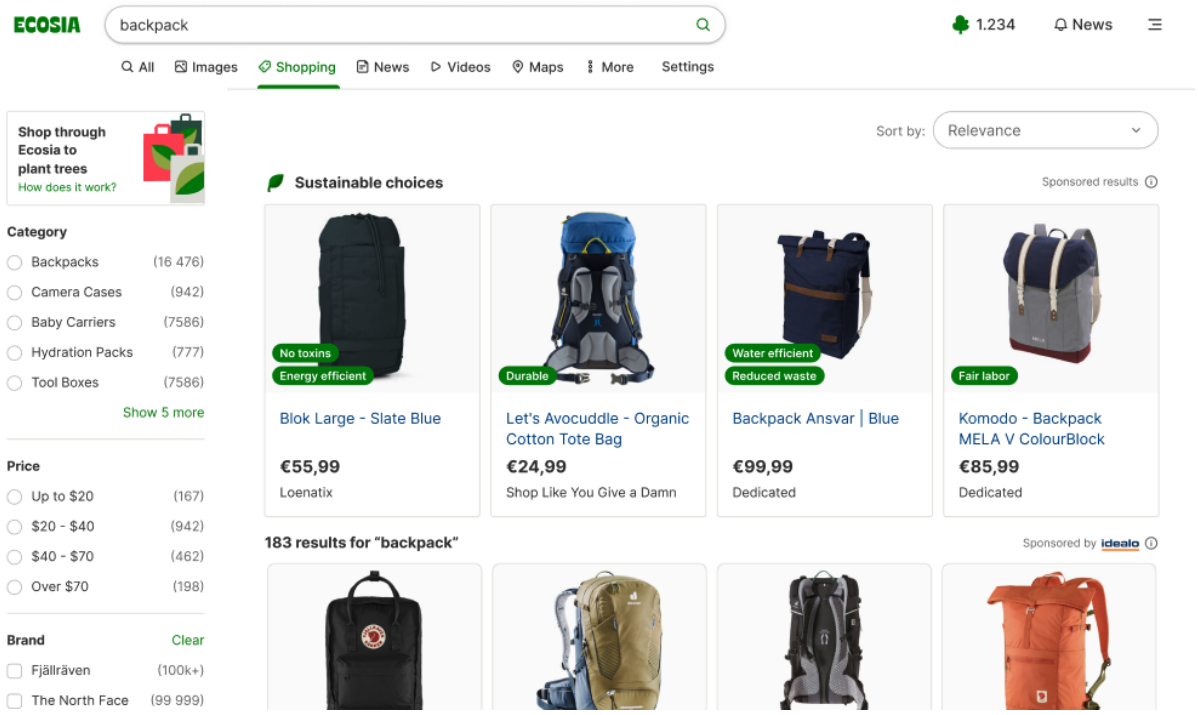

Figure 3: Screenshot from the unmoderated user tests for backpacks.

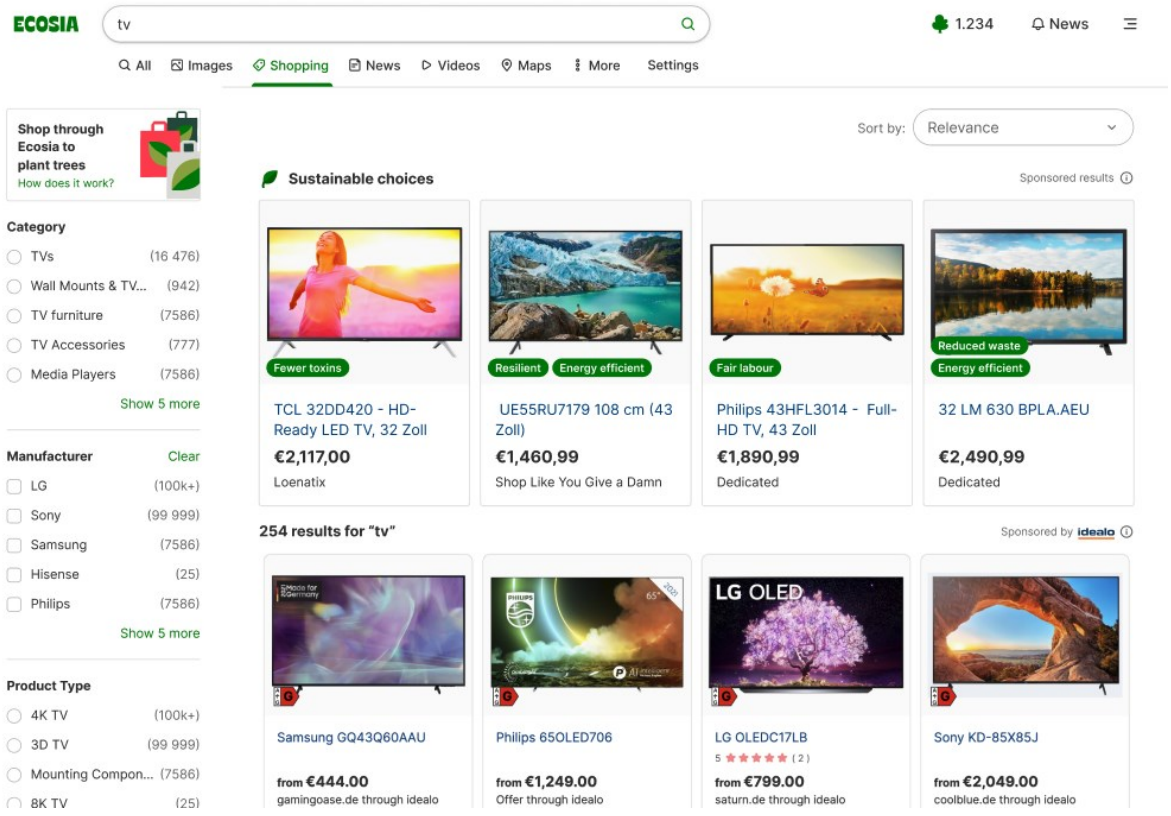

Figure 4: Screenshot from the unmoderated user tests for TVs.

In the first task, participants were asked to answer which search results they wanted to click on and why (see Appendix 1 for the introductory text of the unmoderated user tests). In a second task, we asked participants to interpret and evaluate the meaning of the detailed sustainability tags. In a third task, we asked participants to assess the credibility of the sustainability tags using

a rating scale ranging from 1 to 5 (not at all trustworthy to extremely trustworthy). They were also asked to describe the reasons for their rating. Finally, we asked participants to name the tags that were most and least likely to influence their purchasing decision and the reasons for their choice.

STUDY 2: FIELD EXPERIMENT ON ECOSIA SHOPPING

Data collection, analysis, and sample

Treatment groups

To obtain data on actual consumer shopping behaviour and to investigate a difference in consumer shopping behaviour when sustainable products are enhanced with detailed sustainability tags compared to generic sustainability tags (RQ2), an online field experiment via Ecosia 's website was designed. We implemented the experiment as a randomised A/B test. All product choices in the field experiment are certified sustainable products based on credible third-party sustainability information. However, the communication of sustainability information provided to consumers differed. Based on individual cookie-level data, consumers were randomly allocated to one of the following two groups when they visited the Ecosia Shopping page during the observation period: a treatment group and a control group.

- The *control group* was exposed to the original Ecosia Shopping product page version, where sustainable products are displayed with a generic, stand-alone sustainability tag stating "sustainable" on the lower left side of each of the sustainable product photos on the product page.
- Within the *treatment group*, consumers saw a manipulated website version. Instead of a generic, stand-alone sustainability tag, all sustainable products were displayed with (a set of) detailed sustainability tags with more contextual sustainability information based on the sustainability attributes of the products.

Besides the different versions of product tags communicating sustainability information, all functional and visual attributes were identical for each product in the experimental conditions. The effect of the different sustainability tag approaches on shopping behavior is estimated by comparing the consumers' click-through rates (CTRs) in the two experimental groups.

Material

In this study, we employed two variants of sustainability tags. Variant A was shown to the control group and is the currently implemented approach on Ecosia Shopping (see Figure 1). This variant includes communicating the sustainability performance of products with a generic, stand-alone sustainability tag per sustainable choice. Variant B was shown to the treatment group and offered up to three detailed tags per sustainable choice based on the sustainability attributes of the displayed products (see Figures 3 and 4 for the design). Similarly to the detailed tags used for the qualitative user testing, the tags cover environmental and social sub-dimensions based on credible sustainability label information. However, following the results of the qualitative user test, we updated the list of tags communicating sustainability attributes for fashion and electronics products to avoid misinterpretations in the field experiment. For example, we changed the wording for tags covering product lifetime information from "resilient" to "durable". We excluded three detailed tags for consumer electronics that were not clearly understood by

users in the qualitative study. In total, we tested six detailed tags in the fashion category and three for consumer electronics (Table 3). To account for space and design limitations and to increase readability on Ecosia Shopping, the length of the detailed sustainability tags did not exceed 20 characters. The tags were shown for products that met a categorical (yes or no) fulfillment of a minimum set of standards to compare the sustainability performance of products. The fulfillment standards are based on extending the current evaluation approach (Hoffmann, 2022) while using a product's scoring on each sustainability dimension within the database (see Appendix B). The display priority for the sustainability tags was set to match the user preferences in the qualitative study.

Table 3: Subdimensions and tags for fashion and electronics products within the field experiment

	Detailed sustainability tags per product category	
Sustainability Dimension	*Fashion*	*Electronics*
Energy & Climate	Energy efficient	Energy efficient
Quality / Lifetime	Durable	Durable
Chemicals	No toxins	-
Waste & Air pollution	Reduced waste	-
Water	Water efficient	-
Labour rights and working conditions	Fair labour	Fair labour

Data collection and sample

The open-source feature management tool Unleash was used to implement the two experimental A/B-test conditions on Ecosia Shopping. The randomised experiment was conducted in three core markets: Germany, France, and the UK (see Appendix C for the translation used in each market). The data collection was aggregated and anonymized to not disclose personally identifiable information. The study groups all sustainable product impressions for individual consumers into a session. The final sample contains 244,529 product impressions, of which approximately two-thirds are in the treatment condition (63.88% of all observations). Products were grouped into categories based on a well-established retailer's categorization system. The final data covers 15 product categories for fashion and consumer electronics, with a total of 10 fashion product categories. The product portfolio ranges from socks to jeans and headphones to laptops. To compare the effectiveness of both conditions, we measured the following variables: (1) the experimental condition defined as a binary variable (generic vs. detailed sustainability tags), (2) the number of product impressions, reflecting the number of views of a sustainable product as part of Ecosia Shopping following a corresponding user query, (3) the product names and URLs displayed, (4) the number of clicks on a best-in-class product, (5) the sustainability

tag(s) displayed for each of the best-in-class products, (6) the product category, and (7) the product market (Germany, France, or the UK). The data collection took place over four weeks, from March 16 to April 17, 2023. The treatment condition was implemented on the first day of the experiment.

Data Analysis

The consumer response data was statistically analysed to determine which treatment condition is more effective. The primary success metric is the click-through rate (CTR) for products with sustainability tags, calculated as the number of clicks divided by the number of impressions. We checked for statistical power post hoc using g-power and performed z-tests for equality of independent proportions to compare the proportions of clicks for each of the approaches. For data manipulation and statistical analysis, the "Mountain Hydrangea" version of RStudio (release (2023-07-07) for Windows) with the following R packages were used: pwr (version 1.3.0.; Champely et al., 2020); tidyverse (version 2.0.0.; Wickham et al., 2019).

Hypotheses

Based on the results of the qualitative study and previous research, we applied the following hypotheses:

H1a: Products with detailed sustainability tags (e.g., energy efficient) have a higher CTR than those with a generic stand-alone sustainability tag.

H1b: There is a difference in CTR between the generic and the detailed tag variant for both the fashion and electronics product categories.

H2: The higher the number of detailed sustainability tags for each product, the higher the CTR.

H3: There is no significant difference in CTR for the detailed and generic tag approaches in different markets.

RESULTS

Perception of detailed sustainability tags

Our main research question for the qualitative user tests asked how Ecosia users perceive the detailed sustainability tags and their meaning for fashion and electronics products (RQ1). The user tests revealed that shoppers on Ecosia respond positively to detailed sustainability tags and immediately notice them on the product result pages. The participants stated that the detailed sustainability tags provided much more sustainability context for them. For example, participants indicated that they were reminded of how many factors play into the sustainability of products. In addition, participants tended to choose from the sustainable choices section when they found an option they liked in terms of style and price. Interestingly, participants preferred products with more than one detailed sustainability tag and considered these to be more sustainable.

Fashion

Depending on the product category, participants evaluated the detailed tags according to their relevance and familiarity. Users' perceptions of the detailed sustainability tags for **fashion** items

varied across the different sustainability dimensions. However, users generally correctly interpreted the meaning of all fashion tags. For example, "fair labour" was highlighted as a critical and well-known issue in the fashion industry. The tag "fair labour" was generally associated with the fair treatment of workers involved in the item's production. Some users questioned whether it referred specifically to the conditions of the workers responsible for producing the item or whether it encompassed fair labour practices throughout the production chain, including activities such as farming. The tag "energy efficient" was generally understood to refer to efficient energy use during the production process, with some participants extending their interpretation to include the use of renewable energy sources. The tag "reduced waste" was predominantly associated with the efficient use of materials during production, with a focus on minimising waste. However, some users felt this criterion could apply to all products, as manufacturers inherently strive to minimise material waste. The tag "durable" was generally perceived as an indication of the quality and longevity of a product. However, some users questioned its role as a sustainability criterion, arguing that the durability of an item depends heavily on how it is cared for. Finally, the tags "no toxins" and "water efficient" were associated with the absence of toxic chemicals in the product and the efficient use of water during production, respectively, demonstrating a clear understanding of these aspects of environmental sustainability among users. Overall, the findings indicate that the participants seem aware of the problems in the fashion industry.

Consumer electronics

In contrast, the detailed sustainability tags tested for **electronic products** were less well understood. For example, participants were very familiar with the term "energy efficient" and interpreted it correctly regarding reduced energy consumption in the context of electronics. "Energy efficient" was generally recognized as the most relevant and well-known sustainability criterion for electronics, with users being particularly attentive due to the high electricity prices in 2022. In addition, the tag "resilient" was associated with the longevity of products but was seen as potentially problematic for non-native English speakers to understand. Nevertheless, participants emphasised that they consider the resilience of electronic products to be desirable, as they want their devices to last for a long time. Other sustainability criteria, such as "conflict-free" and "fewer toxins", seem to play a minor role for participants and are less likely to influence their choices for electronic products. The tag "fewer toxins" was generally understood to indicate a reduction in the use or release of toxins during production. However, due to the complex nature of electronic products, participants expressed uncertainty in interpreting this tag, which was perceived as a less important criterion in their decision-making. Unlike in the fashion context, the tag "fair labour" was not considered a critical criterion for electronic products, as users did not attach as much importance to working conditions in electronics production. The tag "reduced waste" was interpreted in various ways. Some users understood it to mean the reduction of waste generated during production. Others, however, associated it with using recycled materials or reduced packaging to minimise waste during the production process. The tag "conflict-free" posed another challenge for users. The different interpretations ranged from products produced in regions without conflict to products not affected by political influences or referred to as fair labour practices.

Reliability

Regarding reliability, participants associated the tags with the Ecosia brand and generally trusted their credibility and objectivity. Overall, participants rated the reliability of both fashion and electronic tags as high, scoring 4 out of 5. However, they also wanted evidence along the sustainability tags to ensure the claims were valid.

Click behaviour on Ecosia Shopping

Impact of tag variants on Click-through-Rates (CTR)

To test whether products with detailed sustainability tags have a higher CTR than those with a generic stand-alone sustainability tag (H1a), we calculated the CTR as the proportion of clicks and impressions for each tag variant. Figure 5 demonstrates that products with a detailed sustainability tag had a higher CTR than products with a generic tag. Thus, the results confirm H1a.

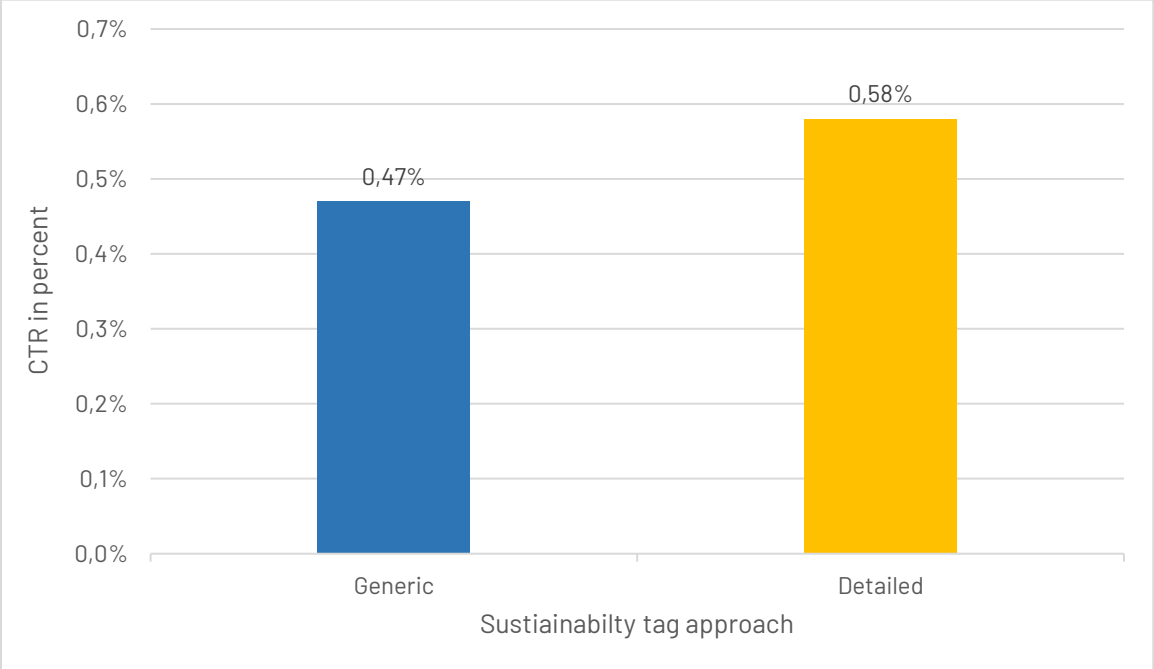

Figure 5: CTR of sustainable products for the control and the treatment conditions.

Table 4 shows the overall clicks and impressions for sustainable products with detailed or generic tag variants. We found a CTR increase for the detailed tag approach by 23.4% compared to the generic approach. To compare the proportions of clicks for each tag type, we performed a 2-sample test for equality of proportions without continuity correction. The test showed a significant difference between the two tag types (X-squared = 11.776, df = 1, p = 0.0003, h = 0.0147). The statistical effect size is very small according to conventional criteria. The results indicate that products with detailed sustainability tags have a significantly higher CTR than those with a generic sustainability tag.

Table 4: Overall clicks and impressions for sustainable products in the two treatment conditions.

Sustainability tag approach	Clicks	Impressions
Detailed	901	156213
Generic	416	88316

Impact of tag variants on CTR for fashion and electronic products

To test whether the CTR is different for the generic and the detailed tag variants for both the fashion and electronics product categories (H1b), we calculated CTR as a proportion of clicks to impressions for each tag approach and product category. The CTR for consumer electronics and fashion products was higher for products with detailed sustainability tags (see Figure 6). Therefore, we can confirm H1b.

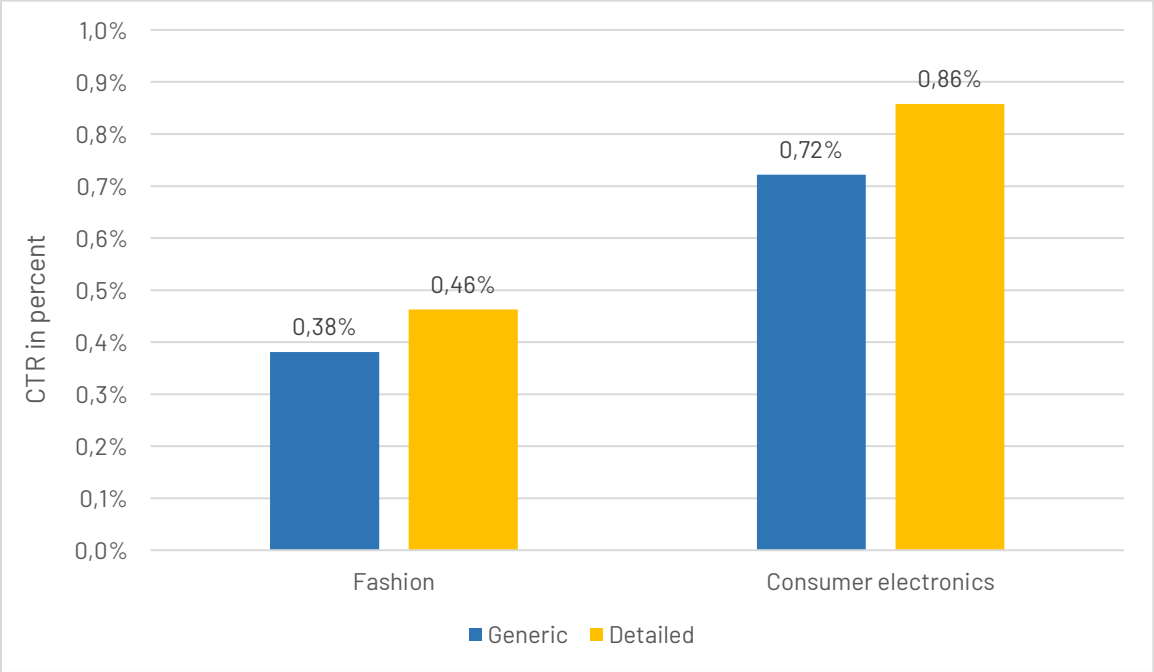

Figure 6: CTR of sustainable products in both treatment conditions for fashion and electronic products.

Table 5 shows the clicks and impressions for products with generic or detailed sustainability tag variants for fashion and electronic products. The CTR increase for fashion products was 21.1%, and 19.4% for consumer electronics. We found a significant difference between the generic and detailed tag approaches for fashion products (X-squared = 6.3114, df = 1, p = 0.012, h = 0.0126) and consumer electronics (X-squared = 3.5143, df = 1, p = 0.030, h = 0.0154). While the statistical effect sizes are small, the CTR increase in both categories is similar and considerable.

Table 5: Clicks and impressions for fashion and consumer electronics in the two treatment groups.

	Generic tag		Detailed tags	
Product category	Clicks	Impressions	Clicks	Impressions
Fashion	248	65052	514	111104
Electronics	168	23264	387	45109

We calculated the CTR for all 16 fashion and electronic product categories to explore these differences further. Table 6 shows the CTR for each product category and tag variant. We find higher CTRs for detailed tags in most fashion categories, except jackets and dresses. Backpacks and sneakers show the largest increase in CTR within the fashion category. We also find consistently higher CTRs for detailed tags in electronic categories, except tablets. The results suggest that the CTR for headphones, laptops and printers benefit most from detailed product tags. For tablets, we see the opposite effect. We found no clicks on sustainable TVs in either category. This could be due to the low number of impressions for these products. It is important to note that these results are exploratory as the low number of clicks makes a (statistical) comparison of proportions difficult. Nevertheless, the results suggest that the contextual tag variant is more effective than the generic variant in both fashion and electronics categories.

Table 6: CTRs for all fashion and consumer electronics product categories in the two treatment groups.

	CTR per product tag approach	
Product category	*Generic tag*	*Detailed tags*
Fashion		
Backpack	0,506%	0,744%
Dress	0,448%	0,364%
Jacket	0,271%	0,239%
Jeans	0,919%	0,410%
Linen	0,716%	1,019%
Shirt	0,137%	0,143%
Sneakers	0,363%	0,446%
Socks	0,449%	0,514%
Sweater	0,413%	0,523%
T-shirt	0,296%	0,311%
Electronics		
Headphones	2,227%	3,003%
Laptop	0,605%	1,033%

Printer	0,549%	1,003%
Smartphone	0,571%	0,605%
Tablet	1,246%	0,694%

Impact of the number of detailed tags per product on CTR

To investigate whether a higher number of detailed sustainability tags for each product increases the CTR (H2), we calculated CTR as a proportion of clicks to impressions for each number of tag combinations for all products. Figure 7 shows the CTR of products with detailed sustainability tags based on the number of tags per product.

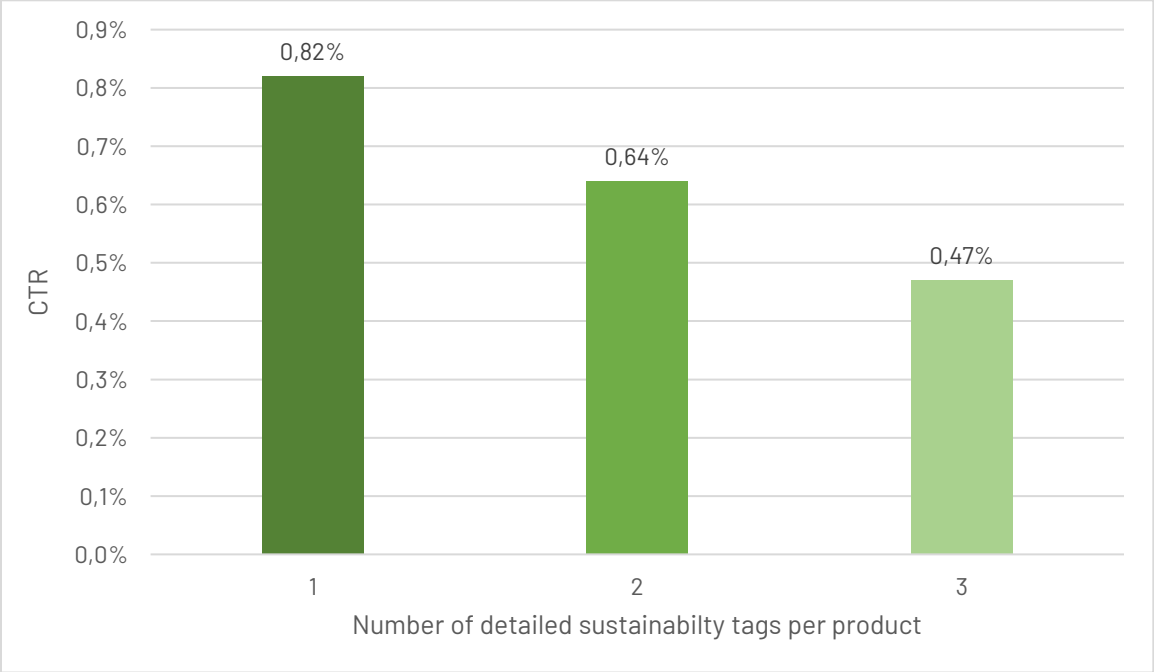

Figure 7: CTR of products in the treatment condition based on the number of detailed sustainability tags per product.

Table 7 shows the clicks and impressions of products in the treatment condition based on the number of detailed sustainability tags per product. Opposingly to our hypothesis, the results show the following pattern: the fewer detailed sustainability tags, the higher the CTR. Using a 2-sample test for equality of proportions without continuity correction, we found that products with more detailed sustainability tags had a significantly lower proportion of clicks than products with fewer detailed sustainability tags ($X\text{-squared} = 60.416$, $df = 2$, $p < 0.001$). The effect sizes for the pairwise comparisons were small to medium in size for the pairwise comparisons (Holm adjusted p-values), including $h = 0.021$ for one vs two tags (0.0082 vs. 0.0064, $p = 0.04$), $h = 0.043$ for one vs. three tags (0.0082 vs. 0.0047, $p < 0.01$), and $h = 0.023$ for two vs three tags (0.0064 vs. 0.0047, $p = 0.015$). Thus, these results disconfirm H2.

Table 7: Clicks and impressions of products in the treatment condition based on the number of detailed sustainability tags per product.

Number of tags per product	Clicks	Impressions
1	326	39895
2	96	14981
3	479	101337

We calculated the CTR for each number of tag combinations for fashion and electronic products to explore the initial hypothesis for different product categories. Table 8 depicts the clicks and impressions for fashion and electronic products based on the number of detailed sustainability tags.

Table 8: Clicks and impressions of products in the treatment condition based on the number of detailed sustainability tags for fashion and electronic products.

	Fashion		Electronics	
Number of tags per product	Clicks	Impressions	Clicks	Impressions
1	12	1754	314	38141
2	23	8013	73	6968
3	479	101337	-	-

Most clicks and impressions for fashion products were recorded for products with a combination of three tags. In contrast, electronic products were mainly shown with only one detailed tag per product and never with more than two. We found a difference in CTR regarding the number of detailed tags per product for the fashion and electronics categories. For example, more detailed tags per product increase the CTR for consumer electronics, while we see no clear pattern for fashion products (see Figure 8).

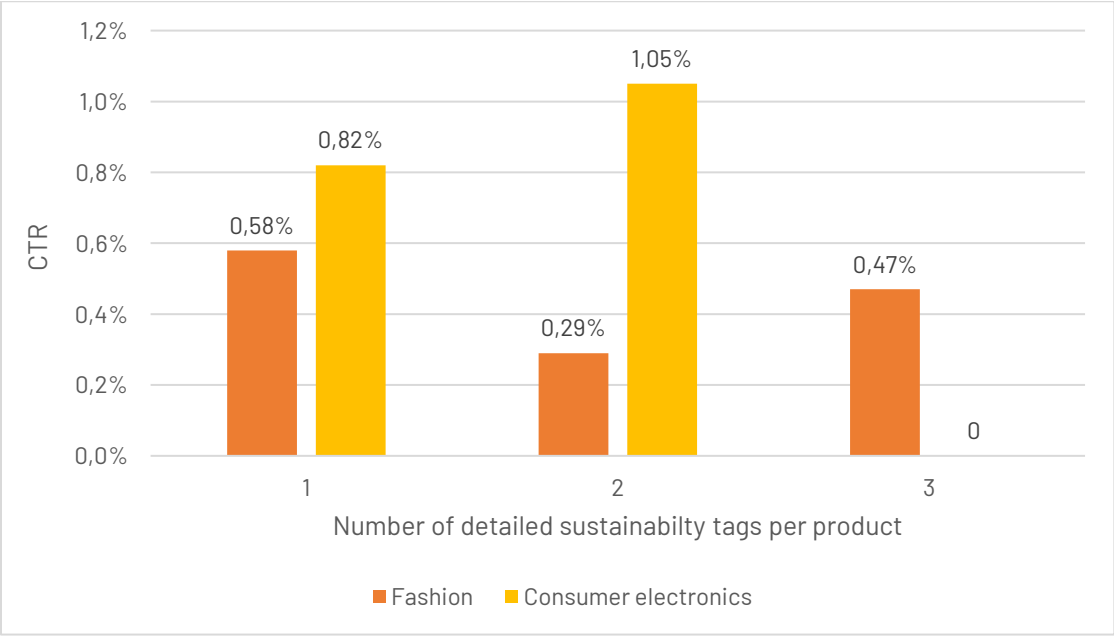

Figure 8: CTR of products in the treatment condition based on the number of tags for fashion and electronic products.

The results suggest that the influence of the number of tags per product on the CTR depends on the product category. Additionally, fashion and electronic products have different tag combinations (see Table 9).

Table 9: CTR of sustainable products with specific detailed tag combinations in the treatment condition.

	CTR	
Detailed tag combinations	*Fashion*	*Electronics*
One tag		
Fair labour	0,684%	2,940%
Durable	-	0,669%
Energy efficient	-	0,187%
Two tags		
Durable + Fair labour	-	1,048%
Fewer toxins + Fair labour	0,373%	-
Fewer toxins + Water efficient	0,115%	-
Reduced waste + Fair labour	0,361%	-
Three tags		
Durable + Energy efficient + Fair labour	0,214%	-
Durable + Fewer toxins + Fair labour	0,505%	-
Durable + Fewer toxins + Water efficient	0,069%	-
Fewer toxins + Water efficient + Fair labour	0,402%	-

It is interesting to note that a single "fair labour" tag has the highest CTR for both electronic and fashion products. The combination of "durable" and "fair labour" tag drives the CTR for electronic products. The combination of "durable", "fair labour", and "fewer toxins" tags led to a higher CTR for the detailed tag for fashion products. It was the most displayed tag combination within this product category.

Impact of tag variants on CTRs in different markets

To test whether there is no difference in CTR for the detailed and generic tag approaches in different markets (H3), we calculated the CTR as a proportion of clicks to impressions for each tag type and market (see Figure 9).

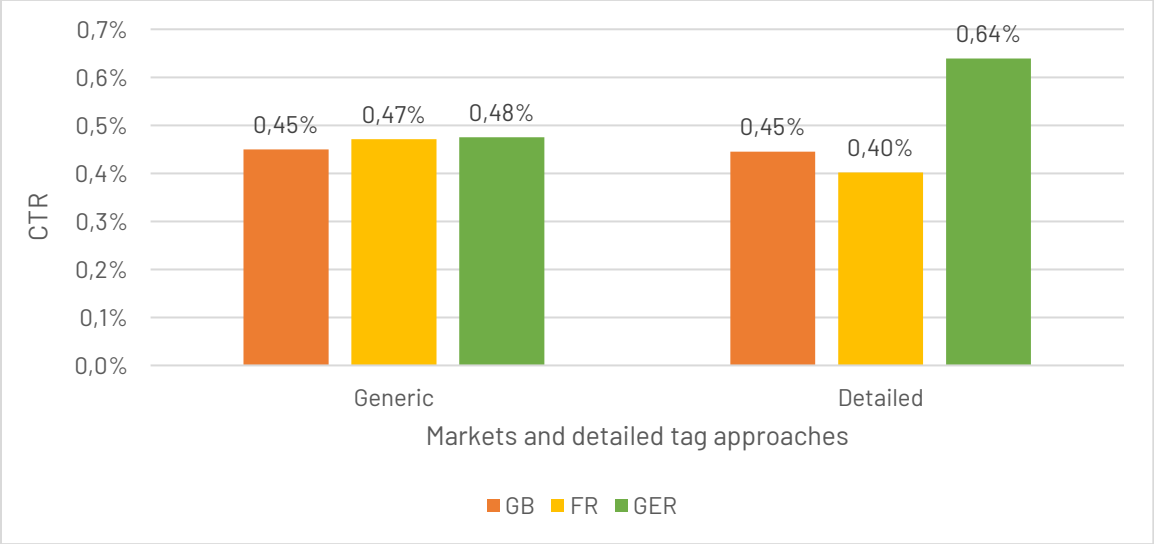

Figure 9: CTR for sustainable products in both treatment groups based on the market.

The results indicate that the detailed tag approach affects user behaviour differently depending on the market. For example, detailed sustainability tags show a significant effect in the German market ($X\text{-squared} = 19.225$, $df = 1$, $p < 0.01$, $h = 0.022$), increasing the CTR for sustainable products by 34.7% when compared to products with a generic stand-alone tag in the same market. In contrast, we found no differences in CTR for products with detailed sustainability tags in the UK and French markets. Additionally, we do not find differences in the CTR for the generic approach in the German, French and UK markets. It is important to note that the low number of clicks on this exploratory level of analysis makes the comparison of the CTR proportions (statistically) difficult.

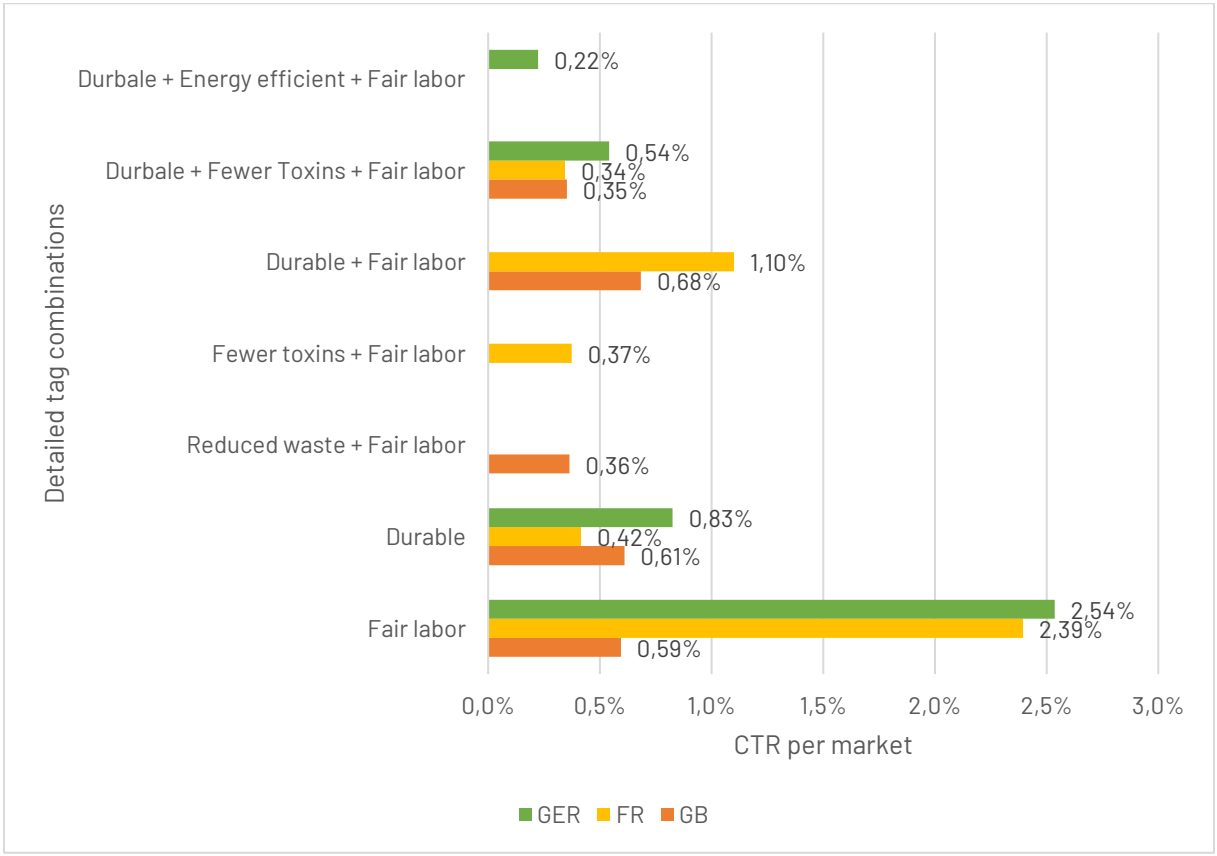

Figure 10: CTR for sustainable products with detailed sustainability tag combinations per market. Note: Results with less than five clicks were filtered out.

Additionally, we observe a significant heterogeneity in CTRs between the different detailed tags and tag combinations across the different markets (see Figure 10). These exploratory results suggest that the 'fair labour' tag seems to be particularly helpful in consumers' decision to buy sustainable products in France and Germany for electronic products. The positive effect is much smaller in the UK. A single 'durable' tag significantly increases the CTR in the UK and the German market for electronics. However, there is no effect on the French market. In the same way, a combination of "durable" and "fair labour" tags increases the CTR for consumer electronics in the UK and German markets. For fashion products, a positive impact of the combination of the "durable", "fair labour", and "fewer toxins" tags is only visible in the German market. Again, the differences are difficult to interpret due to the low number of clicks at this exploratory level in each market.

DISCUSSION AND CONCLUSION

Our study aimed to investigate the perception and effectiveness of different sustainability labels to communicate the sustainability performance of products: a generic, stand-alone sustainability tag or a set of detailed sustainability tags. Using a sequential exploratory mixed-methods research design, our main goal was to explore their impact on consumers' product choices when shopping for electronics and fashion products via the online search engine Ecosia. The findings of the first qualitative phase of the study showed that detailed sustainability tags are perceived positively by Ecosia users. The positive evaluation results from users' better

understanding of the individual sustainability dimensions of products. We found some differences in the evaluation of specific sustainability tags. Participants were particularly aware of the sustainability issues in the fashion industry and, therefore, appreciated the sustainability information provided by the sustainability tags on Ecosia Shopping. In contrast, the detailed sustainability tags tested for electronic products were less well understood.

In general, users trusted the reliability of the detailed sustainability tags in both product categories, as they trusted the Ecosia brand to be objective. However, users preferred to see some proof and background information to make sure the claims were valid. Overall, the qualitative study showed that displaying detailed sustainability tags gives users more context and could encourage them to click on these products more often.

The data from the field experiment confirmed these findings. Actual shopping behaviour indicates that displaying detailed sustainability tags instead of a generic sustainability tag significantly increases the CTR for sustainable products (H1a). Furthermore, the significant increase in CTR is effective for both fashion and electronics product categories (H1b), with the CTR for consumer electronics being almost twice as high as in the fashion category. Overall, we can conclude that sustainable product listings on Ecosia Shopping with detailed sustainability tags are more likely to attract users' attention and interest than sustainable products with a generic sustainability tag. In line with the importance that users placed on fair working conditions in the qualitative study, consumers were more inclined to click on fashion products with tag combinations indicating fair labour conditions. Interestingly, users in the qualitative study did not consider “fair labour” a critical criterion for electronic products. However, consumers were likelier to click on consumer electronics with tags highlighting fair labour conditions in the field experiment. Additionally, a combination of product lifetime information and a tag indicating fair labour conditions increased the CTR for these products. While energy efficiency was generally recognized as the most relevant and well-known sustainability criterion for electronics in the qualitative part of the study, an “energy efficiency” tag showed the lowest CTR for consumer electronics in the treatment condition of the field experiment. While we have ensured that the tag “energy efficient” is only displayed on products that achieve the highest energy efficiency classes “A” or “B” of the EU energy efficiency label, we have no data on how consumers interpret these labels together or whether the short tag adds value for them. As some of these results are exploratory and based on a small number of clicks, they suggest careful implementation of these tags.

In the qualitative phase of the study, users indicated that they would be more inclined to click on products with more than one detailed sustainability tag per product, as these products appeared more sustainable to them. However, the field experiment only partially confirmed the hypothesis that a higher number of detailed sustainability tags per product would increase the CTR for these products (H2). Instead, our results suggest that the impact of the number of tags per product on CTR depends on the product category. For example, more detailed tags per product increase the CTR for consumer electronics, while we do not see a clear pattern for fashion products. Finally, the results of the field study only partially confirm that both approaches for sustainability tags have a similar effect on CTR in all markets (H3). While the CTR for products with stand-alone, generic sustainability tags was very similar in Germany, France and the UK, suggesting no difference in impact in these markets, the impact of the detailed sustainability tags has a different effect depending on the market, especially in Germany. While we found no significant difference in CTR for the detailed tag approach compared to the control group for the French and

UK markets, these tags significantly increased the CTR for product listings in the German market. The results, therefore, suggest that the positive effect of the detailed sustainability tag approach on product selection is limited to the German market.

The insights presented make several contributions to the literature and practice of sustainability labelling and marketing. First, our mixed-methods study extends previous work by examining the perception and effectiveness of detailed sustainability tags displayed on search engines. Second, it suggests that online retailers can benefit from prominently displaying sustainability tags on their product listings. The study provides empirical evidence from actual shopping behaviour for the effectiveness of sustainability tags in bridging the gap between intention and sustainable consumption behaviour. The results show that using detailed sustainability tags instead of a generic, standalone tag has a significant impact, increasing consumer click-through rates on these products by more than 23%. When shopping online and using search engines to obtain product information, consumers constantly switch between exploring and evaluating product options (Rennie et al., 2020). Our research shows that the design of online shopping systems should visually appeal to consumers interested in sustainable consumption. The presence of detailed and easy-to-understand sustainability information in moments of deliberation is a powerful tool to encourage consumers to make more sustainable product choices in online marketplaces. These findings resonate with claims that consumers need significant support to make more climate-friendly choices (Torma & Thøgersen, 2021). The results, therefore, suggest implementing a detailed sustainability tag approach based on credible sustainability information using publicly available datasets such as the GreenDB, particularly on Ecosia Shopping for fashion and electronics products. Third, it is important to provide additional information about the credibility of the sustainability claims presented so that consumers can trust these tags and reassure themselves that the claims are valid. Fourth, the research design could inspire e-commerce managers to use A/B testing tools to investigate whether using the GreenDB data set to implement credible sustainability product tags on their shopping website directly translates into a corresponding increase in the retailer's sales of sustainable products. Finally, the results are also of interest to public policy makers. Financial support for the development of credible product databases and the expansion of publicly available information on the sustainability of sustainable products would benefit both marketers who want to sell more sustainable products and consumers who want to make informed choices about sustainable products. At the same time, it could increase the trustworthiness of sustainability communication if marketers are discouraged from making misleading claims about the sustainability of their products and instead ensure that their claims are reliable.

This study has several limitations that should be considered in future research. Some of our quantitative results are exploratory, as the small number of clicks makes it statistically difficult to compare proportions. This applies, for example, to the variance between the categories and the different tag combinations, suggesting that careful consideration is needed when supporting the user with visual tags. Furthermore, due to practical shortcomings of the feature management tool used to conduct the A/B test on Ecosia Shopping, we were not able to control for an even distribution of users in the experimental conditions during the observation period. Another limitation of the study could be due to the methodological approach of the field experiment. We did not investigate the psychological mechanisms underlying the observed click behaviour of consumers. Furthermore, we were unable to obtain data on the likelihood of purchasing the products, as consumers are redirected to the retailer's website as soon as they click on a product

offer on Ecosia Shopping. Therefore, it is recommended that field experiments be combined with survey data and actual purchase decisions in future research. Future research could also investigate the effect of other product attributes, such as price. Additionally, studies should investigate how much and what kind of additional information consumers prefer to trust the credibility of the sustainability tags. Finally, the findings could be validated for different product categories other than fashion and consumer electronics.

Declaration of Generative AI and AI-assisted technologies in the writing process.

During the preparation of this work the authors used *Grammarly* in order to improve readability and language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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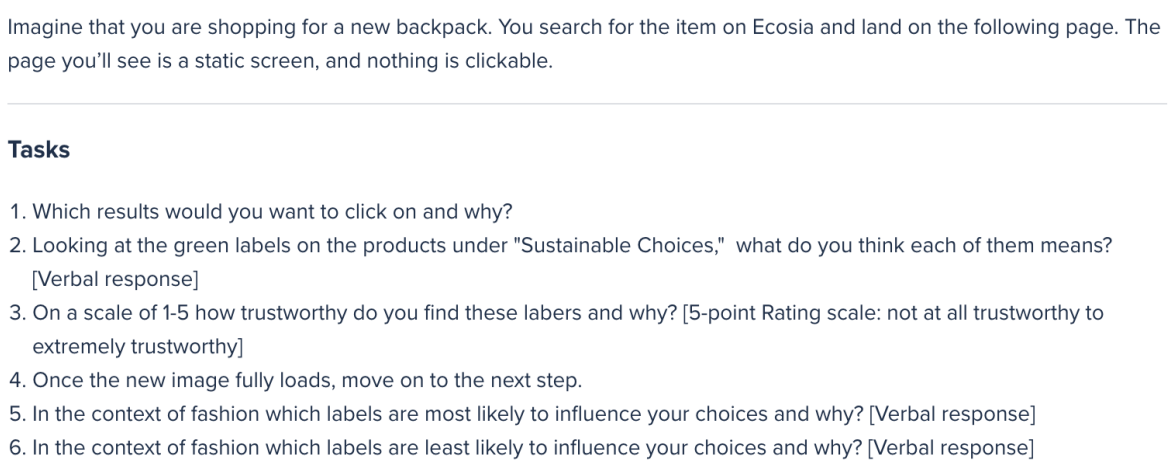
APPENDIX A

Screenshot of the introductory text for the user tests.



Imagine that you are shopping for a new backpack. You search for the item on Ecosia and land on the following page. The page you'll see is a static screen, and nothing is clickable.

Tasks

1. Which results would you want to click on and why?
2. Looking at the green labels on the products under "Sustainable Choices," what do you think each of them means? [Verbal response]
3. On a scale of 1-5 how trustworthy do you find these labers and why? [5-point Rating scale: not at all trustworthy to extremely trustworthy]
4. Once the new image fully loads, move on to the next step.
5. In the context of fashion which labels are most likely to influence your choices and why? [Verbal response]
6. In the context of fashion which labels are least likely to influence your choices and why? [Verbal response]

APPENDIX B

Scoring logic and thresholds for detailed sustainability tags

In determining the detailed sustainability tags shown on a product we used the following logic for the product data in the GreenDB:

1) Only consider the subset of sustainability subdimensions for which we have sustainability tags as shown in the following tables.

2) Only consider subdimension scores that meet and/or exceed the minimum threshold defined for each subdimension in the tables i and ii.

    a) If products have multiple sustainability tags, only consider the maximum score in each sustainability dimension. The results is one score per sustainability dimension (between 0 and 100).

3) Show up to 3 detailed sustainability tags based on the following logic

    a) Two detailed tags from ecological sustainability dimensions: Out of the remaining sustainability dimensions after steps 1 and 2 show the two corresponding sustainability tags with the highest rank in the display priority column in the tables i and ii.

    b) One detailed tag from a social sustainability dimension: Show a social sustainability tag if it meets and/or exceeds the minimum threshold.

    c) If no social tag is available then add a third tag from next highest scoring ecological sustainability dimension in the same fashion as in a)

4) If no sustainability tag is chosen after this approach: Show the sustainability tag for the maximum subdimension score even if it does not exceed the minimum threshold defined in step 2.

i) Subdimensions, sustainability tags, and thresholds for consumer electronics

Subdimension	Tag	Min. Score	Display Priority
eco:lifetime	Durable	75	1
eco:energy	Energy efficient	80	2
social:labour_rights	Fair labor	70	3

ii) Subdimensions, sustainability tags, and thresholds for fashion products

Subdimension	Tag	Min. Score	Display Priority
eco:quality	Durable	100	1
eco:chemicals	Fewer toxins	80	2
eco:energy	Energy efficient	80	3
eco:waste_air	Reduced waste	70	4
eco:water	Water efficient	80	5
social:labour_rights	Fair labor	70	6

APPENDIX C

Translations used in the tested markets

1) Consumer electronics

English	German	French
Energy efficient	Energieeffizient	Efficace en énergie
Durable	Langlebig	Durable
Fair labor	Fair hergestellt	Travail équitable

2) Fashion products

English	German	French
Fewer toxins	Schadstoffarm	Moins de polluants
Energy efficient	Energieeffizient	Efficace en énergie
Reduced waste	Weniger Abfall	Moins de déchets
Water efficient	Wassersparend	Économe en eau
Durable	Langlebig	Durable
Fair labor	Fair hergestellt	Travail équitable