

**Website Navigation Structures: Eliciting Mental Models Using Card-sorting**

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### **Abstract**

This study focuses on eliciting the mental model of individuals using food-brand websites and applying the findings to the domain of sustainable e-commerce websites. By understanding users' mental models and studying the applicability of the model, design recommendations are made for sustainable e-commerce websites to enhance user experience. To elicit the user's mental model a card-sorting study was performed. Subsequently, a comparative analysis was conducted between sustainable e-commerce websites and the identified mental model to evaluate its applicability to other sustainable e-commerce websites. Based on the findings, recommendations are made to improve the navigation structures for sustainable e-commerce websites to provide a better user experience. The findings of this study contribute to the rapidly expanding field of e-commerce and sustainability. The recommendations provide valuable guidance for designers and developers of sustainable e-commerce websites, enabling them to organize and present information in a way that aligns with users' mental models.

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## Introduction

In recent years, e-commerce websites have appeared as crucial platforms for delivering information about sustainable products and values, thereby playing an important role in educating and engaging consumers and driving the widespread adoption of sustainable practices (Tsai & Men, 2013). There is a growing interest of consumers in the social and environmental impact of the products they buy (Borin et al., 2011). Therefore, with the increasing use on the internet and rely on websites as the primary source of information, it is evident that consumers turn to these platforms when seeking information about the sustainability of the products they buy (Case & Given, 2016). For example, if someone is interested in determining whether a company's product aligns with their sustainability goals, they may visit a website specifically for that purpose, to gather information and evaluate the product's environmental impact.

Regardless of the type of product, consumers have certain expectations when they visit websites, especially when it comes to sustainable options (Kemp & Bui, 2011). The way information is presented plays a role in enabling users to navigate the website effectively and acquire information intuitively, leading to a positive user experience (Schall, 2014). A positive user experience can enhance brand reputation, while also increasing consumer satisfaction and loyalty (Schall, 2014; Verhagen, 2015). To make an intuitive and user-friendly website, designers need to think about user's thought processes, and information-seeking expectations (Schmettow & Sommer, 2016). The organization and labeling of content on a website help users find the information they need (Schmettow & Sommer, 2016). While the number of the e-commerce websites with sustainability information increase (Oláh et al., 2018), there is a lack of knowledge about how their websites should be organized. Therefore, this study aims to propose a navigation structure for sustainable e-commerce websites, with the intention of optimizing user experience.

## **Sustainable E-commerce Websites**

Sustainable e-commerce websites are online platforms that prioritize and promote sustainable practices and environmentally friendly products (Oláh et al., 2018).

Sustainability, in this context, refers to the consideration of social, economic, and environmental factors in the production, distribution, and consumption of goods and services (Oláh et al., 2018). The websites provide users with sustainability information, enabling users to make informed decisions that align with their values. With the growing interest in understanding the environmental impact of consumer behaviour, sustainability-related information, and healthier food choices, there has been a rise in the popularity of food brand websites (Borin et al., 2011; Kim et al., 2013; Tsang et al., 2020). In response to this, sustainable food brand websites are experiencing rapid growth, as people also have a growing interest in healthier food choices (Kim et al., 2013; Tsang et al., 2020). Therefore, food brand websites are at the forefront of the sustainable e-commerce domain, catering to the increase in demand for sustainable options (Oláh et al., 2018).

## **Mental Models**

Mental models are someone's individual internally constructed representation of an external reality, a thought process (Otter & Johnson, 2000). A mental model is shaped by past experiences and influences how individuals interpret new information (Otter & Johnson, 2000). Thus, mental models emerge from experiences and are fundamental for adaptation. In the context of websites, users bring their own mental models, which subconsciously guide their expectations of how the website should function and how information should be presented. Consequently, when users visit a website, their mental models influence their assumptions about button placement and the location of specific information (Otter & Johnson, 2000). For instance, when visiting a food brand website, users may expect to find nutritional information, ingredient details, and product origins, reflecting their specific mental model for such websites (Borin et al., 2011). Furthermore, factors like sustainability and social responsibility are increasingly important and sought after by users on these websites (Borin et al., 2011).

Thus, the organization and arrangement of menus, links, and other elements on a website (i.e., the website navigation structure), are essential for effective information organization (Morville & Rosenfeld, 2006). How users navigate the website to explore and interact, including actions, such as scanning content and clicking on menu items, is essential to access sustainability information and enable them to make informed decisions.

However, designing navigation structures that meet expectations of all users, is challenging, as every single user has a unique mental model. Designers often overlook users' individual mental models and rely on an average model (Nielsen & Pernice 2010; Stibel, 2005). However, aligning the website's navigation with the individual user's mental model, on the other hand, is critical for a positive user experience (Otter & Johnson, 2000). If a website's navigation does not match the user's mental model, it leads to negative effects on the user experience, including confusion, frustration, and lower satisfaction (Stibel, 2005). Furthermore, studies have shown that products with easily accessible environmental information tend to be more appealing to consumers and are more likely to be purchased compared to when this information is not easily accessible (Peattie & Peattie, 2009). Therefore, sustainable e-commerce brands have a need to create easily accessible websites that consider users' mental models when designing website navigation, ensuring it matches expectations and is intuitive for a better user experience.

### **Card-sorting**

Card-sorting is a method used to elicit users' mental models for website navigation (Schmettow & Sommer, 2016). Participants categorize information into categories based on their logic, revealing how they mentally organize information (Schmettow & Sommer, 2016). There are two types of card-sorting: open and closed. In open card-sorting, participants sort the cards into categories they create themselves. Whereas, in closed card-sorting, participants sort the cards into pre-defined categories.

In this study, in which the aim is to propose a navigation structure open-card storing is used. Hence, when referring to card sorting, open card sorting is meant. Card-sorting can be conducted by using physical or digital materials (Carroll & Olson, 1988). The resulting

groupings derived from the card-sorting experiment can be used to gain an understanding of how users mentally organize information. This knowledge enables them to align the website's navigation structure with the users' mental models.

### **Usability**

Once a mental model has been proven as the basis for a website's navigation structure, it is important to ensure usability, to guarantee that users can easily navigate and find information on the website (Stinson et al., 2010). Usability is defined as the effectiveness, efficiency, and satisfaction with which specific users can achieve goals in specific environments (ISO, 1998). Usability plays a crucial role in website design, where effectiveness measures the achievement of goals and efficiency evaluates the level of effort required (Bevan et al., 2015).

Usability considerations are particularly important in e-commerce websites, as they directly impact the connection with consumers (Bevan et al., 2015; Sivaji et al., 2016). Although there has been relatively less research on usability in sustainable e-commerce, it is essential to prioritize usability to enhance user experiences. By integrating mental models with usability considerations, designers gain a deeper understanding of how users think and interact with the product (Carroll & Olson, 1988).

The study conducted by Schmettow and Sommer (2016), emphasizes the importance of considering usability when designing a navigation structure. By evaluating user perceptions and interactions, designers can optimize the website to better match with users' mental models, ultimately improving the overall user experience. This connection between mental models and usability highlights the significance of integrating both aspects in website design and ensuring that users can effortlessly navigate and engage with sustainable e-commerce platforms.

### **Research Goal and Outline**

The aim of this study is to propose a navigation structure for sustainable e-commerce websites with the aim of enhancing user experience. To make a design recommendation



several steps were taken in this study. First, the mental model of food brand websites was elicited using a card-sorting experiment. Second, the study focused on investigating usability and applicability, by examining how the found navigation structure aligned with other sustainable e-commerce websites. Finally, based on the findings, design recommendations for sustainable e-commerce websites can be made to perfect the navigation structure of food brand websites, aiming to enhance the user experience.

## **Methods**

### **Participants**

In this study, participants were recruited through convenience sampling and the SONA credit system, a tool for psychology test subjects of the Faculty of Behavioural, Management, and Social Sciences (BMS), University of Twente. Participants recruited through SONA received credits for completing the experiment. The participants needed to have an internet connection and had to be over 16 years. The research was approved by the BMS ethical committee / Domain Humanities & Social Sciences of the University of Twente. All participants gave written informed consent prior to participation.

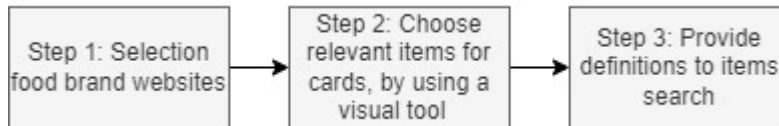
A total of 42 participants took part in the experiment (9 were recruited through convenience sampling and 33 through the SONA credit system). In total, three participants were excluded from the data since they did not complete the card-sorting experiment. Hence, there were 39 valid participants ( $M_{age} = 21.9$  years, Age range 17-56 year, 61.5% female, 38.5% men). The nationality of the participants was 46.1% Dutch, 35.9 % German, and 18% from other countries. Among the participants, 4.7% had English as their native language, while 95.3% reported another native language.

### **Selecting Items for Card-sorting**

To create items for the card-sorting task, three steps were taken, see Figure 1.

## Figure 1

*Process for selecting items for card sorting experiment*



First, a selection of food brand websites was made on which the set of cards should be based. The websites for the study were found using specific keywords on Google, such as "Sustainable," "Planet," "Food," "Food brand," "Europe," and "Netherlands." Additionally, an investigation was conducted on supermarket websites to identify popular and sustainable brands. These two approaches resulted in a list of 21 sustainable food brands. The selection included both large and smaller food brands, offering a variety of products such as meat substitutes, chocolate, ice cream, and granola. All websites were accessible in English.

To have a diverse item pool, an initial analysis of the 21 websites was done. The selection process aimed to include websites with varied navigation structures, next to similar websites. For instance, Ben & Jerry's has a navigation bar that contains main categories (i.e., 'Favors', 'Shops&Catering', 'Values', 'About us', 'What's new' and 'Find us'). The home page of Holie contained fewer, but more broad categories (i.e., "Home", "Our story", "Planet", and "Where to buy"). These websites were chosen because they differ in aspects like the main heading for sustainability. In total of 15 websites were selected to enable a comprehensive assessment and a sufficient number of items. Further details about the chosen websites can be found in Appendix A.

The second step involved choosing the relevant items for the cards. To ease this process, a visual tool called a MIRO board was used (*Miro | Online Whiteboard for Visual Collaboration*, n.d.). This board enabled to visually see the organization of websites and compare them. This simplified the process of comparing and identifying relevant website items. Each website was thoroughly scanned to identify the most pertinent menu items, headings,

and broad categories displayed on their home pages. Additionally, any available sitemaps provided on the websites were also looked at, to get a better understanding of the website's structure. A site map is a visual or textual representation of the organization and structure of a website (Maareck et al., 1997). In the absence of a sitemap, the MIRO board was vital for understanding and visualizing the website structures (Appendix B). The main items displayed on the menu and their associated subheadings were documented. Subheadings are the pages on a website that are linked to the main headings on the home page (Maareck et al., 1997). For example, if the home page of a food brand had a heading for "Our Products", the corresponding subheading pages would include categories related to products, such as "Ice cream bites" and "Ice cream flavors". Then, the website pages of the subheadings are scanned through to get an overview of the information present. This process allowed for a comprehensive understanding of the website's navigation structure. By scanning the website pages and assessing the frequency of items, a list of 42 relevant cards was created (Appendix C). Items were considered relevant if they appeared on multiple websites or addressed unique topics, for example, the items "Allergies" and "How to". To accommodate participants' motivation and avoid fatigue, prior studies recommend using 30-60 cards for card-sorting activities (Optimal Workshop, 2022). However, alternative research suggests including 40-80 cards to cover the main content of a website (Sherwin, 2018). Considering this, a collection of 42 cards were produced to ensure the resulting set of cards. These cards underwent multiple revisions and adjustments. For example, "Emissions" was updated, and it was decided to split this item into two categories: "Carbon footprint" and "Water footprint". This decision was made because different websites included both water and carbon footprint in their emissions data, or sometimes only one of the two. Splitting the emissions into these categories provides a clearer and more specific understanding of the item.

Lastly, in the third step, the set of cards for the card-sorting experiment was finalized by providing clear definitions for each item. To ensure that participants had a common

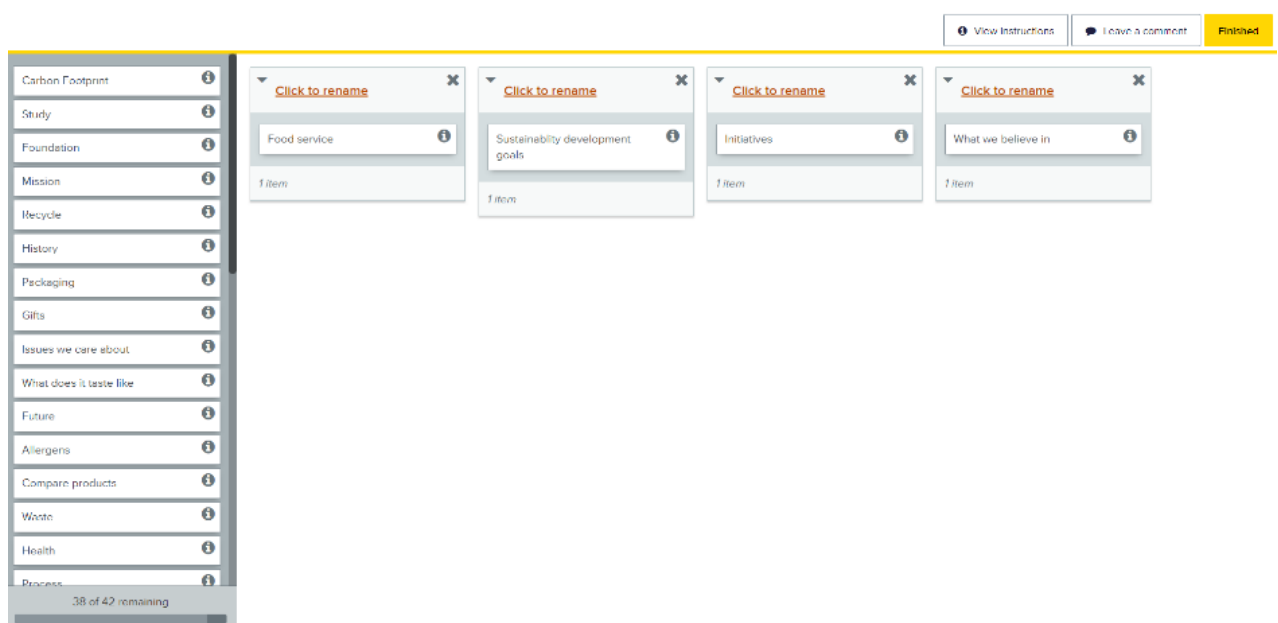
understanding of each item, a definition was written down for each card. The definitions were created by reviewing search results of that item on Google. The most pertinent information from various sources was synthesized to develop concise and accurate definitions specific to each item. The final set of cards included 42 items, each accompanied by a title and definition (Appendix C).

## Materials

The primary material used in this research was a digital card-sorting interface created using the “Optimal Sort” program from Optimal Workshop (Optimal Workshop, 2022). Figure 2 shows the card-sorting tool interface when some categories are created. The interface is blank when there are not existing categories. On the left a column is displayed where all the items are presented in a randomized order. The interface allows participants to drag and drop items into groups. Participants select a card by clicking on it, then move the cursor to the desired location while holding onto the card. Releasing the mouse button drops the card in the desired spot. Participants can create new groups, merge groups, and rename them as needed.

## Figure 2

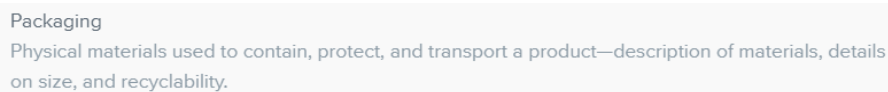
Card-sorting tool interface when categories are created



Each item is presented as a card, which includes a label that shows the definition of the item. The definition can be accessed by clicking on an information icon located on the right of the card. What the card looked like when the definition was visible can be seen in Figure 3.

### Figure 3

#### *Example card and definition*

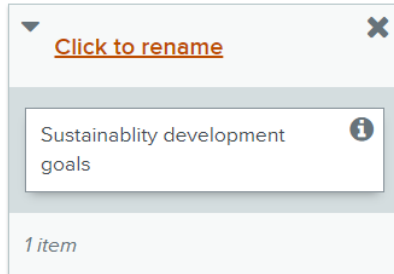


Packaging  
Physical materials used to contain, protect, and transport a product—description of materials, details on size, and recyclability.

The card sort experiment instructions consisted of four steps (Appendix D). The first two steps displayed initially, and the remaining steps appearing after the first two were completed. Participants could review the instructions by clicking on the instruction button. The first step was that participants were presented with a list of 42 cards, representing items found on food brand websites, along with descriptions. They were then asked to group these cards in a manner they deemed appropriate for food brand websites. In the second step, participants could drag an item from the left to create their first group and provide a name and description for it (Figure 4). They had the option to add more items to a group by dropping them on top or create additional groups in unused spaces. If a card did not fit into any group, participants could either create an "others" category or assign it to a suitable group. The instructions were accessible through an instruction button, allowing participants to review them as needed. Upon completing the experiment, participants were directed to a thank-you page that confirmed their completion of the task. The page also expressed gratitude to participants and provided them with contact information for the researcher in case they had any questions or concerns.

## Figure 4

### *Rename category interface*



## Design

This study employed a within-subjects design, all participants performed the same task. The participants recruited through the SONA credit system performed the task in an unmoderated setting, whereas the participants who were personally invited by the researcher were in a moderated setting. The inclusion of a moderated setting allowed for deeper insights into participants' thinking (Bussolon, et al., 2006).

### ***Unmoderated Setting***

In the unmoderated setting, participants completed the experiment remotely using the card-sorting tool on their own devices. This allowed for a larger sample, as participants could participate from anywhere with internet access. By doing so, the data collected could be more representative and accurate. During the experiment, participants were instructed to complete the task independently, without any input or guidance from the researcher.

### ***Moderated Setting***

In the moderated setting, the researcher conducted a digital card-sorting experiment with the participants in an experiment room. The experiment room was specifically designed to provide an environment that minimizes distractions. During the experiment, participants were instructed to express their thoughts aloud while performing the task to articulate their thought processes and decision-making strategies. This methodology was adopted to obtain a deeper understanding of the participants' thought processes. Furthermore, the researcher

used clarifying questions and probes to better comprehend the participant's reasoning and ensure that they were correctly comprehending the task at hand.

## **Procedure**

### ***Unmoderated Setting***

In the unmoderated setting, participants started the study through a link that was shared by the researcher or the SONA system. The study took place on the participant's device. First, a welcome page was seen (Appendix D). Here the study was introduced, and contact information of the researcher was given. Second, eight questions were asked. Five informed consent questions were asked followed by three questions about the demographic information of the participant. Third, the card-sorting experiment started. During the card-sorting experiment, participants were presented with an interface that displayed instructions in two steps. First, they were provided with an overview of the 42 cards and their descriptions and were instructed to create categories based on their understanding of the content. This step served as an initial organization of the items. In the second step, participants dragged items from the list on the left and dropped them into designated areas on the right side of the interface to create categories. The participants were instructed to continue this process until they had created all the desired categories. Once the participants finished the first two steps, instructions for steps three and four were given. The third step involved grouping the cards into categories based on their similarities, while the fourth step required labelling each category with a descriptive name. Then the participant could continue to do the full experiment. At the end of the study, a thank you page was shown.

### ***Moderated Setting***

The study was conducted in a distraction-free experiment room, to allow participants to focus solely on the task at hand. Prior to beginning the experiment, the researcher provided the participants with an explanation of the study's purpose and detailed instructions on how to perform the task using the thinking-aloud method. Participants were instructed to

vocalize their thoughts while sorting the cards, expressing their ideas, confusions, and insights.

The card-sorting activity was presented on a laptop screen, and participants were instructed to group the cards into categories and label the categories with descriptive names. The participants read the instructions out loud. Throughout the activity, the researcher closely monitored the participants' behaviour and asked probing questions to clarify their thought processes. Open-ended questions, such as "Why did you choose to put those cards together?" and "What was your reasoning for creating that category?", were used to elicit more information from participants. Furthermore, if the participant expressed confusion, the researcher would ask them to elaborate on their thought. After completing the sorting activity, the researcher asked the participants to explain their final division of cards, inquiring about their understanding of the task, the goals, and the cards.

### **Data Analysis**

The data analysis process involved several steps to examine the results of the card sorting experiment. First, the dataset was reviewed to ensure that all participants had completed the card sorting task, resulting in 39 participants after three incomplete responses were excluded. The data analysis was done, using the Optimal Sort result section and RStudio. In RStudio, the demographic information was analysed, age, gender, and nationality. Optimal Sort generated summaries of participant categories, labels, and category frequencies. It also created tree maps, similarity matrices. These visualizations were employed to gain a brief insight and enhance the understanding of the outcomes of the experiment.

A similarity matrix was used to determine the percentage of times each item was placed in the same group as other items (Wood & Wood, 2008). The higher percentages in the matrix indicated stronger semantic proximity, which is represented by darker colours in the results (Schmettow & Sommer, 2016). This provided an indication of the level of



semantic similarity between the individual items, revealing the extent of their mutual semantic proximity (Schmettow & Sommer, 2016).

The mental model was developed by examining the formed similarity matrix and identifying clusters. Therefore, a cluster analysis was conducted to identify patterns and clusters of related items. Clusters represent groups of items expected to be found in the same location on a website. The identification of clusters was done looking at the visual proximity and colors of the cell. Darker cells and higher similarity scores indicate that these items were frequently grouped together.

Ambiguities were also judged manually by the researcher. Ambiguities are items or groups of items that stand out in the similarity matrix, indicating higher similarity scores compared to other items. These ambiguous items can create uncertainty about where they should be categorized. Participants place items in categories that only partially fit or create categories that are not entirely suitable. The interpretation of ambiguous items can be challenging and complicate the analysis of the sorting data. By identifying ambiguities, researchers can identify areas of confusion or overlap in how participants categorize certain cards. Ambiguities can be further analysed by examining card proximity, the frequency of their co-occurrence with other cards, and participants' thinking-aloud protocols. Identifying ambiguities is crucial as it reveals potential issues with the categorization scheme. This study included any scores of 30% or higher in the ambiguity group to ensure accuracy and avoid potential errors associated with relying solely on visual assessment (Stroes, 2018).

Lastly, the researcher examined participants' category labels to identify common patterns. Since the similarity matrix did not include information on category labelling the examination of labels was important. While the labels were not always identical, there were notable similarities observed, such as "About the company" and "Corporate values". To gain a more comprehensive understanding of the data, this analysis was repeated for all categories. Labels that were phrased similarly were merged under a single label that captured the essence of all the similar labels.

## Results

In order to identify the mental model of food brand websites, similarity matrixes were used (Figure 5 & Appendix E). According to Tullis and Wood (2004), a minimum of 20-30 participants is required to obtain reliable and meaningful results in card sorting studies. Supporting this notion, Paul (2008) asserts that even with a smaller number of participants, card sorting studies can still yield accurate outcomes. Since 30 participants took part in the unmoderated setting the findings of these setting will be used to create the similarity matrix. Nonetheless, it is important to note that the moderated setting did provide additional insights, particularly in identifying ambiguous items. As such, these insights were also considered when analysing the results. Appendix E shows more details of the moderated setting specifically.

The similarity matrix revealed the formation of five main clusters (Figure 5 & Appendix E). A summary of the identified clusters is presented in Table 1. In figure 5, the similarity matrix is presented. The similarity matrix provides the insights formed clusters and ambiguities. Each cell in the matrix represents the degree of similarity or correlation between two items.

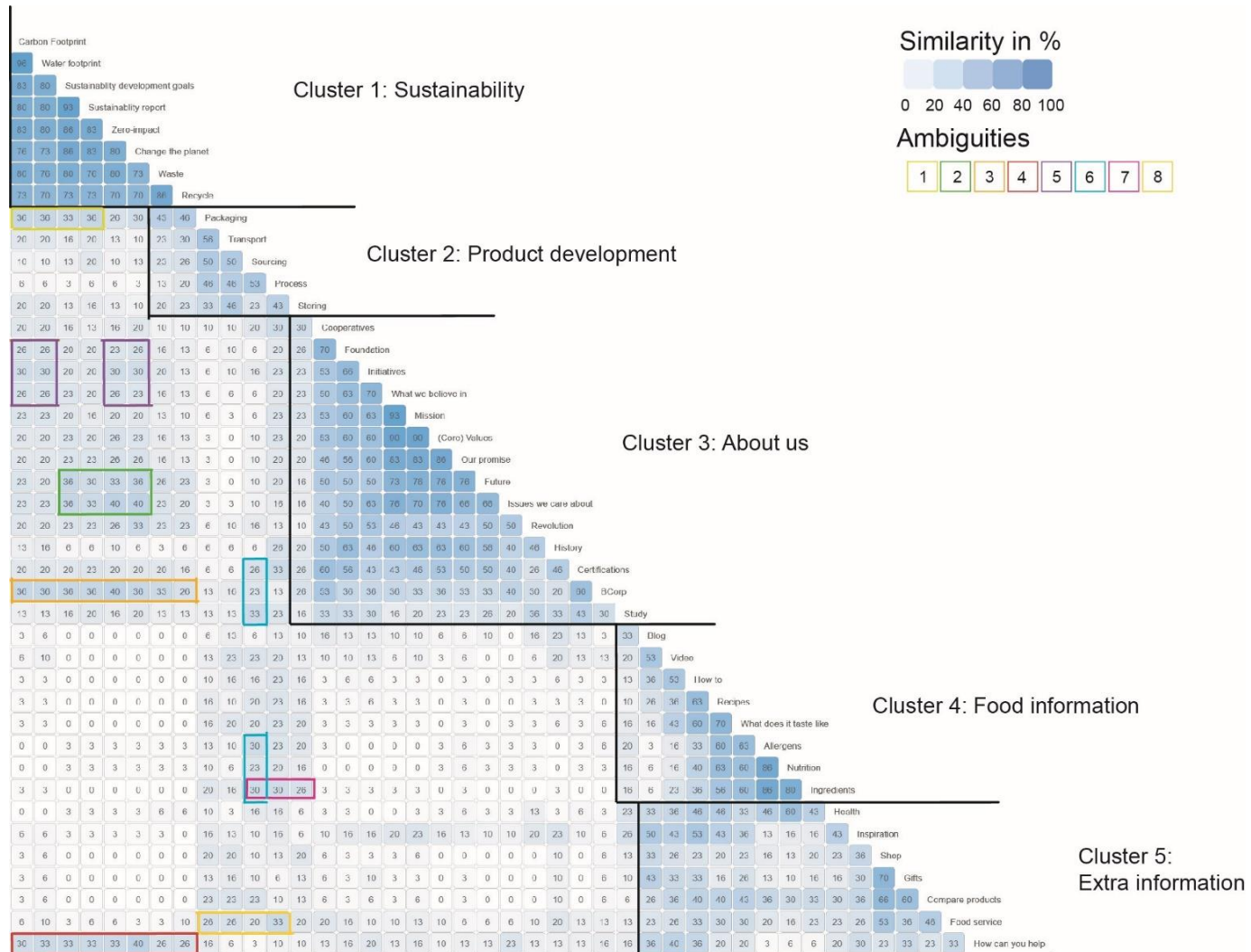
**Table 1**

*Summarized identified clusters of all cards*

Cluster 1: Sustainability	Cluster 2: Product development	Cluster 3: About us	Cluster 4: Food information	Cluster 5: Extra information
Carbon footprint	Packaging	(Core) Values	Blog	Health
Change the planet	Sourcing	BCorp	Video	Inspiration
Recycle	Process	Certifications	How to	Shop
Sustainability development goals	Storing	Cooperatives	Recipes	Gifts
Sustainability report	Transport	Foundation	What does it taste like	Compare products
Waste		Future	Allergens	Foodservice

Figure 5

Mental Model Similarity Matrix for Food Brand Websites

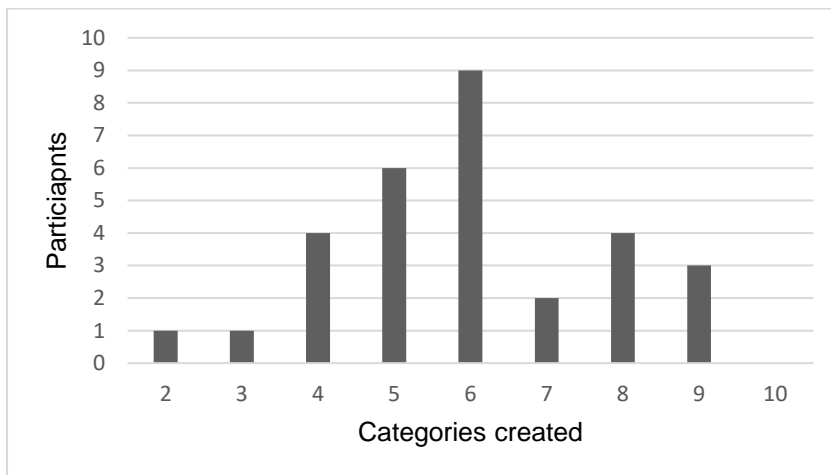


Note. The black outlines of the similarity matrix depict the cluster that represents the mental model of the users. The name of the cluster can be found next to the clusters. The coloured blocks outline ambiguities, they are categorized into groups based on their colours. The darker the hue of blue of the blocks the higher the similarity score is. A stronger similarity means that two items are grouped together more frequently.

In Figure 6, the frequency distribution is presented of the number of categories created by participants. According to the data, 30% of the participants created six categories, making it the most common number of categories created. Followed by 20% of participants that created five categories. The time to complete the task took on average of 19.7 minutes (range 3.6 – 252.9 minutes, standard deviation 44.3 minutes; excluding one outlier with 252.9 minutes, the average time to complete the task was 11.7 minutes, range 3.6 to 24.4 minutes, standard deviation 5.3 minutes).

**Figure 6**

*Frequency Distribution Number of Created Categories*



During the open card- sorting experiment, participants had to label the created categories. These labels provide a way to group the items and better understand the underlying themes and categories within the data. Table 2 presents the most common proposed category labels created by participants. In total 350 labels were created. The labels assigned to each cluster were based on the participant categories that were most like the selected group. The percentage provided indicates the degree of similarity between the selected group and the participant categories.

**Table 2***Proposed category labels by participants*

Cluster 1: Sustainability	Cluster 2: Product development	Cluster 3: About us	Cluster 4: Food information	Cluster 5: Extra information
Sustainability	How to get the product	Goals, identity, and initiatives of the company	Possibilities for customers to engage with the product and the company	Food related and recipes
Ecological values	Product development	About the business	Information (Access)	Product information and tips
The environment	Production	The company/about us	Extras on the website that can be useful, but are mostly useless	Food product information
Our vision: the environment Sustainability brand image	Chain operation  How our products are made	About us		Food  Information about the food

**A Detailed Description of Clusters*****Cluster 1: Sustainability***

The first cluster consisted of eight items: “Carbon footprint”, “Water footprint”, “Sustainability Development Goals”, “Sustainability report”, “Zero-impact”, “Change the planet”, “Waste”, and “Recycle”. The proposed labels for this category were for example, “Sustainability brand image” and “Ecological values sustainability”. The label “Sustainability” chosen most of the time by participants hence why this cluster is called Sustainability, accurately representing the items.

The similarity scores between these items ranged from 86% to 96%, indicating a relatively high understanding of their content similarities. The highest similarity score was between “Carbon footprint” and “Water footprint” (96%), this wording may have contributed to participants' tendency to link them together. Additional information of the moderated session revealed that cluster was the first group to be created by participants, further

confirming the logical grouping of these items. Notably, there were no ambiguities identified within this cluster, indicating that participants had a clear understanding of the items, leading to a logical and cohesive cluster.

### ***Cluster 2: Product Development***

The second cluster of items consisted of five items: “Packaging”, “Transport”, “Sourcing”, “Process”, and “Storing”. This cluster was named “product development,” since it included the items related to the production process and supply chain. Other proposed labels were "How to get the product," "Product development," "Production," and "How our products are made”.

The similarity scores for these items ranged from 56% to 30%. The items in this cluster differ in their specific focus, which could explain the lower similarity scores. Participants may have struggled to find commonalities among these items due to their indirect connection to product development. Notably, "Packaging" was identified as an ambiguous item, suggesting that participants had different interpretations of what it meant. During the moderated session, it became apparent that some participants had difficulty understanding the meaning of certain items in this cluster, particularly "Sourcing" and "Storing". Indicating a potential lack of comprehension of their content similarities. This could contribute to the lower similarity scores for these items.

### ***Cluster 3: About Us***

The third cluster consisted of twelve items: "Foundations", "Cooperative initiatives", "What we believe", "Mission", "Core values", "Our promise", "Future", "Issues we care about", "BCorp", "Certification", "History" and "Study". The proposed labels for this category were: "Goals, identity, and initiatives of the company”, and "The company/about us". Participants most often chose the “About us” label for this category, since the category consisted of items related to the company, its values, goals, and initiatives. Participants found the label "Goals, identity, and initiatives of the company" too broad, favouring the more specific label "About us”, hence the name of this category.

The similarity scores for these items ranged from 93% to 43%, indicating that the participants perceived these items as being closely related to each other. Some items, such as "Foundations" and "Cooperative initiatives", may have been less familiar to participants, resulting in lower similarity scores. Additionally, the term "BCorp" may be ambiguous to some participants, which could have also contributed to the lower similarity score for that item. "BCorp" is a type of certification that companies can obtain if they meet certain social and environmental performance standards. Participants may not have been aware of this beforehand and had to read the descriptions of the items to understand their meaning. As a result, it is possible that participants who read about "BCorp" may have also read about "Certification" and made a connection between the two. This could explain why these two items were grouped together higher within this cluster. During the moderated session, participants explained that these items provided general or background information about the company, contributing to a broader understanding of its goals, identity, and history.

#### ***Cluster 4: Food Information***

The fourth cluster included in the items "Blog", "Video", "How to", "Recipes", "What does it taste like", "Allergens", "Nutrition", and "Ingredients". It represents food-related information. Proposed labels like "Food-related and recipes", "Product information and tips", "Food", and "The food itself" were considered. Based on these labels, the final label is "food information".

The similarity scores for these items ranged from 80% to 53%, indicating a moderate to strong grouping. The content of the items "Video" and "Blog" was not shared, leading to a more general perception of the items. This indicates that the grouping observed may not be based on a true understanding of the item, but rather a lack of clarity or information about the content of the items. Furthermore, participants strongly linked the items "Nutrition" and "Allergens" together, suggesting that they perceive these aspects as interconnected and expect to find information about both when accessing product or menu information.

In the moderated session, participants perceived this cluster as a distinct and relevant group, understanding the common theme shared by the items. These items were

considered important for consumers when making purchasing decisions, as they provide information about the product's nutritional value, ingredients, and allergens. This information is particularly crucial for consumers with specific dietary requirements or restrictions.

#### ***Cluster 5: Extra Information***

The fifth cluster consisted of the items "Health", "Inspiration", "Shop gifts", "Compare products", "Food service", and "How can you help". This cluster is named "extra information", it encompasses various aspects of the company without a clear theme. Proposed labels included "Customer engagement possibilities", "Information access", and "Useful but mostly useless extras on the website". The final category label chosen was "Extra information". This cluster differs from others as it focuses on the customer experience and interaction with the company rather than the product itself. During the moderated session, participants struggled to identify a clear theme, suggesting a lack of coherence.

The similarity scores for this cluster ranged from 70% to 33%, indicating a moderate grouping. However, there are some observed similarities. For example, "Compare products" and "Shop gifts" may be related as they involve product selection and purchasing decisions. Participants tend to group these three items together more frequently, indicating a perceived connection among them. One possible explanation for this could be that all three items are related to consumer behaviour, particularly in the context of shopping. This grouping may also be influenced by the fact that these three items are all relatively concrete and specific. In terms of wording, there are no clear similarities between the items.

The moderated session revealed that some items in this cluster were difficult to categorize by participants. This suggests that this cluster may lack a clear and distinct theme. As a result, the similarity scores for this cluster were relatively lower compared to the other clusters. Additionally, certain items in this cluster did not fit cohesively into any other category and were thus grouped together here. These observations support the notion that this cluster may comprise miscellaneous items without a strong underlying logic or theme connecting them.



## **A Detailed Description of Ambiguities**

By analysing the similarity matrix in Figure 5, it is possible to identify ambiguous items. They are indicated by their stronger colour compared to surrounding blocks, indicating their higher similarity score with adjacent items. These ambiguous items tend to be located on the outskirts of clusters or groups with high similarity scores (Schmettow & Sommer, 2016). This is because the ambiguous items may share some similarities with multiple clusters or groups of items, but not be clearly associated with any single one.

### ***Packaging***

The item "Packaging" is ambiguous as it could fit into different clusters depending on the context. It has a similarity score of 36% with both the "Carbon footprint" and "Water footprint", and the "Sustainability report", but it was ultimately grouped with the product development category and not the sustainability group.

Participants may have had varying interpretations of the meaning of the term "Packaging," which could have contributed to its placement in different clusters. For example, some participants may have interpreted it to mean the physical materials used to wrap a product, while others may have interpreted it to mean the design and branding of the packaging. In the monitored conditions, participants did not show that they found this an ambiguous item.

### ***Future & Issues We Care About***

The second ambiguous items are "Future" and "Issues we care about". These items have a similarity score range of 33-40% with the items "Zero impact" and "Change the planet" and these categories are not part of their main cluster. This suggests that participants may have struggled to categorize them consistently. It also suggests that these items may be abstract or conceptual, unlike tangible and concrete items such as nutrition or recipes, making it more challenging to categorize them. Unlike concrete items that have a direct connection to the product, these abstract items lack a clear physical form and are more tied to values and beliefs rather than a specific product or category. Consequently,

participants had varied interpretations and understandings of these items, making their categorization more difficult.

In the moderated session, participants showed different interpretations of these items. For instance, "Future" could refer to environmental sustainability, the future of technology or the company's future, depending on individual perspectives. Similarly, "Issues we care about" could be understood in terms of social justice, environmental concerns, or other ethical considerations. The lack of clarity and specificity around these items led to ambiguity in their placement and inconsistent categorization. Participants also expressed confusion and sought clarification on the intended meaning of "Future" and its specific focus. Similarly, the item "Issues we care about" lacked a clear definition, resulting in different interpretations. It was suggested that this item would be better placed in the general values of the company cluster rather than sustainability. These findings highlight the importance of providing clear definitions and context for ambiguous items, which can contribute to more consistent categorization among participants.

***BCorp: Credentials that a business can earn by meeting certain social and environmental standards.***

The third ambiguous item is "BCorp" exhibiting weak grouping within its cluster (30%). "BCorp" is matched with 25 other items, both within and outside its main cluster, with similarity scores ranging from 13% to 60%. Notably, "Zero-impact" has a higher similarity score of 40% with "BCorp", suggesting a connection. This suggests that "BCorp" may not fit well within their clusters, and there may be other categories or labels that could better capture their meaning.

Participants in the moderated setting expressed uncertainty about the meaning of "BCorp," leading to varied interpretations and categorizations. Some viewed it as a specific certification or standard for businesses, while others saw it as a broader concept of socially responsible or sustainable business practices. This lack of clarity contributed to the diverse similarity scores and inconsistent placement of "BCorp" within and outside its main cluster.

***How can you help***

The fourth ambiguous item, "How can you help", shows a similarity score of 30-40% with the "Sustainability" cluster, like its current similarity score within its own cluster. This suggests a potential connection between the concept of helping and sustainability. However, the relatively low similarity scores for this item indicate some confusion or ambiguity around its meaning and relevance. Different interpretations, such as seeking or offering help, could lead to varied categorizations. The broad and vague nature of the term "help" may contribute to this ambiguity.

During the moderated session, participants struggled to categorize the item "How can you help" due to its vague and nonspecific nature. They were not sure what "Help" referred to in this context and whether it was related to the company's sustainability efforts or something else entirely. One possible interpretation is that it relates to the company seeking support or involvement from stakeholders to achieve sustainability goals. This could involve encouraging customers to adopt eco-friendly practices or soliciting input from employees on improving sustainability practices. Another interpretation is that the company is offering assistance or resources to others, such as providing sustainability training or funding environmental initiatives. The lack of clarity around the term "Help" contributed to the ambiguity and difficulties in categorization.

***Foundation, Initiatives, What we believe in***

The fifth ambiguous items are "Foundation", "Initiatives", and "What we believe in". They have ranging similarity scores of 23 to 30% with the items "Carbon footprint", "Water footprint", "Zero-impact", and "Change the planet". This suggests a potential connection with the "Sustainability" cluster.

During the moderated session, it appeared that some participants may associate these items with sustainability goals or initiatives, indicating their belief in the importance of environmental and social responsibility. Another interpretation could be that these items reflect the values and principles guiding sustainable practices.

### ***Sourcing***

The sixth ambiguous item is "Sourcing". It demonstrates a similarity score of 23% to 33% with items such as "Certification," "BCorp," and "Study," suggesting a potential association between the "About us" section. Additionally, it shows similarity scores of 23% to 30% with the items "Allergens," "Nutrition," and "Ingredients," indicating a potential connection with considerations of product information. However, when examining the overall similarity scores, "Sourcing" displays relatively low scores across various clusters, which suggests that it does not fit strongly within any specific cluster.

During the moderated condition, participants encountered challenges in categorizing the item "Sourcing" due to its lack of specificity. Therefore, different interpretations of sourcing, such as the procurement of ingredients or materials and the ethical aspects of sourcing, could lead to varying categorizations by participants.

### ***Ingredients***

The seventh ambiguous item is "Ingredients". It demonstrates high similarity scores within its own cluster, suggesting that participants generally categorized ingredients together. However, when compared to other clusters, "Ingredients" shows similarity scores ranging from 26% to 20% with the "Sourcing" "Process" and "Storing" items. This indicates a potential connection between ingredients and the product development cluster.

During the moderated session, participants had no difficulties in interpreting the item "Ingredients." The meaning of "ingredients" was clear, and participants were able to categorize it without confusion. The relatively high similarity scores within the ingredients cluster support this notion. However, similarity scores with the sourcing process and storing clusters suggest that participants may have perceived a secondary connection between ingredients and product development.

### ***Food service***

The last ambiguous items is "Food service". It shows similarity scores ranging from 20% to 33% with the "Product development" cluster, indicating a potential association.

Additionally, "Food service" falls within the "Extra information" category, which is a broad category that encompasses various types of information. This broad categorization likely contributes to its partial match with the "Product development" cluster.

During the moderated session, the meaning of "Food service" was perceived as vague by participants. This ambiguity resulted in different interpretations among participants regarding its intended meaning. Some possible interpretations of "Food service" include its association with catering services, the provision of meals in a restaurant setting, or the management and organization of food-related activities within a business. broad nature of the term "Food service" and its potential connections to product development contribute to the uncertainties in categorization.

### **Second part: Applicability Mental Model to Other Sustainable E-commerce Brands**

The second part of this study evaluates the alignment between sustainable e-commerce website navigation structures and the found mental model. By applying the mental model to various websites, design recommendations are formulated to optimize user navigation efficiency across different platforms in the sustainable e-commerce section.

### **Methods**

First, the websites are selected, based on their relevance to sustainable e-commerce brands. To ensure a diverse range of websites, a Google search was conducted using relevant keywords such as "Sustainable e-commerce brands", "Sustainable cosmetics", and "Sustainable products". The websites obtained through this search process were then evaluated for their clarity of navigation structures. Furthermore, to ensure a diverse range of websites representing the sustainability domain, two websites were chosen for evaluation: Happy Soaps and Wesmyle (HappySoaps EU, z.d.; Smyle, z.d.). These websites were selected because they offer different sustainability products, allowing for a broader understanding of the domain and enabling comprehensive design recommendations.

Second, navigation structures were generated for the selected websites. Since not all the information on the websites was available in the navigation bar, a hierarchical structure

was made to capture the complete organization of the websites. The sitemaps included headings, main headings, subpages, and content items, providing a comprehensive overview of the website's structure and content organization.

Third, a comparative analysis was performed. The created sitemaps were compared to the mental model. The goal of the comparative analysis is to identify similarities and differences between the website navigation structure and the mental model. The focus was on the alignment or different between the identified clusters of items in the mental model and the content and organization of the website.

## **Results**

### ***Case 1: Happy Soaps EU***

When examining the navigation structure of Happy Soaps in relation to the found mental model, similarities and differences are noted. In Figure 6 the navigation structure of the website is shown. With this, the organization and arrangement of information of the website is shown.

Figure 6

Navigation structure Happy Soaps



### **Similarities**

The first similarity is the "Our Story" section. This section aligns with the content of the "About Us" section in the mental model. The "What We Stand For" section in this case is also aligned with the content of the "About Us" section in the mental model. These sections aim to provide users with an understanding of the brand's values, purpose, and sustainability goals.

The second similarity is the inclusion of product information. Both Happy Soaps' website and the mental model recognize the importance of providing product information separately. Happy Soaps also has an item "What is it" for each product. This allows users to access details such as ingredients, usage instructions, and other specifications related to the products in a dedicated section.

The third similarity is the "Initiatives", "Promise" and "Mission" items. Happy Soaps emphasizes these items on its website, which aligns with the mental model's expectation of finding such information.

The fourth similarity is the inclusion of videos. Happy Soaps incorporates videos within the "How to Use" section of its website. This aligns with the presence of videos in the mental model, indicating that users expect visual instructions or demonstrations related to product usage.

### **Differences**

The first difference is the "Our Story" heading. In the mental model, "Our Story" is associated with understanding the brand's background and values. In Happy Soaps' case, this section aligns with their promise of providing sustainable and eco-friendly products. The mental model does not specifically link "Our Story" with sustainability items.

The second difference is the inclusion of "Ingredients" and "Mission goals" under the "Our Story" heading. Happy Soap chooses to combine these sections. In the mental model, these elements are perceived as more general categories and may not necessarily be directly linked to the "Our Story" section. In the mental model, information about product



ingredients is typically associated with the broader category of "Product Information". Users would expect to find ingredient information under a more specific heading related to product details.

The third difference is the "What we stand for" section. Within the "What We Stand For" section, Happy Soaps differs from the users' mental model in terms of emphasis. While the mental model associates this section with understanding the brand's core values and purpose, Happy Soaps predominantly focuses on issues they care about, which primarily relate to their sustainability goals. They emphasize various aspects such as reducing CO2 emissions, using recyclable packaging, minimizing water emissions, and sharing information about what customers can do to contribute to sustainability efforts. These sustainability-related topics cover a range of items from the found mental model related to sustainability.

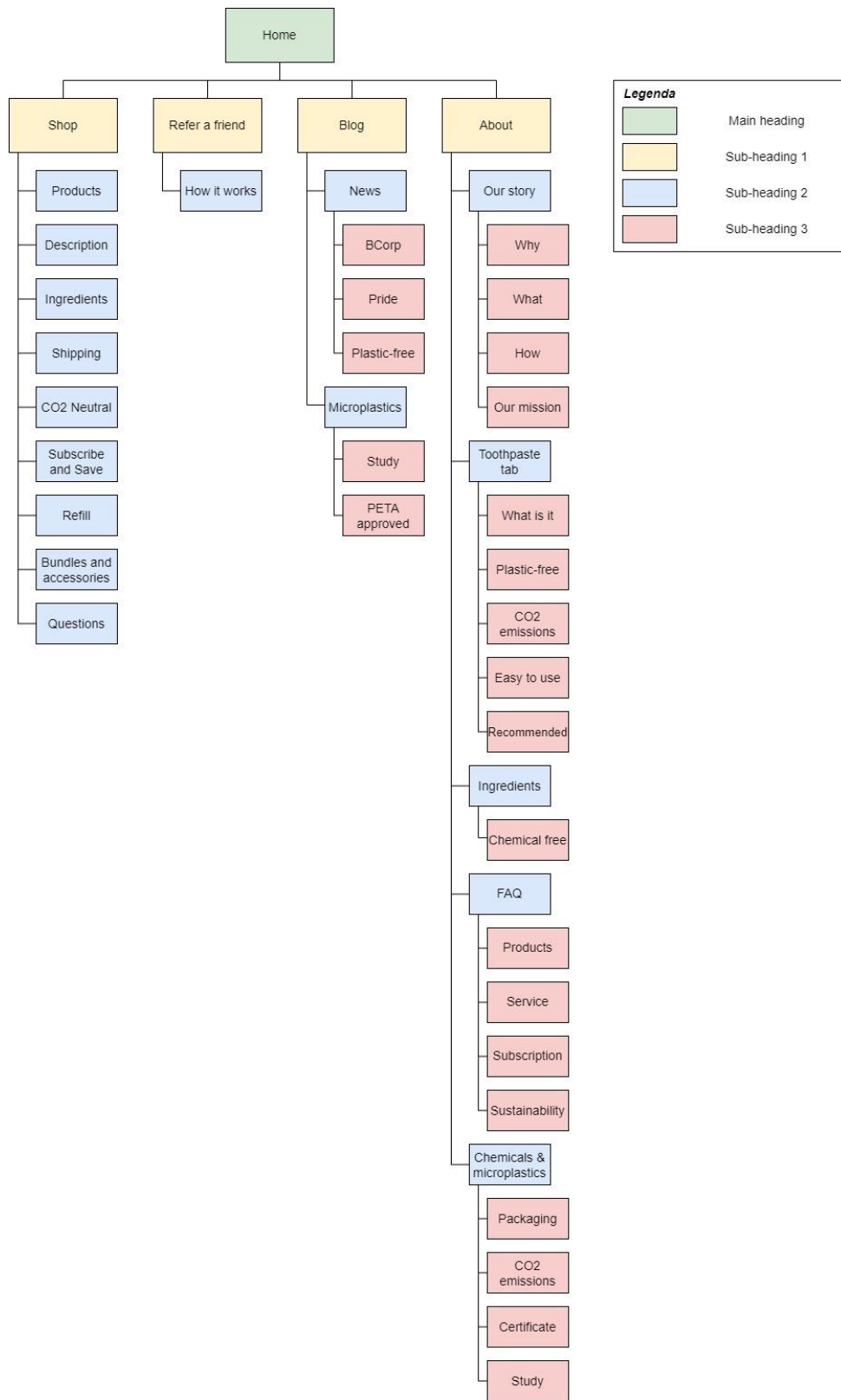
The fourth difference is the placement of the "How to use" and the "How to store" items underneath the "Contact" heading. Happy Soaps includes subheadings such as "How to Use" and "How to Store" within the "Contact" section. However, in the found mental model, these items would be better placed under the "Product Information" category or within a dedicated "Product Usage" section. Placing them under the "Contact" section may not align with users' expectations. Additionally, Happy Soaps could incorporate a "Product Development" category within their navigation structure. This category would encompass information about their product formulations, ingredients, and any innovative aspects related to the development process. Placing the "How to Use" and "How to Store" subheadings under this category would better align with users' mental models, as they would expect to find such information when exploring product-related details.

### ***Case 2: Sustainable Toothbrushes; Wesmyle***

When comparing the navigation structure of Wesmyle to the identified mental model, there are some similarities as well as notable differences, see Figure 7

**Figure 7**

*Navigation structure Wesmyle*



## **Similarities**

The first similarity is the main headings of the “Shop” section. Similarly, the “About” main heading is also similar with the main headings in the mental model. These headings serve as key navigational elements that provide users with direct access to essential sections of the website.

The second similarity is the inclusion of the main heading for the "Blog" section on the Wesmyle website, which aligns with the mental model's emphasis on including a blog section. With the goal of having a separate space for informative content related to products or the industry. In the mental model, the presence of a "Blog" section was identified as a common feature across different websites, encompassing news, articles, and videos. Similarly, the Wesmyle website has a distinct main heading or category specifically for the blog section. However, it should be noted that there is a slight difference in the way the blog section is presented on the Wesmyle website. While the mental model indicated a high similarity score between the items "Blog" and "Study," it is noteworthy that on the Wesmyle website, studies are currently found within the articles within the blog section and in the "our story" section. Furthermore, items such as “BCorp” and “issues we care about” of the mental model can also be found in this section, without having a subheading.

The third similarity is the "Our Mission" item in the "About Us" section. Since by providing a dedicated space to communicate the brand's purpose and objectives it is aligned with the found mental model.

## **Differences**

The first difference is the "About" section. In the mental model it is recommended to organize content within the “About” category concerning the brand’s narrative information. In this case the “About” section entails sustainability information, ingredients, and products. These items could benefit from the further organization into subcategories as found in the mental model.

The second difference concerns the “Packaging” and “Product Development” sections. On the Wesmyle website, information related to packaging and product development is presently embedded within the sustainability category and the ingredients section. This differs from the mental model's expectation of having dedicated sections or categories specifically addressing packaging and product development.

The third difference between the mental model and the Wesmyle website is the dispersal of sustainability items across various categories. In the mental model, there is an expectation for a dedicated category specifically addressing sustainability, where all relevant information would be consolidated. However, on the Wesmyle website, sustainability-related items are spread out across different sections and categories. This dispersion of sustainability content may result in a less cohesive presentation and make it more challenging for users to access comprehensive information about the brand's sustainability efforts. While this organizational approach may have been a deliberate choice by Wesmyle to integrate sustainability throughout the website, it deviates from the mental model's suggestion of a single, focused sustainability category.

### **Discussion**

This study set out to propose a navigation structure for sustainable e-commerce websites with the aim of enhancing user experience. This was done by eliciting the user's mental model by doing a card-sorting experiment. This identified five main clusters: Sustainability, Product development, About us, Food/Product information and Extra information. The ambiguous items found were Packaging, BCorp & Study, Inspiration and, How can you help. Second, it was investigated if the founded navigation structure is aligned with other sustainable e-commerce websites by doing a case study analysis. Several differences and similarities between the were found. The identified similarities, include the presence of an "About us" section with initiatives, promise, and mission items, as well as a shop and blog section. The main difference was the dispersion of sustainability information across different categories instead of being united under a single sustainability heading. Then a design recommendation for sustainable e-commerce websites was created, based

on all findings. Implementing these recommendations help website designer to make more positive experience websites.

### **Design recommendation**

This study has found the following proposed navigation structure. It involves five main categories that should be included in a website's navigation bar (Table 5).

**Table 5**

*Proposed navigation structure*

Cluster 1: Sustainability	Cluster 2: Product development	Cluster 3: About us	Cluster 4: Food information	Cluster 5: Extra information
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Sustainability is a critical aspect of sustainable e-commerce websites, this is in agreement with other studies (Haryanti & Subriadi, 2021). To effectively communicate sustainability, it is recommended to create a dedicated section. This section can cover various topics, including environmental impact, CO2 emissions, sustainability goals and impact. This allows visitors to gain a deeper understanding of the brand's commitment to sustainability and encourages them to more informed sustainable choices (Brydges et al., 2022). By organizing this information in a dedicated section, users can easily access and explore sustainability-related content, fostering transparency and discrete showing it to customers (Brydges et al., 2022).

“Packaging” and “Product development” section should also deserve attention. By creating a separate category for packaging, designers can showcase the brand's eco-friendly packaging materials, recycling programs, and innovative practices regarding the product's supply chain. Prominently featuring these aspects helps users understand sustainability efforts and make informed decisions (Brydges et al., 2022).

The "About Us" section of a sustainable e-commerce website plays a crucial role in conveying the brand's story, values, and mission, this is in agreement with Wiese et al. (2012). In this section cooperative initiatives, partnerships, certifications, and future goals can be highlighted. Furthermore, issues the organization cares about and their promise to customers can be highlighted. Lastly, relevant studies and research can be also put in this section to reinforce expertise and credibility. By implementing these design recommendations, the "About Us" section can effectively communicate the organization's values, mission, and impact, fostering user engagement and building trust (Wiese et al., 2012).

Lastly, a "Product Information" category is suggested. In this category comprehensive ingredient lists, certifications, how to instructions and allergens can be influenced. Additionally, consider incorporating sustainability metrics, such as carbon footprint or water usage, to showcase the product's environmental impact. This is in agreement with found studies that people value knowing details about products regarding sustainability, ingredients, and labels (Borin et al., 2011). By following these recommendations, the "Product Information" category can effectively educate and engage users, enabling them to confidently make sustainable choices (Brydges et al., 2022).

### **Limitations**

This study has certain limitations that should be taken into consideration. The first limitation is the sample representativeness for the population. Participants of this study predominantly belonged to a young age group with an average age of 22 years. This does not capture the perspectives and experiences of older individuals, who have found to demonstrate different attitudes and behaviour regarding both towards environmental impact and interacting with sustainable e-commerce websites (Wiernik et al., 2013). Consequently, the generalizability of the study's conclusions is restricted to young users.

Furthermore, participants' educational backgrounds were not assessed. Higher education correlates with greater environmental awareness, understanding, and prioritization of sustainability (Oreg & Katz-Gerro, 2006). In this study, only university students were recruited from to the SONA credit system and the convenience sampling of the researcher maintained higher educated participants. In order to make generalizable findings for average users, participants with a variety of education levels should have been included.

Another limitation of this study relates to the selection of items used in the card sort study. The items used do not fully represent the content and features of sustainable e-commerce websites, as elements like contact information and store locators were not included. The absence of these items in the study's item list poses a limitation to the comprehensiveness of the mental model and should be considered when interpreting the study's conclusions and recommendations.

Additionally, the provided definitions for the items may have influenced participants' understanding and categorization of the items. Previous research emphasizes the importance of carefully selecting and wording items to avoid unintended biases or limitations in participant responses (Faiks et al., 2000). Varying labels rather than identical words are recommended to prevent participants from solely grouping items based on label similarity rather than considering the underlying concepts. For instance, in this study, items like "Carbon footprint" and "Water footprint" were grouped together due to their similar labels.

### **Future studies**

Future studies in the field of sustainable e-commerce website design should aim to delve deeper into specific aspects that influence user perceptions and behaviour. First, future studies should aim to conduct a more diverse sample, encompassing participants from a wider range of age groups. By including participants from various demographics, such as different age groups, cultural and educational backgrounds, insights can be gained into how user experiences and mental models may vary across different populations, making the findings more generalizable. This can be done by using alternative recruitment methods beyond convenience sampling and the SONA credit system. Furthermore, future studies

could examine the influence of participants' education, providing insights into the impact of intelligence on user experiences.

Second, usability testing can be done to further explore and evaluate the user's experiences associated with the found mental model, as was previously shown in the study of Schmettow and Sommer (2016). This allowed for the exploration and evaluation of user interactions, navigation patterns and decision-making processes. Usability testing can be done by designing specific tasks for participants to complete, such as finding a particular product, or information, or navigating through different sections of the website. Researchers may be able to measure task completion, and error rates, and gather user feedback. These insights then provide a more comprehensive assessment of the website's usability and areas for improvement (Nielsen & Pernice, 2010), which cannot be obtained through a card-sorting study, since usability focuses on practical aspects of a website's interface and user experience (Schmettow & Sommer, 2016).

Additionally, future studies could investigate the influence of design elements on users' engagement and sustainability-related behaviours, as previous studies indicated their positive impact on user's attitudes, intentions, and behaviour towards sustainability (Kim and Lee, 2019). For example, examining the effects of visual cues, such as eco-friendly icons or badges, on users' perceptions and decision-making processes could provide valuable insights into how to effectively communicate sustainability information. By addressing these aspects in future research, website designers can continue to refine and optimize the design of sustainable e-commerce websites, ultimately enhancing the user experience and promoting sustainable consumption practices.

## **Conclusion**

This study set out to propose a navigation structure for sustainable e-commerce websites with the aim of enhancing user experience. The findings of this study contribute rapidly expanding field of e-commerce and sustainability. While replicating previous studies on card-sorting for mental models, this study extends the research to the context of sustainability e-commerce websites.



By conducting a card-sorting experiment to elicit users' mental models, insights were gained into their preferred clustering of items. Then a case study analysis was done to investigate whether the found navigation structure was aligned with other sustainable e-commerce websites. Based on the findings of this study, recommendations were developed to guide the adjustment of navigation structures for sustainable e-commerce websites. Therefore, sustainable e-commerce websites should have five main categories in their navigation bars: sustainability, product development, about us, product information and extra information. The proposed navigation structure for sustainable e-commerce websites serves as a framework, for organizing and presenting information according to user's mental models. This improves user experience, reduces cognitive load, and increases user satisfaction.

In conclusion, this research contributes to the field by eliciting the mental model of users and providing recommendations for the navigation structure of sustainable e-commerce websites. Implementing these recommendations can result in more intuitive websites that are aligned with user's mental models.

## References

- Bevan, N., Carter, J. M., & Harker, S. (2015). ISO 9241-11 Revised: What Have We Learnt About Usability Since 1998? In *Lecture Notes in Computer Science* (pp. 143–151). Springer Science+Business Media. [https://doi.org/10.1007/978-3-319-20901-2\\_13](https://doi.org/10.1007/978-3-319-20901-2_13)
- Borin, N., Cerf, D.C. and Krishnan, R. (2011), "Consumer effects of environmental impact in product labeling", *Journal of Consumer Marketing*, Vol. 28 No. 1, pp. 76-86. <https://doi.org/10.1108/073637611111101976>
- Brydges, T., Henninger, C. E., & Hanlon, M. (2022). Selling sustainability: investigating how Swedish fashion brands communicate sustainability to consumers. *Sustainability: Science, Practice and Policy*, 18(1), 357–370. <https://doi.org/10.1080/15487733.2022.2068225>
- Bussolon, S., Russi, B., & Missier, F. D. (2006). Online card-sorting: As good as the paper version. In *Proceedings of the 13th European Conference on Cognitive Ergonomics* (pp. 113–114). New York, NY: ACM. doi:10.1145/1274892.1274912
- Case, D. O., & Given, L. M. (2016). Looking for information: A survey of research on information seeking, needs, and behaviour.
- Carroll, J. M., & Olson, J. R. (1988). Mental models in human-computer interaction. *Handbook of human-computer interaction*, 45-65.
- Faiks, A., Hyland, N. J. C., & libraries, r. (2000). Gaining user insight: a case study illustrating the card sort technique. 61(4), 349-357. <https://doi.org/10.5860/crl.61.4.349>
- HappySoaps EU. (z.d.). *HappySoaps | 100% Plastic-Free and Natural Care - HappySoaps*. <https://happysoaps.com/>
- Haryanti, T., & Subriadi, A. P. (2021). E-commerce acceptance in the dimension of sustainability. *Journal of Modelling in Management*, 17(2), 715–745. <https://doi.org/10.1108/jm2-05-2020-0141>

- ISO. (1998). Ergonomic requirements for office work with visual display terminals (vdts)—part 11: Guidance on usability. ISO Standard 9241-11: 1998 (Vol. 55).
- Kemp, E., & Bui, M. (2011). Healthy brands: establishing brand credibility, commitment and connection among consumers. *Journal of Consumer Marketing*, 28(6), 429–437.  
<https://doi.org/10.1108/07363761111165949>
- Kim, M. J., Lee, C., Kim, W. G., & Kim, J. (2013). Relationships between lifestyle of health and sustainability and healthy food choices for seniors. *International Journal of Contemporary Hospitality Management*, 25(4), 558–576.  
<https://doi.org/10.1108/09596111311322925>
- Maarek, Y., Jacovi, M., Shtalhaim, M., Ur, S., Zernik, D., & Ben-Shaul, I. (1997). WebCutter: a system for dynamic and tailorable site mapping. *Computer Networks and Isdn Systems*, 29(8–13), 1269–1279. [https://doi.org/10.1016/S0169-7552\(97\)00050-0](https://doi.org/10.1016/S0169-7552(97)00050-0)
- Miro | Online Whiteboard for Visual Collaboration. (z.d.). <https://miro.com/>.  
<https://miro.com/app/dashboard/>
- Morville, P., & Rosenfeld, L. (2006). Information architecture for the World Wide Web: Designing large-scale web sites. " O'Reilly Media, Inc.".  
[https://books.google.nl/books?hl=en&lr=&id=2d2Ry2hZc2MC&oi=fnd&pg=PR5&dq=information+architecture&ots=oohexl\\_PAe&sig=qN4YbQnmDou3ZojpH\\_gl0UetkHw#v=onepage&q=information%20architecture&f=false](https://books.google.nl/books?hl=en&lr=&id=2d2Ry2hZc2MC&oi=fnd&pg=PR5&dq=information+architecture&ots=oohexl_PAe&sig=qN4YbQnmDou3ZojpH_gl0UetkHw#v=onepage&q=information%20architecture&f=false)
- Nielsen, J., & Pernice, K. (2010). *Eyetracking web usability*. New Riders. *Mental Models and User Experience Design*. (z.d.). Nielsen Norman Group.  
<https://www.nngroup.com/articles/mental-models/>
- Oláh, J., Kitukutha, N. M., Haddad, H., Pakurár, M., Máté, D., & Popp, J. (2018). Achieving Sustainable E-Commerce in Environmental, Social and Economic Dimensions by Taking Possible Trade-Offs. *Sustainability*, 11(1), 89.  
<https://doi.org/10.3390/su11010089>

- Optimal Workshop. (2022, 2 november). *Card-sorting 101 - How To Run An Online Card Sort* | Optimal Workshop. <https://www.optimalworkshop.com/learn/101s/card-sorting/>
- Oreg, S., & Katz-Gerro, T. (2006). Predicting Proenvironmental Behaviour Cross-Nationally. *Environment and Behaviour*, 38(4), 462–483.  
<https://doi.org/10.1177/0013916505286012>
- Otter, M., & Johnson, H. (2000). Lost in hyperspace: metrics and mental models. *Interacting with Computers*, 13(1), 1–40. [https://doi.org/10.1016/s0953-5438\(00\)00030-8](https://doi.org/10.1016/s0953-5438(00)00030-8)
- Paul, C. L. (2008). A modified Delphi approach to a new card sorting methodology. *ResearchGate*.  
[https://www.researchgate.net/publication/200553019\\_A\\_modified\\_Delphi\\_approach\\_to\\_a\\_new\\_card\\_sorting\\_methodology](https://www.researchgate.net/publication/200553019_A_modified_Delphi_approach_to_a_new_card_sorting_methodology)
- Peattie, K. J., & Peattie, S. (2009). Social marketing: A pathway to consumption reduction? *Journal of Business Research*, 62(2), 260–268.  
<https://doi.org/10.1016/j.jbusres.2008.01.033>
- Schall, A. (2014). Eye tracking insights into effective navigation design. In *Design, User Experience, and Usability. Theories, Methods, and Tools for Designing the User Experience: Third International Conference, DUXU 2014, Held as Part of HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014, Proceedings, Part I* 3 (pp. 363-370). Springer International Publishing.
- Schmettow, M., & Sommer, J. (2016). Linking card-sorting to browsing performance – are congruent municipal websites more efficient to use? *Behaviour & Information Technology*, 35(6), 452–470. <https://doi.org/10.1080/0144929x.2016.1157207>
- Sherwin, K. (2018). Card-sorting: Uncover Users' Mental Models for Better Information Architecture. Nielsen Norman Group. <https://www.nngroup.com/articles/card-sortingdefinition/>
- Sivaji, A., Nielsen, S., & Clemmensen, T. (2016). A Textual Feedback Tool for Empowering Participants in Usability and UX Evaluations. *International Journal of Human-*

*computer Interaction*, 33(5), 357–370.

<https://doi.org/10.1080/10447318.2016.1243928>

Smyle. (z.d.). *Smyle Toothpaste- Home*. Smyle. <https://wesmyle.com/>

Stibel, J. (2005). Mental models and online consumer behaviour. *Behaviour & Information Technology*, 24(2), 147–150. <https://doi.org/10.1080/01449290512331321901>

Stinson, J., McGrath, P. J., Hodnett, E., Feldman, B. M., Duffy, C. M., Huber, A. M., Tucker, L. B., Hetherington, R., Tse, S. M. L., Spiegel, L., Campillo, S., Gill, N., & White, M. (2010). Usability Testing of an Online Self-management Program for Adolescents With Juvenile Idiopathic Arthritis. *Journal of Medical Internet Research*, 12(3), e30. <https://doi.org/10.2196/jmir.1349>

Stroes, J. D. (2018). Adjusting the navigation structure of a faculty intranet to the average user with Card Sort and Q-sort. University of Twente

Tsai, W. H. S., & Men, L. R. (2013). Motivations and Antecedents of Consumer Engagement With Brand Pages on Social Networking Sites. *Journal of Interactive Advertising*, 13(2), 76–87. <https://doi.org/10.1080/15252019.2013.826549>

Tsang, Y. P., Wu, C. Y., Lam, H. Y., Choy, K. L. T., & Ho, G. C. (2020). Integrating Internet of Things and multi-temperature delivery planning for perishable food E-commerce logistics: a model and application. *International Journal of Production Research*, 59(5), 1534–1556. <https://doi.org/10.1080/00207543.2020.1841315>

Tullis, T., & Wood, L. (2004, June). How many users are enough for a card-sorting study. In *Proceedings UPA (Vol. 2004)*. Minneapolis (EUA): Usability Professionals Association (UPA).

Verhagen, T., Swen, E., Feldberg, F., & Merikivi, J. (2015). Benefitting from virtual customer environments: An empirical study of customer engagement. *Computers in Human Behaviour*, 48, 340–357. <https://doi.org/10.1016/j.chb.2015.01.061>

Wiernik, B. M., Ones, D. S., & Dilchert, S. (2013). Age and environmental sustainability: a meta-analysis. *Journal of Managerial Psychology*, 28(7/8), 826–856. <https://doi.org/10.1108/jmp-07-2013-0221>

Wiese, A., Kellner, J. N., Lietke, B., Toporowski, W., & Zielke, S. (2012). Sustainability in retailing – a summative content analysis. *International Journal of Retail & Distribution Management*, 40(4), 318–335. <https://doi.org/10.1108/09590551211211792>

Wood, J. R., & L. E. Wood. (2008). Card Sorting: Current Practices and Beyond. *Journal of Usability Studies* 4 (1): 1–6 <https://doi.org/10.1057/9780230226203.1953>

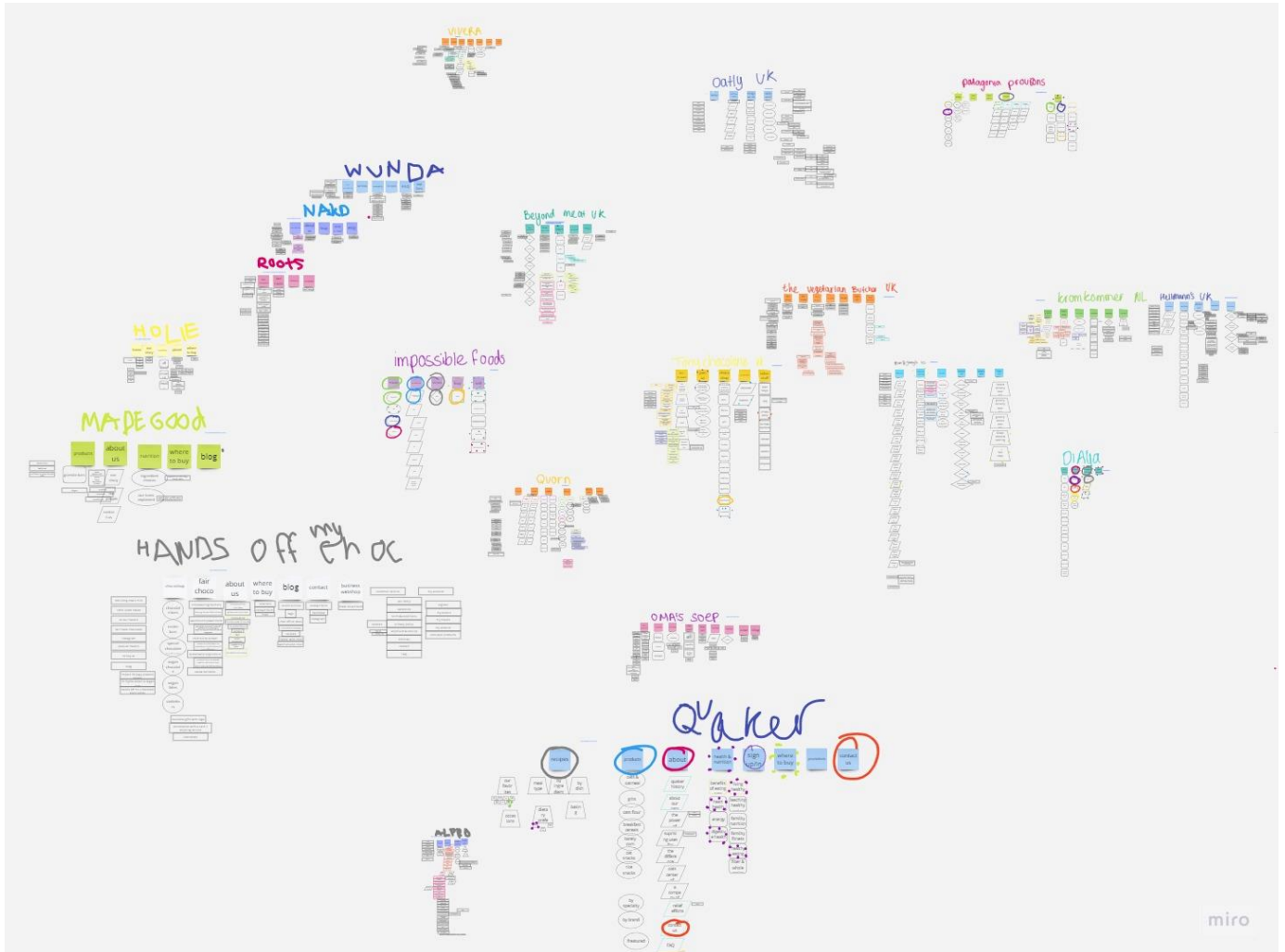
## Appendix A.

### Final selection of websites

No.	Brand	URL
1	Alpro	<a href="https://www.alpro.com/caen/about-alpro/">https://www.alpro.com/caen/about-alpro/</a>
2	Oatly	<a href="https://www.oatly.com/en-gb">https://www.oatly.com/en-gb</a>
3	Wunda	<a href="https://www.beyondw.mywunda.co.uk/">https://www.beyondw.mywunda.co.uk/</a>
4	Ben&Jerry's	<a href="https://www.benjerry.com/">https://www.benjerry.com/</a>
5	Tony chocoloney	<a href="https://tonyschocoloney.com/uk/en">https://tonyschocoloney.com/uk/en</a>
6	Hands off	<a href="https://www.hands-off.com/en/">https://www.hands-off.com/en/</a>
7	Quorn	<a href="https://www.quorn.co.uk/">https://www.quorn.co.uk/</a>
8	Beyond Meat	<a href="https://www.beyondmeat.com/en-GB/">https://www.beyondmeat.com/en-GB/</a>
9	The Vegetarian Butcher	<a href="https://www.thevegetarianbutcher.co.uk/">https://www.thevegetarianbutcher.co.uk/</a>
10	Hellman	<a href="https://www.hellmanns.com/us/en/home.html">https://www.hellmanns.com/us/en/home.html</a>
11	Roots coffee	<a href="https://www.rootscoffee.nl/en/coffeeshop">https://www.rootscoffee.nl/en/coffeeshop</a>
12	Kromkommer	<a href="https://www.kromkommer.com/">https://www.kromkommer.com/</a>
13	Holie	<a href="https://www.holiefoods.com/">https://www.holiefoods.com/</a>
14	Nakd	<a href="https://en-gl.eatnakd.com/">https://en-gl.eatnakd.com/</a>
15	Yfood	<a href="https://en.yfood.eu/">https://en.yfood.eu/</a>

## Appendix B.

### MIRO Board Items Website





## Appendix C.

### Final set of cards & definitions

No.	Title	Description
1	Change the planet	Actions or initiatives that aim to reduce the negative impact of human activities on the environment.
2	Packaging	Physical materials used to contain, protect, and transport a product—description of materials, details on size, and recyclability.
3	Revolution	Significant and fundamental change in a particular field of the industry. Describe a product or service that is intended to change the status quo.
4	Mission	The ultimate goal for the existence of the business.
5	What we believe in/what matters	Set of values, beliefs, and principles that guide the business actions and decisions.
6	History	Past events, achievements, and milestones of the business. Timeline of origins, development, and growth.
7	Recipes	Instructions for preparing specific meals with the product.
8	Ingredients	Components that are used to make a product.
9	Carbon footprint	Amount of greenhouse gases (CO <sub>2</sub> ) emitted because of the company.
10	Water footprint	The amount of water used by a business for its products. Direct and indirect use such as supply chain.
11	Future	The company's vision or plans for what it hopes to achieve in the coming years.
12	Blog	Section where articles, updates, and other content related to products and companies are posted.
13	Sustainability report	A document published that contains details about the environmental, social, and governance performance, practices, and initiatives.
14	Sustainability development goals	17 goals established by the United Nations, to provide a blueprint for a more sustainable and equitable world, to ensure that by 2030 all people enjoy peace and prosperity.
15	Health	Information or advice to help people achieve and maintain good health.
16	Sourcing	Origin of the ingredients used in a product, which may include farmers and methods to grow ingredients.
17	Cooperatives	Information about the self-governing group of companies who willingly come together to fulfill their shared goals by owning and managing an enterprise democratically.

18	Initiatives	Outlines the various activities that a business is undertaking.
19	Certifications	Official documents that demonstrate a company's expertise or knowledge obtained through recognized institutions.
20	BCorp	Credentials that a business can earn by meeting certain social and environmental standards. Make a positive impact on society and the environment, a high account of transparency and accountability.
21	How we make it / process	Outlines specific steps and methods that the company uses to create its products.
22	Nutrition	Information about the nutritional value and health benefits of the food products. Details about ingredients, macronutrients, and micronutrients.
23	(Core) values	Fundamental beliefs underpin the mission of a company.
24	Issues we care about	Social and environmental issues that the business prioritizes. Such as diversity and inclusion. May also provide details about initiatives, partnerships, and collaborations the company has established.
25	Allergens	Information about the ingredients a company's products have that may cause an allergic reaction. Details about common allergies and how they are labeled on products.
26	Shop	Section where customers can browse, select, and purchase products.
27	Waste	Information about how the company manages and reduces waste in its operations and products. Waste reduction strategies.
28	Gifts	Browse, select, and purchase products that are intended as gifts. Gifts sets, personalized items, or gift cards.
29	Inspiration	Content designed to stimulate creative thought or encourage how to use the product.
30	How can you help	Information about ways customers can contribute to a particular cause or initiative. May include various options for involvement.
31	Video's	Video's to explain and demonstrate the product or concepts of the company.
32	Study	Research conducted by the organization to gain a better understanding of the topic. May be used to promote a particular product.
33	Zero-impact	The goal that a company is striving to achieve, states that the activities of the company have no negative impact on climate change.
34	Foundation	A non-profit organization is established to support a certain mission. Have the goal to provide financial support to charitable organizations.
35	Our promise	A statement that a company makes to its customers.
36	What does it taste like	Description of the flavor and sensory experience of a particular food product.

37	Transport	Information about the shipping and delivery of products.
38	Storing	Information about the storage of products. May provide details about the recommended storage conditions, such as temperatures.
39	Recycle	Information about the company's commitment to sustainability in the context of recycling. Details about which materials can be recycled as well as information about recycling programs.
40	Compare products	Compare features, specifications, and prices of multiple products.
41	Foodservice	Information about a company's offerings and services for commercial or institutional clients, such as restaurants, schools, or catering companies.
42	How to	Information that may include step-by-step guidance on how to use, preserve, and cook products.

## Appendix D.

### Experiment design: welcome page & instructions

#### Welcome

You have been invited to take part in a research project entitled "Website Navigation Structures: Eliciting Mental Models Using Card-sorting," which is being conducted by Selena Hof as part of her B.Sc. Psychology Bachelor's thesis at the University of Twente. This study aims to explore users' mental models when they visit a food brand's website (e.g., Ben & Jerry's, Tony's Chocolonely). To achieve this, the "card-sorting" method is used. This study will take about 30 minutes to complete. First, 8 questions will be asked, followed by the card-sorting experiment.

We interpret the world through mental models. Mental models are how we simplify complexity, why we prioritize certain things over others, and how we reason. When visiting a website, users have mental models of how information should be presented and how they should navigate through the website. Congruency between the user's mental model and the website is essential to ensure a positive user experience.

The data obtained from this research will be analyzed to create design recommendations for websites and determine which websites are more or less in line with users' mental models.

Your participation in this study is entirely voluntary, and you may withdraw at any time. There are no known risks identified with this research study; but, as with any online-related activity, the potential of an information breach is always possible. Your responses to this survey will be anonymous. Any risks will be mitigated by securely keeping and processing anonymized data in accordance with the University of Twente's data storage policy.

#### **Study contact details for further information:**

Selena Hof ([s.a.hof@student.utwente.nl](mailto:s.a.hof@student.utwente.nl))

#### **Contact Information for Questions about Your Rights as a Research Participant:**

If you have questions about your rights as a research participant or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee/domain Humanities & Social Sciences of the Faculty of Behavioural, Management, and Social Sciences at the University of Twente by [ethicscommittee-hss@utwente.nl](mailto:ethicscommittee-hss@utwente.nl)

**Step 1**

Take a quick look at the list of items on the left. You see a set of 42 cards, each depicting an item that can be found on food brand websites, along with a description. (The description of the item can be found when clicking on the I icon).

Your task is to group these cards in a manner that you deem appropriate for food brand websites. There is no right or wrong answer, so please group the cards in a way that seems logical for you.

**Step 2**

Drag an item from the left into this area to create your first group.

**Step 3**

Once you have created a group, you can give it a name and describe the contents of each category using a single word, phrase, or sentence.

**Step 4**

Add more items to this group by dropping them on top of it. Make more groups by dropping them in unused spaces.

Please try to assign every card to a relevant group. In case you encounter a card that appears to fit nowhere, you can create an additional category called "others" and place the card there. Or else, please assign such cards to the most fitting group. If you believe that a specific card belongs to more than one group, kindly place it in the most suitable location.

There is no limit on the amounts of groups that you make.

