



Website Navigation Structures: Eliciting Mental Models Using Card Sorting

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Abstract

In the time of COVID-19 pandemic, health has become an even more important subsection of e-government. To best aid user's navigation in finding what they are looking for inside these sites, the information must be structured in a way that is intuitive to them. One way of doing this is by making the website information architecture match the mental models of the users. In this study, card sorting was used to elicit mental models from a group of 36 participants. This would determine a natural navigational structure for this domain and be useful in making recommendations for the GGD Twente website. A group of 40 items were selected from 10 GGD municipal health sites and an online open single level card sorting task was conducted. The data was analyzed qualitatively through heatmaps, and seven different categories were found. Some of the categories, such as Parenting and Childcare, Sexual Health, Travel Advice, Violence and Abuse, COVID-19, had generally high agreement levels between participants. Two of the categories, Housing and Environment and Health and Lifestyle had lower agreement levels and were seen as more ambiguous. In comparing with the website of GGD Twente, the navigational structures largely match that of our results and few clear recommendations can be made. The results of this study can assist future research in clarifying the user's mental model of this domain.

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In today's world, websites have become one of the most widespread sources of information. With the COVID health crisis, e-government websites related to health have been one area of particular importance as even more people have needed to keep informed about health-related concerns. Thus, we must make it easy for users to find the information they are looking for, especially in these websites. To best aid the users' navigation, it is important that the information held on these websites is organized in an intuitive way. One way of achieving this is by eliciting the users' mental model of the site and using it to categorize the information in a way that matches their expectations. However, in the regards to municipal health care, very little research has been done to investigate the user's mental model. Therefore, this study sets out to explore the mental models of the users in this domain and make recommendations to edit website structure based on them.

One common assumption in literature is website usability can be increased by bringing the website organization closer to the users' mental model. A mental model is a perception or idea of how something works that is subconsciously constructed by the human mind (Westbrook, 2006). For a web user of a municipal health site, it can be their inner representation of the information structure found in the site. Users' mental models are built through interactions with the world, experiences with similar sites and influenced by their level of knowledge of the field (Roth et al., 2009). Various design guidelines suggest a need for systems to be congruent to the user's mental models instead of the experts' (International Standards Organisation, 1998; Koyani, 2006; Nielsen, 2010; Shepherd, 2020; Vinney, 2021). The overarching expectation is that by anticipating the users' expectations of where to find information, designers can help prevent errors and increase efficiency in user interactions with the site.

To aid in the users' navigation of a site and information findability, the sites' structure should match the user's mental model. In sites that are designed to present information to users, findability and ease of navigation become critical issues to tackle (Bussolon, 2009). Building a good information architecture, which deals with how information is classified, structured, labelled and presented, is a part of this solution (Dillon & Turnbull, 2005). This has to do with the way that webpages are clustered and hierarchically categorized inside the website. Websites with an information architecture that fits the users' ideas can aid them in meeting information goals, as well as affect their satisfaction and influence return visits (Gullikson, 1999). In addition, a study by Bentley et al. (2005) finds that the ease of navigation on a website affects the amount of content that is read, the user's emotional response and frustration levels, as well as their willingness to revisit the website. Across research, there seems to be a common ground that usability and ease of navigation can be increased if the information architecture of the website meets the users' needs and expectations (Sinha & Boutelle, 2004). Due to this, it is important to pay attention and ensure that the information architecture of websites meets the user's needs.

As experts, web developers typically organize information based on their own mental models of information structures within the site. However, mental models are not consistent between different groups of people, and experts sometimes classify information differently from end users (Bussolon, 2009). For example, experts could structure online governmental services in terms of departments, whereas users tend to categorize this information depending on life situations. Hence, the involvement of experts alone is possibly insufficient in developing a design that fits the users' needs (Bussolon, 2009). User-centered design advises web developers to focus the attention toward the needs and preferences of the users, which can contribute to a better user experience as well as increased usability (Abrams et al., 2004). Various methods are

used to achieve this, however they are often judgements from the expert's perspective, such as heuristic assessments or cognitive walk throughs (de Quincey & Mitchlell, 2021). However, in order to reach better correspondence between the design and the user's needs and expectations, it can be vital to consider the user's own mental models as well (Olaverri-Monreal & Gonclaves, 2014). Customers are more likely to accept and adopt e-services from systems that feel natural to them, as that increases their trustworthiness and gives a sense of confidence (Kotamraju & van der Geest, 2012). Hence, understanding and applying the user's mental model to website design can ensure that their expectations and needs are met, and lead to a smoother experience.

One method of eliciting mental models from users is by card sorting, a technique commonly used to evaluate the information architecture of sites. In card sorting, participants are given a set list of topics that they classify according to their thought processes (Maguire, 2001). In the context of website, participants might be given cards of words or categories that relate to pages in the site, and they need to sort these cards into piles they find meaningful. This way, card sorting can allow us to investigate the way that users group and label the contents of a domain, which makes up their mental model of its organization structure. The categories that users come up with can be used to edit the clustering inside the website's information structure. In addition to its popularity, previous research has also shown that card sorting is a reliable method and valid as a means of discovering optimal navigational structures based on the user's thoughts (Pampoukidou & Katsanos, 2021; Ntouvaleti & Katsanos, 2022). As humans structure knowledge in various semantic networks linked by their personal relations, the results of the card sorting differ for each user. The degree of overlap between the different answers in a cluster analysis can indicate the groupings that majority of the users agree on (Maguire, 2001). In sum,

by giving participants the opportunity to directly categorize information based on their mental models, card sorting is a very informative method for website designers.

Designing efficient websites is particularly important for the domain of municipal and service-based websites as they handle citizen information needs, requests, and reports in facilities that were formerly offered physically. Furthermore, Kotamraju and van der Geest (2012) argue there is a special tension in e-government websites stemming from the difference between the needs of the government and that of its users and that adoption of these e-services can stagger if user opinion is not considered. The choice for GGD websites comes not only from its importance as an official Dutch healthcare service but also the added value of these services in the time of the COVID-19 pandemic. In the domain of health care, a website that does not meet the user's needs and expectations can lead not only to frustration but also potentially dangerous situations. For example, if someone is looking to help a person in need of psychological assistance, they need to be able to find the information regarding this as quickly and efficiently as possible so that they can manage the situation in a timely manner. In other cases, bad website usability can lead to users giving up on finding information altogether.

Despite its added importance, little research has been done to explore the user's mental model of health care websites from a user perspective. Instead, majority of research for mental models in this domain focuses on the professional workplace standpoint to improve team performance or explore work environment (Floren et al., 2018, Giscik et al. 2018, Bogdanovic et al., 2019). However, as much of today's health care services are becoming online, this domain should be explored from the perspective of the user to facilitate their needs as recipients when navigating the site. As users navigate sites through the main menu, its structure should be carefully utilized to help users complete their information goals. Due to this, the items of the

menu must be labeled in ways that users can understand and organized so that is meaningful to them (Sundt & Eastman, 2019). Designing web pages that are congruent to the users' mental models can improve memorability and speed up navigation (Olasvirta, 2004). Hence, by focusing attention on the information architecture of these sites, it is possible that they will have a stronger user-focused basis and lead to more efficient interactions and long-term user gains. The present study sets out to explore the users' mental models of GGD websites using card sorting techniques. In addition, comparisons will be made between the mental models of users and the GGD website of Twente region to make recommendations.

Methods

Participants

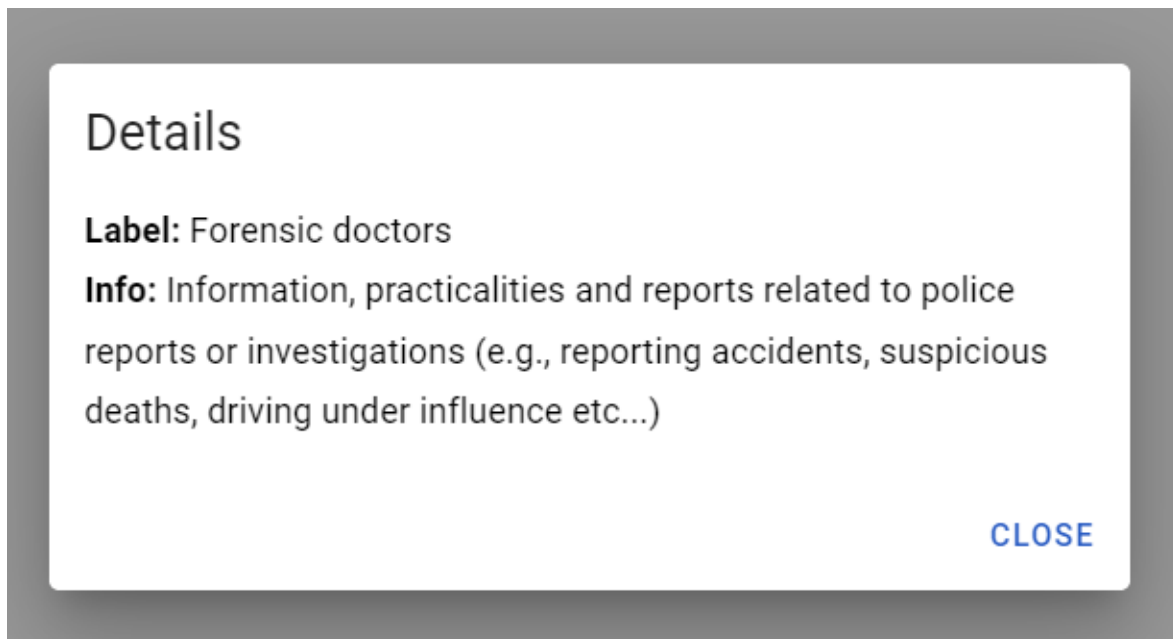
This study consisted of a total of 45 initial respondents. As the sampling method was convenience sampling, the participants were either students at the University of Twente or acquaintances of the researchers. The participants were approached by text messaging, social media, or saw the study while on the Sona website. Out of original respondents, nine were excluded from the study for suspicions of unserious attempts at completing the exercise. These consisted of participants making too few categories, seemingly random groupings, or labels that were not meaningful. In the end, the responses of 36 participants were analyzed, nine of which were male, 16 female, and one non-binary. All but three participants originated from Europe, with 16 from Germany and eight from The Netherlands being the biggest groups. Only two participants considered themselves experienced with professionally structuring websites. The students were rewarded with Sona credits in return for their voluntary participation through the website "Sona systems" while the rest were not compensated for their participation. This study was approved by the BMS Ethics Committee of the University of Twente.

Materials

This study comprised of an online card sorting task using the remote conduct card sorting website kardsort.com via a laptop or PC with access to the internet. The kardsort.com website allows users to perform web-based single level card sorting for free and supported results exported to Casolysis and SynCapsV3. On the website, new categories of cards could be formed and named into which a preexisting list of cards had to be dragged and dropped into. The list consisted of a maximum of 40 cards each relating to specific pages of GGD websites. All cards included a label and a more detailed description of what it represented from the website. Participants could view the description by clicking on the card information (see Figure 1). A full list of the cards can be found in Appendix A.

Figure 1

Example of a card and its description as seen by participants.



Item Selection and Design

In order to conduct the card sorting task, a list of items present in GGD websites needs to be selected. To better generalize the information from multiple different GGD websites, we chose the cards in such a way that broadly represents the content present in them. The reasoning behind this procedure was motivated by Spencer (2009), who in their book regarding card sorting techniques recommends using items that are representative of the site, that participants can easily understand, have to do either with functionality or content but not both, and selecting content that can be grouped. One recommendation of Spencer (2009) that was ignored in our study was using the same level of content e.g., broad “Vegetables” and specific “Carrot” cards should not both be included in the card sort. However, due to a limit of 40 maximum cards usable in the kardsort.com website, edits had to be made to not include items that were too specific. To limit bias, we only made sure to do this for items that were always included under the same category (e.g. information about scabies was always included under infectious diseases, so the card scabies and other similar ones were left out and represented instead by “Infectious Diseases”, but information about safe swimming was only sometimes included under “Unhealthy Housing”, so the swimming card was left in to test how participants would group it).

The selection procedure consisted of the two researchers choosing ten GGD websites of the bigger Dutch municipalities and each writing down a list of relevant pages in five of these sites individually. For the aim of this study, the professional and contact pages were left out, focusing only on the information intended for public use. Then, a filtering of the web pages that appeared most often across GGD sites was made based on frequency. All pages intended for public use that appeared on four or more sites were kept in the item selection procedure. After, the two lists were further compared leading to a draft of the final card collection. The final

selection for items was based on (1) whether cards contained information that was too similar (e.g. noise, air, soil pollution were merged into one card “Unhealthy Living Environment”), (2) whether or not it included content as an information goal (e.g. pages of only redirect links, news, or sign ups were left out), and (3) on how specific the information was (e.g. cards like Pesticides or Regional Advisers were left out).

For most cards, their information was found on the same pages across all ten websites, and they were labelled and described according to the topics covered. For certain cases, websites presented and included information in slightly different ways from each other. This was the case for items such as “Overweight”, “Exercise” and “Elderly Health Care”, which did not always have pages of these matching labels in the websites but information about these topics was found more scattered. These cards remained in the selection in, and their descriptions were generalized to the information that majority of the websites included. The card description was based on what people could find or do in that page, usually containing keywords like “information about”, “reports of”, “consultation about”, “tips and advice for”. In terms of editing item labels, we tried to reduce the amount of same words found in the cards as to limit obvious keyword groupings between them. To do this, we followed Nielsen (2009) recommendations of introducing synonyms and non-parallel structures in card labels. For example, instead of “Drug Examination” “Medical Examination” and “STD Examination”, cards were instead labeled “Analyzing Drug Content”, “Medical Examinations” and “Examination for STDs”.

The card sorting method used in this study was a single-level open card sort conducted remotely. Using open card sorting was necessary given the exploratory nature of this study for looking into the mental models of users on a domain, as this method offers more information on the clusters and category labels people create (Spencer, 2009). Online card sorting was seen as

more convenient given its added benefits of making the study more accessible to participants and easing the process of data collection and analysis for the researchers. However, it is possible that in-person card sorting could have also been beneficial given its decreased constraints, as there would be no maximum number on the cards used and the possibility for multi-level card sorting would be present. Across previous research, hierarchal card sorting, where participants are asked to further divide categories in an extra step, seems to be successful and offer more information per participant (Harloff, 2005 ; Schmettow & Sommer, 2016). Unfortunately, this was not a possibility in the design of our online study.

Procedure

At the start of this online study, participants were presented with general information about the study and a consent form explaining that their participation is voluntary, they have the right of withdrawal and data confidentiality. Then, a five-question demographic questionnaire recording age group, gender, country of origin, education level and experience with creating website structures was taken. Before starting the card sorting task, participants were presented with instructions on how to complete the task and additional information which they could access at any time by the click of a button. In this information, they were told that they should sort the cards into groups as they would expect to find them on a municipal health service website and reminded that there are no right or wrong answers but only the grouping that makes sense to them. They also received instruction about how to use the website of the online task.

As the task itself was an open card sort, so the participants created and labelled the categories themselves. Participants had to drag and drop the cards from a list into the groupings they saw fit. The groups could be edited, removed, or renamed at any time. They were instructed that they should use the labels to describe the cards in each category, and to try to put all cards

into meaningful groups. The card sorting task was not hierarchal, so participants could not make subgroups inside the categories and the order in which cards were put was not important. Additionally, they could not put one card into multiple categories. When the participants finished making the categories, they pressed next, were thanked for their participation and contact opportunities were provided. The study was expected to last approximately 20 minutes.

Data Analysis

Before analyzing the data, the participant entries were looked through to check whether all participants made a serious attempt to complete the card sorting exercise. Card sorting entries would be considered suspicious and excluded from the analysis if the participant had created less than five categories, or if the quality of labels was not meaningful (Righi et al., 2013). For example, participants with more seven or more cards grouped into labels like “other” or labels like “x”, and participants who grouped 14 or more cards into one category were also excluded. The cards put in these categories were seemingly random to the researchers and the participants were seen as outliers, because their sorting did not seem to match each other or other participants. In the end, nine respondents were excluded from the study.

The card sorting data was analyzed using the application SynCapsV3, which produces similarity matrix heatmaps based on the data from the kartsort website. The similarity matrix is dichotomous and looks at whether two items are grouped together or not, and how often. Based on this, a heatmap was created based on the percentage of times each item was placed with every other item, thus giving an indication on the strength of the relationship between individual items. SynCapsV3 also created its own categories based on stronger item to item correlations it recorded, which were marked by lines,. However, in analyzing the results of the card sort these lines were hidden as to not conflate with the researcher’s interpretations.

This item-by-item heatmap does not provide information on the category labeling, so labels of each category participants made were investigated in order to find common themes. Although labels were rarely worded in the exact same way, there were often similarities between them, such as between “sexual health”, “sexual safety”, “sex health”, “sexual health and safety”, “safe sex”, “health in sex”, which were all merged under the label that appeared most often: “sexual health”. This process was repeated for other category labels such as “parenting”, “parental”, “parents and kids”. The choice for creating the final category label depended first on what appeared most frequently in the participant data, and second on similar labels seen across GGD websites.

When dealing with category labels that included multiple concepts linked by “and”, attention was paid to the individual items in these categories. For example, “Physical Health”, “Health and Lifestyle” and “Physical Health and Lifestyle”, or “Housing”, “Housing Issues”, “Housing and Shelter”, and “Housing and Homelessness” were merged as the items included in these categories were largely the same. For labels like “Housing and Environment” or “Housing and City”, initially the choice was made to keep them separate as new item concepts were included. However, after looking at the results from these merged categories the included items were largely the same, as it seems multiple participants included environment related items into the initial housing category. Therefore, the housing and environment groups were merged into the more general housing category.

In addition to the item-by-item matrix, SynCapsV3 creates an item-by-category matrix, which presents categories in one axis and individual items on the other. In this heatmap, the frequencies in which each label appeared with which items are visible. Merging the common categories together under new labels was important in making the cluster labels in this matrix

readable. For this reason, some of the categories were merged a second time based on the similarity of items present even if the specific labelling of the categories differed somewhat.

Based on the clusters of item-by-item matrix and the item-by-category matrix, the average mental model of users was interpreted and described by the researchers. Specifically, similarity score, which is the number of times that participants grouped a particular item together with another item, was looked at. Those items with a score of higher than 55% indicates a high similarity score, as more than half the people have grouped these items together. Conversely, for items with a score of between 30% and 55% the similarity score was seen as inconclusive as no agreement could be found between participants. Meanwhile scores between 0% and 30% were considered low as those items do not seem to have a distinct grouping with each other. For the item-by-category matrix, there is instead a percentage of how many times a category included a particular item.

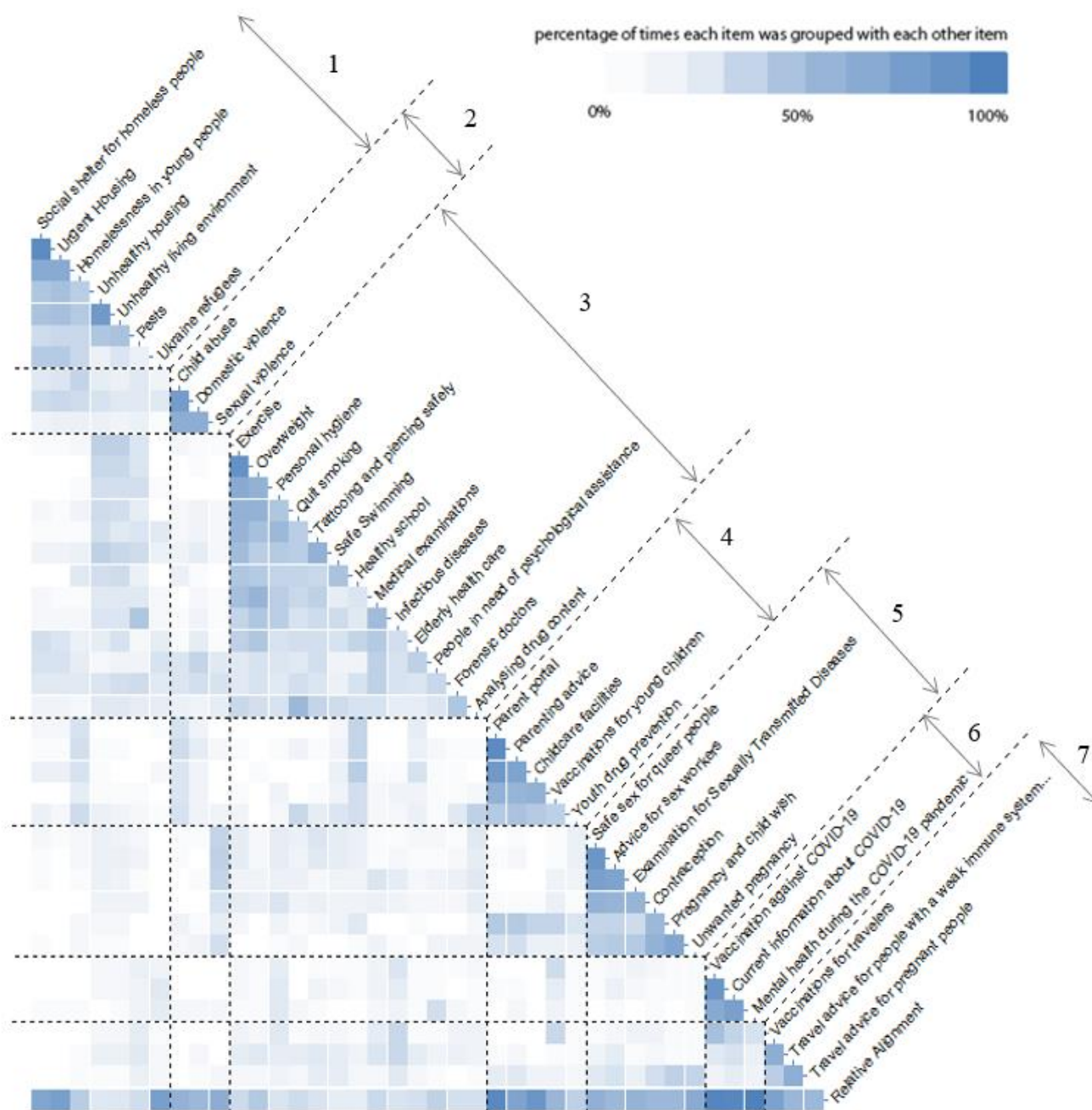
Results

On average, the participants made nine categories, with a mean of four items into each category. In the final result, the researchers could identify seven clusters. By looking at the item-by-item heatmap in Figure 2, we can see that certain items are far removed from each other (in white or light blue color), while other items are linked together more often (darker blue color). For most items, there are “hotspots” created which show that these items form a cluster. The clusters can be seen in Figure 2 by looking at the distinct triangles formed in the heatmap. In addition to the item-by-item matrix, the item-by-category matrix shows the number of times participants put certain items in certain categories by label (Figure 3). The darker the color, the more frequently participants have grouped these items under the category that can be read on the x axis. This heatmap allows us to have a better look at the mental model of the users by

investigating their wording of categories. In the following section, the seven clusters and the different categories formed by participants will be discussed.

Figure 2

Heat Map of the item-by-item matrix



Category 1: Parenting and Childcare

One of the most distinct categories visible in the heatmap is about parenting and contains items like “Parent Portal”, “Parenting Advice”, “Childcare facilities” and “Vaccinations for Young Children” all of which have a high similarity score with each other. This category was the one that appeared most often as 29 participants (80%) used this label or similar. It also contains the item of “Youth Drug Prevention” which has a medium similarity score with the other items of around 42%. The item is also grouped together with “Analyzing Drug Content” 36% of the time, usually under the category of “Drug and Substance Abuse”. These similarity scores are inconclusive, which makes the “Youth Drug Prevention” item more ambiguous compared to the rest of the group, but we decided to categorize it with the parenting cluster as that has the higher score.

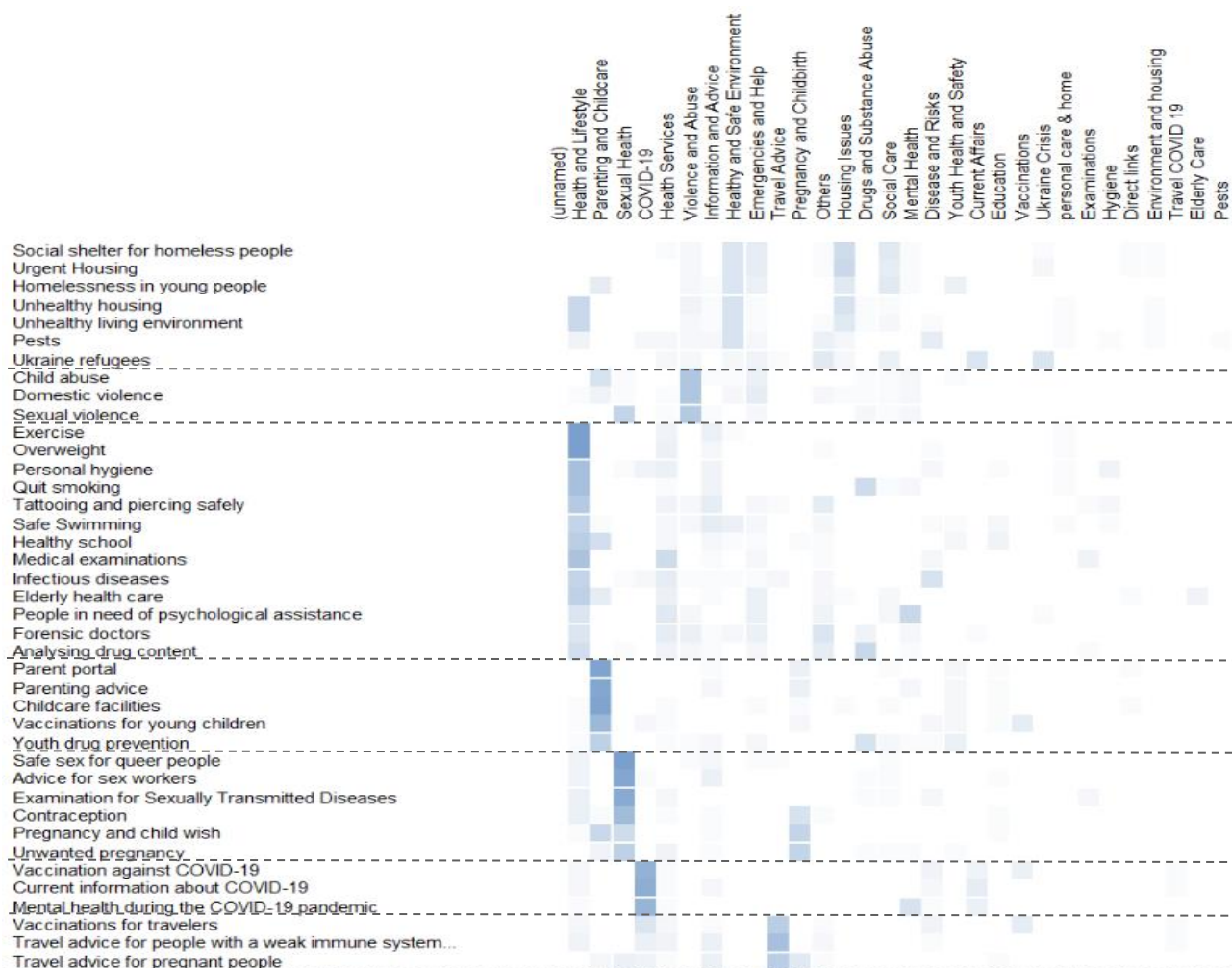
Category 2: COVID-19 3

A second category of items that were grouped together very often is that of COVID-19, including the items “Vaccination against COVID-19”, “Mental Health during the COVID-19 Pandemic”, and “Current information about COVID-19”. These items were very strongly linked together, as around 75% of participants put them with each-other and 64% of participants made a category called “COVID-19” which mostly included these items. However, around 10% of participants opted to make a category labeled “Current Affairs” which included the three COVID items as well as the card “Ukraine Refugees”. This latter categorization stems from the fact that the card “Ukraine Refugees” lacks good logical links to other cards, as its other strongest category groupings were in “Ukraine Crisis” and “Others”.

Some participants also opted to enlarge the COVID-19 category by including items about travelling like “Vaccination for Travelers” (19%), or “Travel advice for people with a weak immune system” (10%). This is likely due to the impact that the COVID-19 pandemic has had on travel regulations and perception of vaccinations, which strengthens this link in people’s mental models although the cards did not specifically talk about COVID-19. Despite these small differences in the category groupings, we decided that the final category should only include the original COVID-19 items as that is what the majority of participants agreed with.

Figure 3

Item-by-category matrix with the edited category labels



Category 3: Travel advice

Another small category similar to COVID-19 is that of “Travel Advice”, which includes items like “Vaccination for Travelers”, “Travel Advice for Pregnant People”, and “Travel advice for people with a weak immune system”. These items all had a high similarity score and 53% of participants made a category called “Travel Advice” or similar. Second to the COVID-19 links mentioned above, the only other matching clusters with items of this group were the card “Travel Advice for Pregnant People” being put with the category “Pregnancy and Childbirth” 17% of the time and the card “Vaccination for Travelers” being put with the category “Vaccinations” 14% of the time.

Category 4: Sexual Health

The items of the Sexual Health cluster were “Safe Sex for Queer People”, “Advice for Sex Workers”, “Examination for STDs”, “Contraception”, “Pregnancy and Childwish”, “Unwanted Pregnancy”. This was the one second most frequent category, as 28 participants (77%) created a category with label. One smaller cluster inside this category is about items relating to pregnancy. In particular, “Pregnancy and Childwish” and “Unwanted Pregnancy” had an inconclusive similarity score with the other items and were only included in the Sexual Health category around 32% of the time. Conversely, 12 participants (33%) opted to make a new category of Pregnancy and Childbirth, sometimes alongside the item “Contraception” (found 22% with Pregnancy and Childbirth, and 53% with Sexual Health”).

The participant’s choice to separate the two categories makes sense considering the other pregnancy and child related items in the card sort such as “Travel Advice for Pregnant People”.

However, considering “Travel Advice” is its own category, without that card the pregnancy cluster would be left with only two main items. Due to this, we decided to include the Pregnancy and Childcare items with the other sexual health items despite the somewhat ambiguous results.

Category 5: Violence and Abuse

This category included items “Child Abuse”, “Sexual Violence”, and “Domestic Violence” which were put with each other around 68% of the time. Although 16 participants (44%) made a Violence and Abuse category, sometimes these three items were divided among other categories instead. What stands out the most is “Child Abuse” being put in the Parenting and Childcare category 22% of the time and “Sexual Violence” being put in Sexual Health category 33% of the time. Other noteworthy groupings of these three items were in a category called “Emergencies and Help”, which included various other items relating to things people could get help from or services offered to people in need. These two groupings portray the differences in people’s mental models of the website. While most people opt for the literal grouping based on the wording of the items themselves, some others look what the situation in these items entail and how it relates to other cards.

Category 6: Housing and Environment

One of the more ambiguous categories present in these results is that of Housing and Environment, which includes items “Social Shelter for Homeless People”, “Urgent Housing”, “Homelessness in young people”, “Unhealthy living environment”, “Unhealthy housing”, and “Pests”, “Ukraine Refugees”. The average similarity score of all items in this category is 44%, which makes this cluster less definitive than the earlier ones. However, the similarity score of the first two mentioned items in this category to each other is very high at 92%, and the first three

items all have a high similarity score to each other as they all relate to housing and homelessness. One of the alternative ways in which people grouped these items is under the label of “Social Care”, which would have been a good category because it also includes items outside this group seen as ambiguous, such as “Elderly Healthcare”, “People in need of Psychological assistance”, and “Ukraine Refugees”. However, as only six participants created this grouping, it does not reflect the average mental model of the participants and is therefore not included.

Category 7: Health and Lifestyle

The most ambiguous cluster seen in the two heatmaps is a category most often labeled by participants as “Health and Lifestyle”, and it has the lowest average similarity score of all clusters, at 36%. Containing 13 total items, it is also the biggest category. The items in this cluster are “Exercise”, “Overweight”, “Personal hygiene”, “Quit smoking”, “Tattooing and piercing safely”, “Safe Swimming”, “Healthy school”, “Medical examinations”, “Infectious diseases”, “Elderly health care”, “People in need of psychological assistance”, “Forensic doctors”, and “Analyzing drug content”. Although the most common category label of these items was under Health and Lifestyle, people often included similar items or subgroups of these items in categories such as “Physical Health”, “Health Services”, “Information and Advice” or “Others”. One of the subgroups was in the label “Drug and Substance Abuse”, which 11 participants made. Alongside “Youth drug prevention” mentioned previously, this label also often included the items “Quit smoking” and “Analyzing drug content”, which had a similarity score of 56%.

In regard to specific items in this category, the ones with the strongest link seem to be “Exercise” and “Overweight”, which have a very high similarity score of 86%. Meanwhile, the item “Healthy School” has a medium similarity score to the other items in this group and is put

in this category 36% of the time, and in the Parenting and Childcare category 25% of the time. It seems that for some this item relates better to the education part of parenting while most others would rather relate it to health in general. Other items such as “Medical examinations” and “Infectious diseases” have a high similarity score to each other at 55% and less to the other items in the group. This is likely because they are sometimes grouped under categories like Health Services, or Disease and Risks alone. Another item that does not have any strong links in this group is “People in need of psychological assistance”, which is only put in this category 12% of the time and in a category labeled “Mental Health” 31% of the time instead. However, the group Mental Health mainly only includes the item “Mental Health during the COVID-19 Pandemic” and is not consistently linked to other items. Items like “Forensic Doctors” and “Elderly Health Care” also do not have strong links in this category and do not seem to belong somewhere in particular.

Comparison with the GGD Twente website

After looking at the results of the card sorting task, the mental model of our participants can be compared to the information structure of a GGD website. The choice for GGD Twente came partially from its function as the website for the same region as University of Twente as well as its clearly defined structure and similarity of its pages to our card selection. While other websites varied strongly between each other and our 40 item selection, GGD Twente was found to be one of the most similar ones in terms of site pages which had corresponding cards in our task. In order to compare the mental model of our users with this website, each category was looked at individually. Given the simple visuals of the site’s main categories, seen in Figure 4, identifying its structure was a straight-forward task. The site did contain other pages and information outside of the ones pictured in the screenshot, such as current news relating to


COVID-19 and the Ukraine Crisis being found mainly on the home page. The detailed comparison of our participant's mental model to the GGD Twente website follows in the section below.

Figure 4

A screenshot of the GGD Twente "Audience" page, translated from Dutch by Google


🏠 > Audience

Audience




Children and young people

Care at a consultation office and at school. About vaccinations, upbringing, head lice, proper nutrition and childcare inspections.




Sexuality

For all your questions about safe sex, HIV, STD testing, sexual violence, and so on.




Infectious Diseases

What are infectious diseases? How do you prevent infection? What are you doing about it?




To travel

Reliable advice and vaccinations for travelers.




Supervision, advice and care

Notification Center for Worrying Behavior
Inspectors
District Public Health Service
Consultation hour for homeless people
Forensic medicine



Home

About fresh air, bugs and asbestos in the house.
Report a contaminated home.



living environment

Harmful critters, asbestos.
Swim safely.

Similar to our results, the GGD Twente website also contains seven main categories. Some of the category topics and labels match almost exactly, while others have less similarity to the mental model of our participants. One of the categories that is most similar is “Children and Young People”, which matches our “Parenting and Childcare” category and includes information about upbringing, childcare, facilities, school and education, parenting support, youth health and more. The main difference in this category is the inclusion of the information in the card “Healthy School”, which was more ambiguous in our results. Another remarkably similar category is in “To Travel”, which mirrors almost exactly with “Travel Advice”, giving information about vaccines while traveling and advice for people with health problems or pregnant people.

A third category is “Sexuality”, which matches our category “Sexual Health”. This includes information about STDs, consultations for testing, safe sex and contraception, sex worker consultations and sexual violence. One thing missing from the website is specific pages relating to pregnancy, so the somewhat inconclusive results for our pregnancy items being included into Sexual Health rather than their own category are not significant here. However, the item “Sexual Violence” which was most often put in its own category is instead present here. This is not necessarily inconsistent with our results considering that 33% of our participants did choose to classify “Sexual Violence” into Sexual Health and the information for domestic violence and child abuse are not present in this website as separate pages. This means that the category Violence and Abuse is not included in the site as most of that information is missing.

Our category for “Housing and Environment”, is represented in this website as two separate categories: “Home” and “Living Environment”. One major change is that we included some the information from the category Home (critters, pests, dirty housing, lead in water, fresh

air) and Living Environment (pollution, smoking, safe swimming, oak processionaries, asbestos, ticks) as cards themselves into “Unhealthy home” and “Unhealthy living environment”. This was done to simplify the task as the information about the exact pollutants was considered too specific. Nonetheless some of the information, such as “Pests”, “Quit Smoking” and “Safe Swimming” was left as separate cards due to other websites categorizing them differently. Majority of people opted to include “Pests” into the same category as the “Unhealthy environment”, but not the other two. The items “Quit Smoking” and “Safe Swimming” did not have a high similarity score with each other or the “Unhealthy Environment” card in our participant’s mental model. Albeit our results stray from the website categorization, it confirms our suspicions about these two items not necessarily belonging into this category.

Instead of the previously mentioned category, the GGD Twente website opts to put the homelessness and housing issues information into a category called “Supervision, Advice, and Care”, alongside pages about forensic doctors, worrying behavior and psychological assistance, hygiene, health services, and inspections of tattoos and piercings. This is similar to some of the items in our category “Health and Lifestyle”. However, a lot of the items included in that category like “Elderly Health Care”, “Exercise”, “Medical Examinations”, “Analyzing Drug Content” and more are missing from this specific website, so it is difficult to determine their position and relation into this website category. Although there is no category from our results that matches exactly, the website classification does seem to vaguely mirror that of our participants, but this could be a result of these items being left over from both categorizations.

A final category on the website is “Infectious Diseases”, which does not match anything in our results since infectious diseases was included only as a card. The category in this website had information about whooping cough, hepatitis B, tuberculosis, scabies, food infection, etc.

which was seen as too specific to be separate cards and was instead linked into one. Although this does not give a lot of insight into our results for this category, this choice helped the card sorting task to be easier on the participants. In addition, the GGD Twente website also contains extensive information about COVID-19 in a separate part from the rest of the categories. Nonetheless, the information matches the one found on our results and the participants' mental model of the COVID-19 category being separate.

Discussion

To increase the user's ease of navigation it is important that the website information is organized in way that is intuitive for the user. One method that makes it possible is by eliciting the user's mental models and designing the information architecture of the site accordingly (Sinha & Boutelle, 2004). The goal of this research was to discover people's mental models of GGD websites and use them as the basis for evaluating and giving recommendations to a website of choice. To this end, we collected data from a card sorting task where users sorted a group of 40 of the most frequent pages found in GGD websites. Comparing the user's results to the website of GGD Twente, it seems that the mental models of the users are largely in tune with the information architecture and organization of this website. Although there are no major deviations, the findings of user's mental models of the site are particularly of note.

Findings about the user's mental models

The way that people chose to group items together under their own categories gives indications for their understanding and expectations of the domain. The results reflect that users preferred to think about the cards meanings in a straightforward way and link information based on topical similarities. For example, instead of categorizing all cards related to reporting

something with each other, participants generally opted to group them under the topics for which the reports would be about. This suggests that users search for information primarily based on their momentary goals and needs of a certain area of health. Similarly, instead of grouping all cards related to vaccination together, majority of users divided them into the topics that the vaccinations were about: travelers, covid, and young children. This interpretation is reasonable considering the user's information goals when trying to access the GGD Twente website before travelling for example: one would prefer to find everything related to travel in the same place instead of having to think about travel vaccinations separately. It seems based on the results of the mental model, that users generally prefer to have the information categorized based on what will best serve their momentary information goals.

In a similar vein, users also used semantic similarity to guide them through the card sorting task. In most of the high agreement categories, there were common words or synonyms that linked the cards together: e.g. in the category "Violence and Abuse", all card labels contain the word "violence" or "abuse", in the category "Travel advice", all cards labels contain the word "travel" or "Traveling". This suggests that majority of people are driven to group based on the label of the card potentially more than its description or meaning. This can be seen as an extension of fast and slow thinking theory, as when there are patterns formed people are inclined to use automatic thinking process (Kannengeiser & Gero, 2019). Conversely, in the ambiguous category of "Health and Lifestyle", majority of the cards did not have a close semantic link. Despite this, certain users did find logical links between the meaning of the cards and opted to make subcategories that focused on commonalities such as "Information and Advice" or "Health Services". In this case, it is possible these users decided to use slower thinking and go through their reasoning processes in a more stepwise method (Solaki et al., 2021). However, pushing

users toward slow thinking may be ill-advised in the context of efficiency in website navigation. Wood and Wood (2008) also bring up the issue of participants taking time to carefully consider their card sorting task while in navigating the Web users would be less likely to be cautious. Users may fail to find information under categories for which they do not see an immediate link.

The results can also be interpreted in terms of where participants chose to draw the line between categories, and how closely linked groups of items were. For example, although most items were related to health in some ways, one category were left more broadly as “Health and Lifestyle”, while another grouped more specific information under the label “Sexual Health”, which some opted to even further divide into “Pregnancy”. This reflects the way that people think about these topics, as in our results a majority of participants seem to feel pregnancy is more closely related to the concept of health rather than parenting. However, this may be a result of the age group and gender of our participant pool, being mostly younger women. Due to this, contrary to our results, a recommendation is made to keep “Pregnancy” as a separate category in order to avoid confusion for the groups of people who did choose to group pregnancy related items under parenting. Various design guidelines also offer that in order to make navigation easier, category labels should be specific and descriptive of the items inside it, which applies in this case (Rosenfeld, 2015). Additionally, it was curious to find that the cluster for COVID-19 did not include “Infectious Diseases”. This could be due to the effect that the COVID-19 pandemic has had on people’s mental model of COVID-19 as a infectious disease that requires separated information. In terms of what information people chose to separate from each other, participants’ mental model was dependent on their personal and situational relations to the items.

Limitations in comparing with GGD Twente

In regards to the method used to solicit participant's mental models, there are apparent limitations for using it as a basis of comparison with the GGD Twente site. The site was found to be very similar to the mental model of the user, with four out of seven of the categories matching almost exactly. However, two of the remaining categories which did not match were due to the nature of the items included in our card sorting task- some of the more specific information found on the site, such as particular diseases or pollutants were merged into singular items. Meanwhile in the GGD Twente site, the cards "Unhealthy Home", "Unhealthy Environment" and "Infectious Diseases" were found as already separate categories. Although the information about diseases and pollutants inside these categories was very common in other sites as well, we decided that it was too detailed and different from the rest of the cards, and it was necessary to merge them to make the task more time efficient and manageable for the participants. However, due to this, our approach does not precisely convey all the pages of this website and assumption was made that our participants would also choose to group the information inside the cards the same way. As a result, it is not possible to make recommendations for redesign within these categories.

Although the category "Health and Lifestyle" somewhat matched the information on the website's "Supervision, Advice, and Care", it is difficult to arrive make recommendations about this grouping as well. Many items included in our card sort were missing from the GGD Twente website, so that itself influenced the results. As the cards were derived from the "average" of 10 websites which contained very different information from each other, it was not possible for this study to choose a website directly comparable to our card sorting task. Although GGD Twente had one of the best matches as majority of the pages present in the site were represented as cards,

not all cards were applicable as our study included more items than this website. Despite the fewer number of items, this cluster does have similarities to the more ambiguous category seen in our results. On the website, ambiguity is reflected by the category label including three different words to join the items together. It seems that in both results the items of this cluster lack the strong logical and semantic relation to each other that is shared by some of the other matching categories such as “Sexual Health” or “Travel Advice”. This might make it more difficult for users to find the information inside these groups, however the GGD Twente category for “Supervision, Advice, and Care” does seem to better encompass the items inside it in terms of semantic closeness which would help guide users.

For other ambiguous items, although our participants found it hard to arrive at a joint conclusion, we can still compare them to the website’s decision of their belonging category. For example, the cards “Safe Swimming” and “Quit Smoking”, which were included in the Living Environment category of the Twente website do not seem to have a good relation to each other or that category in our results. This is one of the deviations that the website has from our participants’ mental models. However, considering that our results were inconclusive as to where exactly these two items belong, we cannot make a clear recommendation to include these items elsewhere. Similarly, the item “Healthy School”, which was ambiguous in our results was put with the “Children and Youth” category on the website. One of the main differences here could be in the category label: while our participants’ label was focused on parenting the website instead put the child as the focus, which might have a closer semantic link to education. As our participants found it difficult to arrive at a conclusion for these items’ categorization, it is difficult to validate the website’s decision although there seems to be some logical reasoning

behind it. For these ambiguous items, a recommendation can be made to include them as cross links under different sections so that both groupings are accommodated (Righi et al., 2013).

Generally, it seems that a lot of the drawbacks of this study method can be related to the process for item selection. However, although tips were followed, no clear guidelines were found in literature in terms of best practices for informed item selection, especially in light of covering the content of a domain in websites. Literature on card sorting focuses more on the number of cards to include rather than the exact process for content selection. Literature review by Hannah (2005), seems to arrive at the conclusion that up to 100 cards is acceptable and would be a good balance between covering the content and not being overwhelming. However, more recent empirical evidence seems to suggest that up to 60 cards might be the upper limit depending on the knowledge needed about the domain (Blanchard & Banjeri, 2016). Additionally, Miller (2011) by use of their theoretical simulations argue that less cards are necessary when making informed item selection rather than random. For our study, it would have been useful to include a higher number of cards so that we could avoid grouping together different information under the same item, but this was not possible due to kardsort.com website limits of 40 maximum cards.

In addition, due to the finding concerning semantic links between items it is important to consider the way our card labels may have biased this result. In their book, Spencer (2009) suggest that participants often put cards together based on pattern matching, and if certain words come up more often this can give them an easier but possibly biased way of grouping content. Indeed, in our card sort multiple items contained synonyms or variations of the same word and there is a possibility that this lead their activity. However, the labeling for our cards was taken from the labels that GGD websites used for their content pages and following recommendations from Nielsen (2009), attempts were already made to limit potential matching as discussed in the

methods section. In our study we do not believe that there was a strong bias effect, as in certain cases despite cards starting with the same word, i.e. “vaccination”, they were put in different categories by participants. Although we believe that our item selection covers the main content of the domain since majority of items in our task were present across all sites, there are differences for each regional website that are difficult to account for and cards might have benefited from further editing to avoid bias as much as possible.

Given that the most ambiguous category was also the largest, making website-specific card sorting tasks could make it easier to subdivide this cluster. In addition, because our card sort included domain specific items from 10 different websites, it was more challenging to apply the results into a single website due to the nature of our item selection process. Majority of website redesigns that employ card sorting do so with the purpose of redesigning a specific website, typically academic libraries and either choose a random set of cards or cards that are representative of same-level content in the website. On the other hand, a card sorting task that includes information from multiple websites might make it easier to explore the mental models of that domain in general and use this to compare websites to each other or conduct further testing (Doran et al., 2018). It is possible then, that our method of item selection for this card sorting task did not fit the subgoal of making recommendations to a specific website, but rather as an exploratory task for the mental model of the domain.

Put together, despite the overarching similarities in the high-agreement categories, parts of these results make it somewhat difficult to validate our method of eliciting mental models for the purpose of a redesign. The fact that some of our items had a low agreement rate between participants is a finding which could be used to follow up on this research by use of interviews or a closed card sort. For example, Brucker (2010) suggests that ambiguous cards and categories

can be avoided by employing a closed card sort, where users have to organize into predefined categories, after looking into the group labels. As an open card sort provides a lot of freedom to the participants, it can lead to such situations where the average mental model cannot be determined. Looking into these cards further might suggest that these are areas of confusion for users, and they might deviate using the menu-based navigation to complete their information goals (Sundt & Eastman, 2019). In future research, follow ups in the form of interviews to determine category labels for the more ambiguous clusters from the results of this study and closed card sorts with similar categories are suggested.

In this study, we looked at the way card sorting can be used to elicit mental models of a GGD website, and we used these results to compare and give recommendations. We found that the mental models of users were generally robust as participants largely agreed on some main categories about parenting, sexual health, travel, covid, violence and environment and housing. One group of items that might need further investigation are those under the category for health and lifestyle, for which the average mental model was ambiguous. In general, this study has provided important results on exploring user's mental models of municipal health websites, which was missing from literature today. Despite areas of ambiguity, a majority of our cards did have high agreement levels between participants and clear categories have been formed which represent the content of the domain well. For the purpose of redesign of existing websites, it would be wise to alter the method of item selection used in this study. In conclusion, card sorting was found to be a good starting point for helping to structure information of this domain based on the user's mental model, and important results about the average mental model of municipal health websites were obtained.

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Appendix A

List of all 40 cards present in the study and their descriptions.

Pests	Reporting of infestations of rats, critters, caterpillars, oak processionaries etc. inside and outside the house
Sexually Transmitted Diseases	Testing and consultation for preventing sexually transmitted diseases
Exercise	Tips and advice on reaching the exercise norm to have a higher chance of aging well
Overweight	Information about being overweight and organized activities for people that suffer from obesity
Elderly health care	Information about health care for elderly, for example, dental care and exercise
Quit smoking	Information on the dangers of smoking and advice on how to stop smoking
Youth drug prevention	Information for parents and care givers on how to prevent teenagers from taking drugs
Unhealthy housing	Reporting and information on asbestos, dirty housing, lead in water, increased moisture
Contraception	Information about what contraception methods exist and options of consultation
Pregnancy and child wish	Tips and advice before and during pregnancy
Unwanted pregnancy	Anonymous decision-making advice for women that are pregnant unintentionally
Vaccinations for travelers	Information about which vaccines are necessary when travelling to specific countries
Vaccinations for young children	Information about the vaccination program for babies and children (What vaccines will my child get? When will they get them?)

Forensic doctors	Information, practicalities, and reports related to police reports or investigations (e.g., reporting accidents, suspicious deaths, driving under influence etc...)
Medical examinations	Medical examinations and general health monitoring with doctor appointments
Infectious diseases	Information about a variety of infectious diseases (e.g., general information, insurance for hepatitis B, C, scabies, chicken pox, whooping cough etc...)
Homelessness in young people	Reporting homeless youth and information on how organizations will care for homeless youth
Tattooing and piercing safely	Monitoring of tattoo and piercing studios to make sure that they are safe and hygienic
Sexual violence	Reporting, information, and help with sexual assault and rape
Safe sex for queer people	Preventing the transmission of STDs through vaccination, medicine and consultations for men have sex with men and trans people
Analysing drug content	Legally getting content and risk of drugs checked before consumption
Advice for sex workers	Offering sex workers to test for sexually transmitted diseases and consultation hours for giving information on how to work safely
Parent portal	A website on which parents can access their children's digital health record (e.g., growth curve, development, registered vaccinations)
Mental health during the COVID-19 pandemic	Information and advice about the negative impact of the coronavirus on mental health
Healthy school	Information and advice about how to be a healthy school (e.g., fruit days, education about relationship and sexuality, smoke-free school grounds)
Personal hygiene	For example, handwashing, cleaning, and food hygiene
Childcare facilities	Childcare facilities that meet requirements of a healthy and safe environment for daycare

Child abuse	Information about child abuse and possibility to report suspicions of child abuse
Ukraine refugees	Information about how to help refugees from the Russia-Ukraine war
Vaccination against COVID-19	Information about vaccination locations and frequent questions about the corona vaccine
Travel advice for pregnant people	Information on how to prepare for travelling while being pregnant
Travel advice for people with a weak immune system or an illness	Information about risks they can encounter, and advice related to travelling to certain countries for people with a weaker immune system
Current information about COVID-19	Latest news about the COVID-19 pandemic, for example corona-updates
People in need of psychological assistance	Reporting or seeking help for people who are exhibiting worrying behavior and might need psychological assistance
Social shelter for homeless people	Access and guidance to various forms of social shelter and sheltered housing for homeless people
Safe Swimming	Information and advice on diseases from swimming waters and clean hygienic swimming
Urgent Housing	Information and advice on getting emergency shelter for people in need
Domestic violence	Reporting cases of psychological or physical abuse in domestic situations (from children, adults, elderly)
Unhealthy living environment	Information about bad air quality, soil pollution, noise pollution
Parenting advice	Advice and information on raising children based on different ages