Bachelor's Thesis

Website Navigation Structures:

Eliciting Mental Models of Dutch Municipality Websites using Card Sorting Test

Can Erdogan

Faculty of Behavioural, Management and Social Sciences

University of Twente, Enschede, Netherlands

First Supervisor: Marlise Westerhof

Second Supervisor: Dr. Martin Schmettow

23-01-2024

Abstract

The purpose of this research is to elicit an average mental model of municipality website users and furthermore compares if existing municipality websites are in accordance with the elicited mental model. The results are intended to provide design recommendations for possible improvements of those websites. In the first phase a remote open card sort study was conducted to determine the average mental model. Participants grouped cards that contained topics of municipality websites together how they expected them structured together on a municipality website. The results of all participants were defined in a heatmap that allowed to find clusters that represented the average mental model. In the analysis six clusters und five ambiguity groups could be found, which were compared in the second phase of the study with existing navigation structures of municipality websites to find similarities and differences. The aim was to identify potential possibilities for improvements in their information architecture and to make accordingly design recommendations. The websites of Amsterdam and Den Haag were used for the comparison, and it was possible to recognise that both websites are mostly in line with the elicited mental model, but nevertheless Den Haag showing better alignment and ease to find topic relations. Five out of six clusters and one ambiguity group could be recognised in their information architecture.

Keywords: Mental model, Card Sorting, E-Government, Municipality Website, Information Architecture, Usability, Accessibility

Table of Contents

Introduction

The widespread availability of using the internet enables to search for any kind of information easily, but just like the versatility of information that can be found, there are countless variations of how websites are structured. Accordingly, the ease of finding desired information is also versatile. This variability underlines the importance of providing websites with user-friendly access to information, which is particularly crucial for e-government platforms such as health services (Dutch: Gemeentelijke Gezondheidsdienst, GGD) or municipality websites. These websites aim to handle citizen information needs, requests, and reports, which were conducted in physical settings before the internet was widespread available. When it comes to municipality websites one might expect that there should be similarities among them as they should offer comparable information. However, if one compares the municipality websites of different towns in the same country the differences between them become obvious at first glance. In the Netherlands e-government websites must follow laws and regulations to offer a standard in accessibility to their websites (Velleman, 2018), but comparing them makes it clear that there is no standard in how these websites are structured.

The website DigiToegankelijk.nl (2023) provides an overview of 9677 government websites and apps and assesses their status of accessibility. Only 5% (442) are fully compliant to the accessibility standards and 32% (3109) of those websites are following the legal objections partly. This leaves approximately 63% of governmental websites that either do not meet the requirements or have not been reviewed yet. According to the World Wide Web Consortium (W3C) (2012) the Web should be designed to work for all users, independent of their used hardware, software, language, culture, location, or physical or mental ability. Badly designed web tools can create barriers that exclude people from using the Web (W3C,2012). Although it is not necessary that all municipality websites offer the same layout, several problems might occur if certain information are not easily accessible. It becomes apparent in the case of the municipality website of Utrecht if this is assessed by the usual way of typing in the URL into the address bar (*Homepage Utrecht.nl | Gemeente Utrecht*, n.d.). The website defaults to Dutch, lacking a visible language change option unlike other Dutch

municipality websites. Although an English version can be found through a search engine, this discrepancy may lead to accessibility issues, such as inequity to access which is contrary to W3C accessibility standards (W3C, 2012). Giving all potential users access to a website is closely related to the usability of a website (Perdomo et al., 2017).

Usability is defined by the International Organisation of Standardisation (ISO) as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO 9241-11, 1998). While effectiveness describes the degree to which a user can achieve their goal, efficiency describes the necessary effort to achieve the respective goal. Measures of web usability involve whether a task can be completed, how long it takes to complete a task, the error counts while completing a task and the perceived satisfaction of using the website (Esmeria et al., 2017). Huang & Benyoucef (2014) claim that perceived usability and perceived ease of use determine the user acceptance of e-government websites. Furthermore, if the usability is not perceived well by users it can lead to the users questioning the credibility of the given municipality (Huang & Benyoucef, 2014). In contrast, higher perceived usability can have a positive effect on the user's trust and satisfaction in a website (Flavián et al., 2006). Moreover, a website that has a perceived good usability by its users can result in the willingness to visit the website again in the future (Wentzel et al., 2016). The willingness to visit these websites again might be important for residents who want to keep up to date with municipality news and events or handle municipal services such as yearly taxes themselves. An aspect that affects the perceived usability of a website is the information architecture of a website (Rosenfeld & Morville, 2006).

The information architecture is the way how information and content of a website is labelled and structured (Ntouvaleti & Katsanos, 2022; Perdomo et al., 2017). If the information architecture of a website has substandard navigability, it can impair the uptake of information (Wojdynski & Kalyanaraman, 2016) and impact the usability negatively (Nawaz, 2013). An information architecture that is good on the other hand can help users to find information they seek easier (Fang & Holsapple, 2006) and therefore can increase the usability (Rosenfeld & Morville, 2006). The accessibility concept

is closely tied to usability, involving that the design of e-government websites is accessible by individuals with disabilities (Perdomo et. Al., 2017). It is not only a usability consideration but also a legal matter acknowledged by e-government initiatives, relying on technology to assist people with disabilities (Alshira'H, 2020). Recognizing and prioritizing this connection is important for fostering inclusivity and ensuring that websites effectively serve all users.

Human Centered Design

One way to ensure that a website meets the requirements and expectations of a user is the human centered design (HCD) approach. The developers put the end users perspective central in development to ensure that the end product matches their preferences and abilities in a way that promotes the usability (Maguire, 2001). Implementing users perspective in creating an information architecture can be done by aligning it to their mental model. Mental models are personal frameworks about how things, such as devices applications or websites, function and therefore influence the respective usage (Roth et al., 2010). Each person creates their own mental models based on their personal life experiences, personal perceptions, given information and their general understanding of the world (Jones et al., 2011). Having such established mental models can enable the users to make predictions about unknown objects such as visiting a new website to get a fast understanding of how the website is build up and works (Phillips et al., 2011). A website structure aligned with the target group's mental model might enhance the perceived usability by reducing the effort required to achieve information-related goals and therefore enhance efficiency (Schmettow & Sommer, 2016). Schmettow & Sommer (2016) suggest that mirroring the mental model of users is a precondition for good usability. This can be due to improved memorability and faster navigation if the website structure matches the mental model (Oulasvirta, 2004). Considering individual differences in mental models, it is crucial to establish an average mental model that represents the average user. To create an information architecture that aligns with the target groups average mental model, a suitable research method to determine it is called Card Sorting.

Card Sorting

Card Sorting is a research method that can be used to determine information structures of a target group with the goal in mind to create a human centered design that matches their mental models (Wentzel et al., 2016). In this approach participants are given a set of unsorted items which they are asked to categorise into groups together where items are related to each other (Schmettow & Sommer, 2016; Wood & Wood, 2008). There are two options how these items can be categorised, either as open card sorting where participants have to define the labels of groups themselves, or closed card sorting where the researchers offer predefined labels in which the items have to be sorted in (Schmettow & Sommer, 2016). Both options can be performed in person which is referred to as paper card sorting or remotely with programs or online platforms which is called digital card sorting test. Bussolon et al. (2006) suggest in their study that there are no differences worth mentioning in reliability and performance between the classic or digital card sorting tests. In this research open card sorting was used in its digital form. The way participants categorise the cards depends on their semantic knowledge and the semantic meaning they give each of these cards. This means that words that have a similar meaning or are at least somehow connected are grouped together which is also called semantic clustering. These categorisations of each participant in turn can then be analysed in a heatmap, where similarities can be found among all participants as clusters. Finally, these results can be understood as the previous mentioned sought-for average mental model. The results of a card sorting study can then be used to create or adjust a website that aligns with the mental models of users.

Previous research

This research builds on the insights of the study by Schmettow & Sommer (2016), who assumed that information architectures are most efficient if the common users mental model are taken in consideration to increase the usability of a website. Contrary to this expectation they found no relation between the congruency of a website with the users' mental model and benefits in the browsing performance. The study was divided into two phases, starting with letting students of the University of Twente sort 35 cards into stacks to identify clusters. A mismatch score was then

calculated for these items across all five websites, with a lower score indicating better alignment with the mental model. However, in the second part of the study, where participants performed search tasks on each website, no correlation was found between browsing performance and the mismatch score (Schmettow & Sommer, 2016). However, despite the inconclusive findings in this study, card sorting is useful for the design of user-friendly ontologies (M. Schmettow, personal communication, January 15, 2024). In this follow up study it will be investigated whether existing municipality websites already align with the users' mental model and whether it is possible to find opportunities for improvements.

Research Aims

The goal of this research is to find a average mental model of users of municipality websites with the help of a card sorting test to offer suggestions to municipalities how they can increase the perceived usability and accessibility of their websites. This study will concentrate on the mental models from the point of view of citizens and will be conducted with a digital open card sorting test. This results in the following two research questions: (1) *"What is the average mental model of citizens regarding search terms on a municipality website?"* and (2) *"To what extent does the elicited mental model matches the information structure of Dutch municipality websites?"*.

Methods

Participants

For this study 55 participants were recruited, of which 21 were recruited by convenience sampling and 34 have enrolled through the SONA system. The inclusion criteria for this study was to have a good understanding of the English language. The convenience sampling was performed by sending the study link to relatives and friends of the researchers via social media. The SONA system is a psychology test subject pool of the Faculty of Behavioural, Management and Social Sciences (BMS) of the University of Twente, through which it was possible to access the study link. Out of 55 respondents, 14 were excluded as these participants either created groups with meaningless names or created groups in which no recognisable categorisation could be found. Therefore, it was assumed

that these participants did not take the study seriously. This resulted in the final sample of 41 participants, of which 11 identified as male and 30 as female. The nationalities of the participants were divided in 25 Dutch, six German, two Indonesian, two from Spain and one each from Australia, Canada, UK, South Korea and Japan. The participants were 18 to 36 years old (*M=21.0, SD=3,28)*.

Item selection

For the selection of items shown on the cards, ten Dutch municipality websites were analysed to identify similarities and differences in their navigation structure (Appendix A). Those websites were chosen as they are widespread over the Netherlands and as their user interface differed from each other based on a first impression of the information architecture. Menu items, headings and subheadings were noted down and compared if these could be found on most websites. This should ensure that the created items were not too specifically tied to one website but applicable to most Dutch municipality websites. Headings and subheadings that could be found on several websites were considered as relevant items, as these seemed to be common topics for municipality websites. Afterwards the websites specific subpages were analysed in more detail to broaden the variety of items. The number of items was set after considering varying recommendations in research papers. Sherwin (2018) suggested to use 40-80 cards, whereas Blanchard & Banjeri (2016) recommended that 60 cards should be the upper limit. Older research however suggests using 30-40 cards, as the motivation of participants should be kept in mind as well (Card Sorting, 2013). Considering the arguments of these studies, a final set of 40 cards was selected. The collected items were analysed once more to assess whether they were mutual exclusive and relevant and were exchanged if necessary. One example are the items “Contact”, “Phone” and “Call” which were reduced to the single item “Contact” as it is the generic term on most websites that includes all three terms. After the final selection of items, descriptions were created which should help to clarify what the label of the cards represented on municipality websites. The list of items with their respective descriptions can be found in Appendix B.

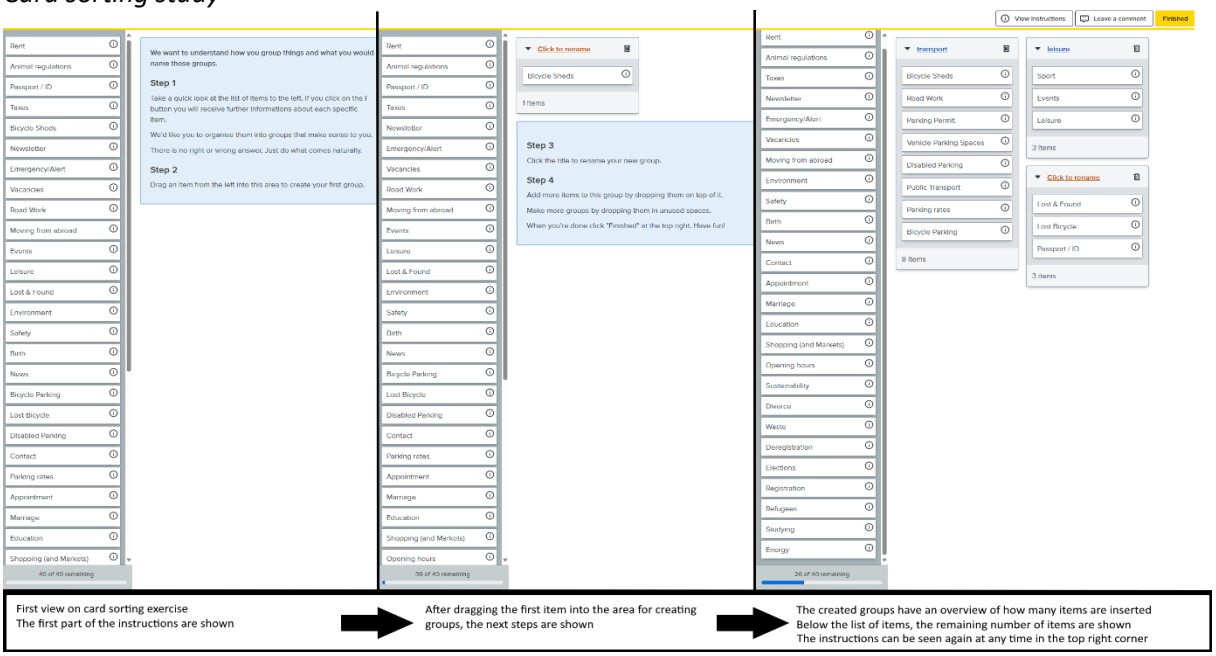
Materials

This study used the remote online card sorting website "OptimalWorkshop.com," accommodating participation on personal computers or mobile devices (see Appendix C for a comparison of interfaces). This enabled the participation regardless of time and location on own devices, provided that an internet connection was available. Furthermore, it allowed quicker participant recruitment as it would have been possible if the study would have been conducted in person. Additionally, the informed consent (Appendix D) and a pre questionnaire on demographics were incorporated into the study on Optimal Workshop, enabling to collect all necessary data on one platform. For processing the collected demographic data excel was used.

From the offered card sorting options on the website the open card sort was chosen. For this study 40 cards were created, which consisted of the item-label as well as a more detailed description for each card to clarify what the label represents on municipality websites. The descriptions of the cards could be viewed with the information button next to each label. The list of the cards can be found in Appendix B. The presentation of the cards was randomised for each participant. Moreover, the instructions and usage of the card sorting was provided on the platform itself (Figure 1).

Figure 1

Card sorting study



Note. The card sorting study is divided into two areas. On the left side the unused cards are listed and must be dragged into the right area and grouped together. The required steps are shown as info boxes and can be reread in the “View Instructions” tab in the top right corner.

Procedure

Participants accessed the Optimal Workshop platform via a shared link through personal messaging or assessing it on the SONA platform. The set up of the study consisted of five steps. Firstly, a welcome page which involved the purpose and instructions of the study was shown (Appendix E). Then the informed consent page (Appendix D) had to be read and accepted to be able to participate. After that a short demographics questionnaire had to be filled in. Following, the actual card sorting study started in which the specific instructions were shown (Figure 1). The 40 items were shown on the left side of the page that had to be dragged and dropped to the right blank side of the page. Once an item was dropped, a group was created that had to be labelled. To add more items to a group, they had to be dropped on an existing one, or if an item was dropped in a blank space another group was created. After all items were used the “Finished” button had to be clicked so that the participants were led to the final step, which was a thank-you screen with researchers' contact details for any questions or comments.

Data Analysis

The data analysis was mostly performed automatically by the platform Optimal Workshop. Before the data was analysed in detail, it was first cleaned of entries that provided not meaningful data. Entries were excluded if too many or too few categories were created as they were considered outliers, or if group labels were named in an unserious manner (Righi et al., 2013). For this purpose, each entry had to be observed individually. Examples of excluded data included participants with unserious labels like "Short term memory" for lost & found items. Participants were excluded if they had fewer than five categories, as this typically indicated the presence of large groups lacking clear differentiation among the included items. Similarly, participants were excluded if they had more than 14 created categories, as there were often single-item categories that were not effectively grouped together.

The relevant data for the results were the demographic data, the overview of created categories and their respective labels, the similarity matrix that was automatically the heatmap as well, and the actual-agreement-dendrogram. A primary way of interpreting card sorting results is the

visual analysis of heatmaps. A heatmap is a visual representation of a similarity matrix, where the intensity of assigned colours corresponds to the strength of a similarity (Stroe, 2018). A similarity matrix is an items x items matrix in which it can be seen if and how often items were grouped together (Optimal Workshop, 2021). This represents the semantic proximity of each paired items (Schmettow & Sommer, 2016). With the heatmap it was possible to analyse the average mental model of the participants by detecting clusters. Clusters are often together categorised items which can be recognised by having the same colour due to their similarity scores. The actual agreement dendrogram shows what proportion of the participants agreed to particular item groupings in percentage. This helped to distinguish further where a cluster ended or where subclusters could be found within the clusters.

These clusters then had to be named to determine how the items fit as a group into the mental model. This was done by analysing the created labels for the items categorised together. The labels are summarised based on either having semantically similar meanings or if labels are similar but differ in grammar or how the words are merged and if they involve mostly the same items. Examples of merging similar labels are “Life events”, “Life situations” and “Life stages” to “Life events”. Labels from groups not fitting into clusters, which were often single-item groups like "Emergency," were excluded. Based on the given labels by the participants, the most fitting one that describes the items of each cluster in a whole was used as the final label for the following cluster description segment.

After identifying clusters, ambiguity groups were declared. Items fitting into multiple clusters may arise from differing mental models among participants, leading to high agreements outside the diagonal line. These groups have to be identified manually by the researcher and this process can therefore be inaccurate (Stroes, 2018). To identify ambiguity groups as accurate as possible, three steps were taken which should help to give the identification a plausibility by determining the same conditions for all groups. First, similar to the cluster identification, groups were identified by the shades of the blue colour. The second step was to determine a threshold for agreement scores to narrow down the inclusion of items. The minimum similarity score that was chosen to determine

whether agreements were worth to put into ambiguity groups was 24%, which is corresponding to 10 out of 41 participants or a quarter of the participants. In the third and last step it was analysed whether there were similar groups made by the participants in which those items were placed. Those group labels were like in the cluster analysis the templates to give the ambiguity groups their names.

In the next step demographic information of the participants were analysed. This was done by importing the provided participants data by Optimal Workshop into Excel and further analysing them there.

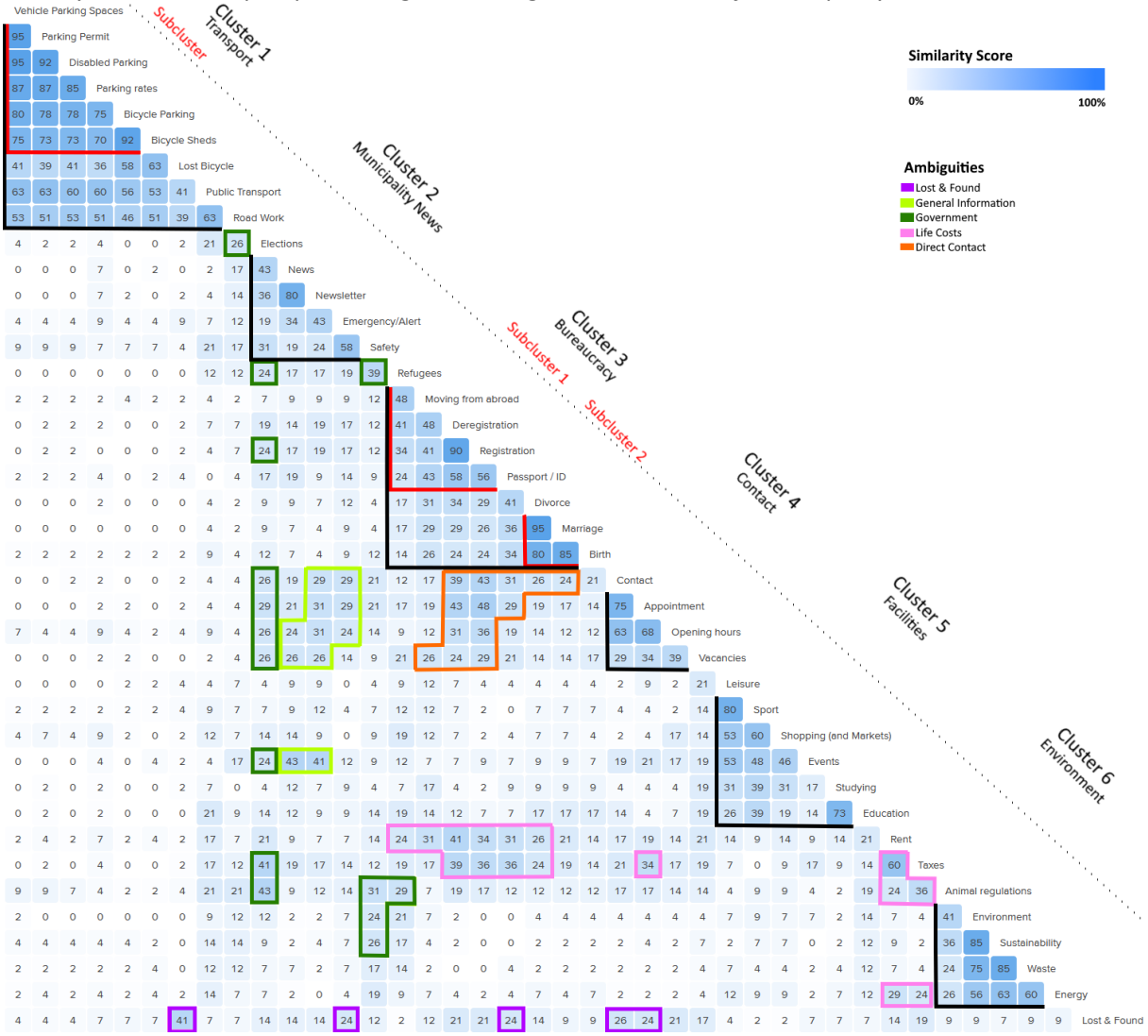
Results

To answer the first research question *"What is the average mental model of citizens regarding search terms on a municipality website?",* an average mental model could be elicited through the card sorting study. The average mental model is represented by an item-by-item heatmap (Figure 2) where the similarity scores show how often items were assigned together in the created groups. A created group consisted of items that were categorised together when participants expected that the topics of the items belong together on a municipality website. Participants assigned the items into five to 12 self-created groups and on average eight groups were created. Based on the visual examination of the similarity scores in the heatmap six clusters could be identified and distinguished. The clusters could be identified by the shades of the blue colour, where the colour represents the similarity score visually. A darker blue and a large cluster represent higher agreements between participants if cards were grouped together. The actual-agreement-dendrogram provided by Optimal workshop (Appendix F) shows what proportion of the participants agreed to particular item groupings in percentages, which helped to distinguish where a cluster ended or where subclusters could be found within the clusters. This resulted in six clusters that could be found. The identified cluster groups were outlined by black triangles to make them easier to distinguish. The identified clusters are shown in Table 1 and each cluster will be described in more detail in the following sections. Next to the main cluster groups, five ambiguity groups could be identified which involve items or group of items that are off the diagonal line as they were not clearly categorised to

one of the clusters. These groups can be identified in Figure 2 by the different outlining colours and will be further explained with the description of the clusters.

Figure 2

Item-by-Item Heatmap, representing the average mental model of Municipality Websites



Note. The black outlines on the diagonal indicate the main clusters and the red outlines show subclusters within those. The shades of blue determine the strength of similarities. The coloured outlines indicate ambiguities, where each colour is assigned to one ambiguity group.

Table 1

Found clusters and the included items

Cluster 1 Transport	Cluster 2 Municipality News	Cluster 3 Bureaucracy	Cluster 4 Contact	Cluster 5 Facilities	Cluster 6 Environment
•Vehicle Parking spaces	•Elections •News •Newsletter	•Refugees •Moving from abroad	•Contact •Appointment	•Leisure •Sport	•Animal Regulations •Environment

•Parking Permit •Disabled Parking •Parking Rates •Bicycle Parking •Bicycle Sheds •Lost Bicycle •Public Transport •Road Work	•Emergency / Alert •Safety	•Deregistration •Registration •Passport / ID •Divorce •Marriage •Birth	•Opening Hours •Vacancies	•Shopping (and Markets) •Events •Studying •Education	•Sustainability •Waste •Energy

Note. The horizontal line in Cluster 1 and 3 indicates the deviation of the cluster into subclusters.

Next to categorising the items into groups, participants also had to give the created groups labels. In total 325 labels were created which are shown summarised in Table 2 and are used to create a final label to describe each cluster. Names for the ambiguity groups were given based on either group labels or possible reasons why they did not fit into one of the given clusters.

Table 2

Group labels made by the participants that involve the items of the clusters

Cluster 1 Transport	Cluster 2 Municipality News	Cluster 3 Bureaucracy	Cluster 4 Contact	Cluster 5 Facilities	Cluster 6 Environment
•Vehicles •Bicycles •Transport •Traffic •Parking •Infrastructure	•Information •Municipality news •News •Government •Updates	•Bureaucracy •Documentation •Refugees •General •Registration •Big life events •Family •Life •Living	•Contact •Service •Communication	•Activities •Arts & Culture •Free time •Events •Facilities •Leisure •Student Life	•Eco •Environment •Nature •Sustainability •Living

Note. The horizontal line in Cluster 3 indicates the deviation of the cluster into subclusters.

Description of Clusters

Cluster 1 "Transport

The first cluster is the biggest one with consisting of nine items and is named "Transport". The included items are "Vehicle Parking Spaces", "Parking Permit", "Disabled Parking", "Parking Rates", "Bicycle Parking", "Bicycle Sheds", "Lost Bicycle", "Public Transport" and "Road Work". The similarity scores are on average the highest among all clusters, ranging from 36% to 95% with a mean of 63%. Five items have semantic similarities as they involve the word parking, which have in general the highest agreement scores in this group. This might be due to that eleven participants created groups labelled "Parking", which exclusively included those items. This indicates that it might be suitable to create a subcluster for the parking items.

Cluster 2 "Municipality News"

The second cluster involves five items and is named "Municipality News" as the word "News" appeared in 13 group labels that consisted most of the involved items. The included items are "Elections", "News", "Newsletter", "Emergency/ Alert" and "Safety". The range of the similarity scores is from 19% to 80% and a mean of 39%. The two lowest similarity scores with 19% are "Elections" with "Emergency/Alert" and "News" with "Safety". This indicates that the agreement of these item combinations in this cluster group are not that clear, but as these items had higher agreements with all other items of this cluster group it was decided that these two agreements are considered exceptions. The highest similarity of 80% on the other hand is given by the items "News" and "Newsletter" and might be due to their semantic similarity or due to the reason that news are often shown summarised in newsletters.

Furthermore, two ambiguity groups are related to this cluster. All item-to-item agreements were made with items from the "Municipality News" cluster with items of other clusters. The ambiguity group "General information" contains 10 item agreements and was named based on group labels that were given by seven participants that involved most of the given items. The similarity scores range from 24% to 43% with a mean of 31%. The highest agreements were 43% with the Items "News" and "Events" and 41% with the items "Newsletter" and "Events". Participants might expect to

see upcoming events in the News section of a website as this is often the case on many municipality websites.

The second ambiguity group related to this cluster contains 15 item agreements and is called “Government”. The name was chosen as there were five groups labelled “Government” and six groups called “Politics” or alike and 10 of these agreements related to the item “Elections”. This might mean that some participants expect to see governmental and political matters in the “Municipality News” section, whereas other participants expect to find those topics on other parts of the website. The similarity scores range from 24% to 43% with a mean of 29%.

Cluster 3 “Bureaucracy”

The third cluster “Bureaucracy” is divided into the two subclusters “Registration” and “Live events” as it could be found that these two subclusters have higher similarity scores with their items, but still an overarching cluster can be seen that involves both groups. The names for the subclusters were chosen in the same manner as for the main clusters as groups were labelled in the respective names that involved most of the items. The main cluster has a range of similarity scores ranging from 14% to 95% and a mean of 41%. The three low similarity scores with 14% to 17% result from the item “Refugees” from the first subcluster with combinations of the second subcluster “Life Events” which indicates that the item “Refugees” mainly fits into the first subcluster “Registration”. Analysing the subclusters shows that dividing the main cluster into subclusters makes sense as the overall mean agreements are significantly higher within the subclusters compared to the whole main cluster. The first subcluster “Registration” has a range from 24% to 90% with a mean of 48% and involves the items “Refugees”, “Moving from abroad”, “Deregistration”, “Registration” and “Passport/ID”. The second subcluster “Live Events” has a range from 80%-95% with a mean of 87% and involves the items “Marriage”, “Divorce” and “Birth”.

Cluster 4 “Contact”

Cluster 4 involves the items “Contact”, “Appointment”, “Opening Hours” and “Vacancies” and is labelled under the name “Contact”. The similarity scores range from 29% to 75% with a mean of 51%. The agreement of putting these items together were therefore by the majority of the

participants given. The high agreements might result from a clear content connection among the items as the items “Contact”, “Appointment” and “Opening Hours” all relate to interacting with a service. Pairings with the item “Vacancies” were the lowest ranging from 29% to 39% but given that this item had no better matching with any other item outside of this cluster, it seems that there are also no ambiguity groups in which it might fit better.

All item-to-item agreements of the ambiguity group “direct contact/appointment” are combinations from the cluster group “Bureaucracy” with the cluster group “Contact”. This ambiguity group contains 13 item agreements. It is possible that participants grouped these items together as they might have considered that the bureaucracy items are topics that need to be handled directly with the municipality. Here it could have been considered to merge these two cluster groups to one big cluster and divide it into three subclusters, but it was decided against it as this merged cluster would have involved many agreements below the chosen 24% threshold. The similarity scores ranged from 24% to 48% with a mean of 33%.

Cluster 5 “Facilities”

The fifth cluster is called “Facilities” and involves the items “Leisure”, “Sport”, “Shopping (and Markets)”, “Events” and “Studying”. The similarity scores range from 14% to 80% with a mean of 42%. The lowest similarity scores are from the item “Events” with a 14% agreement with the item “Education” and a 17% agreement with the item “Studying”. These pairings were considered exceptions as other pairing with these items had similarity scores above the chosen threshold. The highest similarity scores were from the item combinations of “Sport” with an 80% agreement with the item “Leisure” and a 60% agreement with the item “Shopping (and Markets)”.

Cluster 6 “Environment”

The last cluster contains the items “Animal Regulations”, “Environment”, “Sustainability”, “Waste” and “Energy”. The similarity scores range from 24% to 85% and the mean is 55%. This cluster has therefore the second highest agreement overall. The item which shows the lowest agreements to the other items is “Animal regulations” which has 24% agreement to the item “Waste” and 26% to

the Item “Energy”. The similarity scores are within this cluster higher than with other ambiguity groups and therefore it was decided to keep the item “Animal regulations” as part of the cluster.

Ambiguity groups without clear connection to a single Cluster

The items of two ambiguity groups could not be assigned as possible ambiguities of a cluster and will therefore be described separately. The item which serves as the basis for the group of the same name “Lost & Found” could not be allocated to a cluster but has five high agreements with items of other clusters and was used 12 times as a label for groups. Two of them, “Lost Bicycle” and “Passport/ID”, can be considered objects that might get lost. The other three items “Emergency/Alert”, “Contact” and “Appointment” might have been grouped with the Item “Lost & Found” as they might have the purpose to report about found objects or ask whether lost objects were reported or found. The similarity scores range from 24% to 41% and a mean of 28%.

The ambiguity group “Life Costs” is named based on the fact that all agreements are either with the item “Rent” or “Taxes”. The agreements were in a lot of unsimilar labels grouped together and only by two participants put exclusively together from which one label was “Daily costs of life” which was shortened to “Life costs”. Although the agreement of the Items “Rent” and “Taxes” are on the diagonal line with a 60% similarity score, indicating that these would be another cluster group, it was decided to make only the overarching ambiguity group involving this agreement as there would not be other items in this cluster. This group contains 16 item agreements, and the similarity scores range from 24% to 60% with a mean of 33%.

Comparison of the elicited mental model with Dutch Municipality Websites

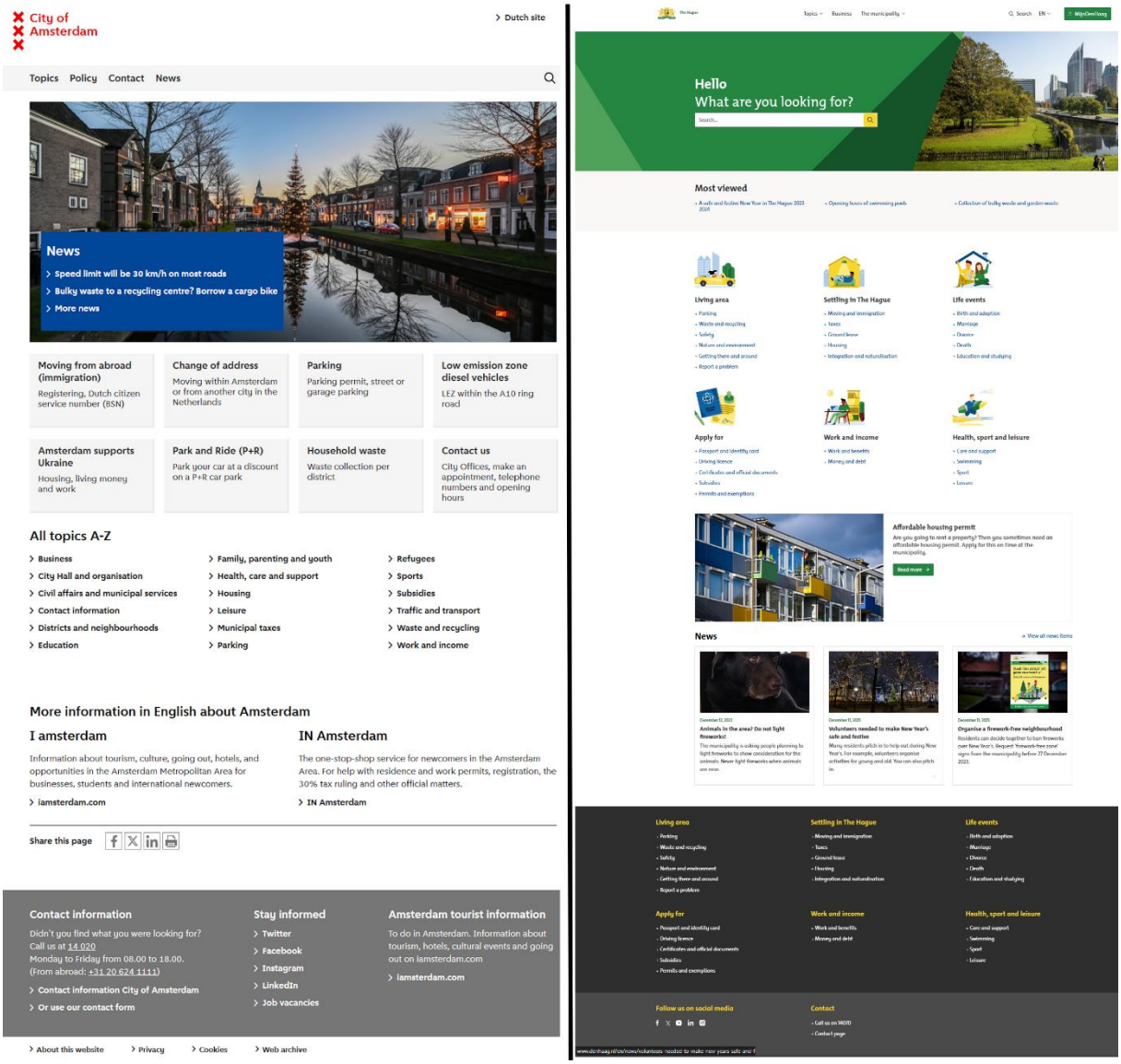
The second part of the results deals with the comparison of the elicited mental model with given Dutch municipality websites. The ten websites that were chosen to create the cards for the card sorting text (Appendix A), were compared with the elicited mental model whether there were similarities in the information architecture with the found clusters. The websites of Amsterdam and Den Haag were chosen to be both compared with the elicited mental model and furthermore similarities and differences of the websites are emphasised in the following section. These two websites were chosen for comparison as they have differing information architectures on the

homepage. Amsterdam has a few suggestions of topics and besides that an alphabetical order of topics. Den Haag on the other hand also offers suggestions and besides that instead of an alphabetical order, categories with different subcategories are used to show the different topics in a hierarchical design (Figure 3). Due to the different information architectures of the two municipality websites, it was assumed that the elicited mental model matches each website to a different degree. Therefore, this part aims to answer the following second research question: *"To what extent does the elicited mental model matches the information structure of Dutch municipality websites?"*.

The comparison is structured according to the found clusters in the elicited mental model (Figure 2) in the sense that it was searched on both websites whether information could be found grouped together similarly like in the elicited mental model. For this purpose, it was searched on the websites whether the item-to-item connections of the clusters could be found by looking for items on the homepage and investigating the respective subpages. If in the subpages were connections to other items like information or forwarding links to another related item of the cluster, it would be considered that these items are structured together. An example is the "Parking" page of Den Haag where forwarding links to items such as "Parking Permit" and "Disabled Parking" could be found. The found connections of items of each website were marked on the previous elicited mental model heatmap as black squares to identify how the clusters of the heatmap are in accordance with the existing information architecture (Figure 4).

Figure 3

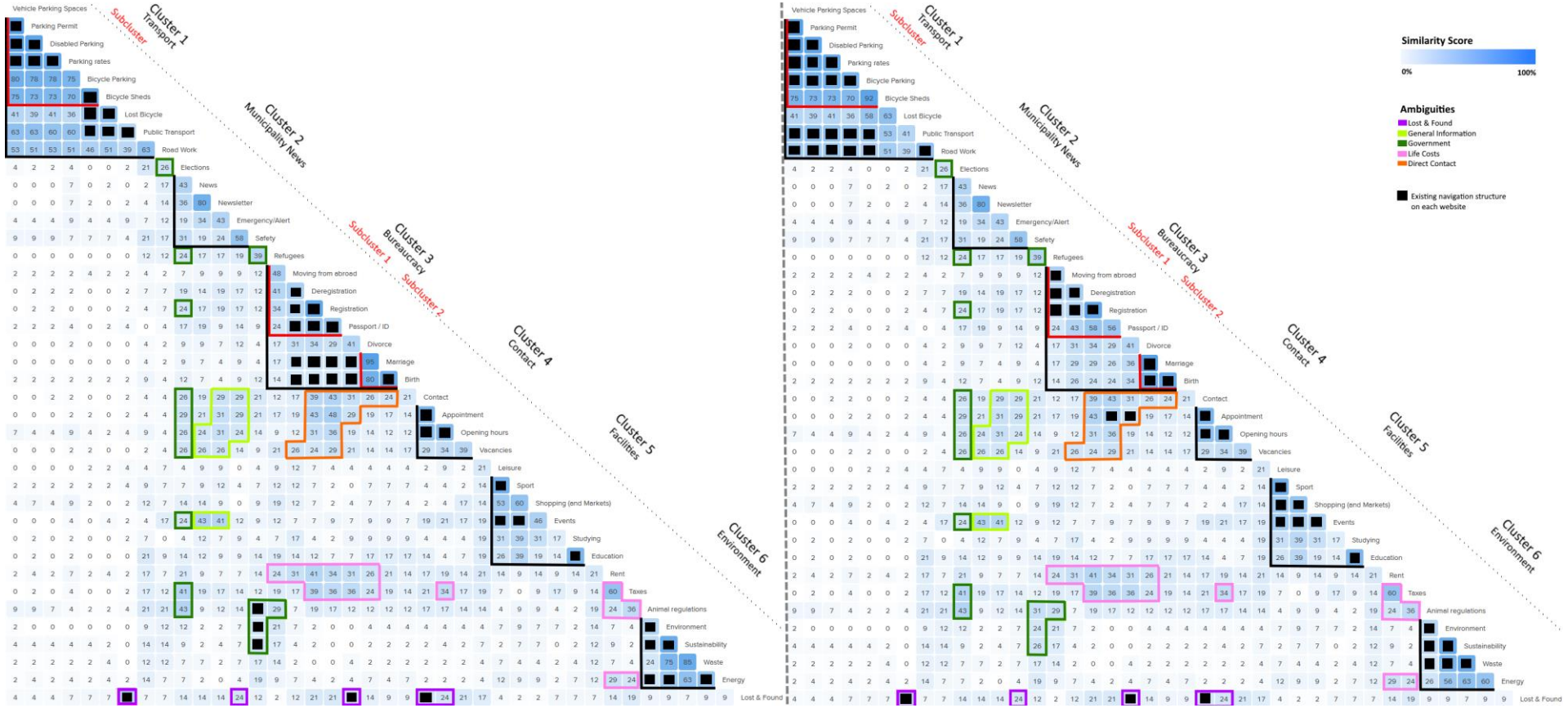
Homepage Comparison of Amsterdam and Den Haag



Note. Both websites offer a selection of topic suggestions. Amsterdam has an overview of topics in alphabetical order, while Den Haag has structured their topics in six different categories. Both websites offer a footer that is visible in any topic of the websites: Amsterdam offers contact information, links to social media platforms and a link to an external website with tourist information, whereas Den Haag offers contact information, all the topics of the homepage and links to social media platforms.

Figure 4

Comparison of elicited Mental Models with the existing navigation structure of Amsterdam (left) and Den Haag (right)



Note. The previous elicited mental model heatmap (Figure 2) was used to compare item-to-item connections in the existing information architecture of each website with the found clusters and ambiguity groups. If an item-to-item connection of a cluster or ambiguity group was found on the website, it was marked as a black square in the heatmap.

Description of Cluster and Website navigation structure comparison

Cluster 1: Transport

The items of the first cluster were mostly in line with the elicited mental model as they could be found grouped together to some extent in both websites but in different constellations. Amsterdam's municipality website offers a "Traffic & Transport" category which shows information about public transport and all topics regarding bicycles. Topics about parking are inconsistent as on the "Traffic & Transport" page there are information regarding bicycle parking facilities and electric vehicle parking facilities, but all other parking information are on a separate "Parking" page which does not involve these two topics but instead all other information regarding parking. While this separate "Parking" page goes partly in hand with the found subcluster there is no linking between the general "Traffic & Transport" page and the "Parking" page. The only missing item, which also could not be found anywhere else with the help of the search bar is the "Road Work" item.

Den Haag's website similarly separates parking information and other traffic information into the pages "Parking" for all parking matters, including the electric vehicle parking information. "Getting there and around" is handled for general traffic information such as public transport, all information regarding bicycles and road maintenance. The parking subcluster of the heatmap can be therefore also found here but in a more coherent and complete manner. Furthermore, both topics are found in the category "Living area" on the homepage and there are quick links between these two pages which validates the main "Transport" cluster of the elicited mental model more than it does the website of Amsterdam. Nevertheless, the link between these two pages is inconsistent as the "Parking" quick link can be found immediately visible on top of all topics on the "Getting there and around" page but not the other way around. In these two categories of Den Haag two items could not be found which are "Bicycle Sheds" and "Lost Bicycle". The missing of "Bicycle Sheds" might be due to that their used term "bicycle parking facilities" might be a generic term for all kind of bicycle parking spots. The "Lost Bicycle" item could be found on the Lost & Found page instead which goes in hand with the ambiguity group "Lost & Found" in the elicited mental model.

Cluster 2: Municipality News

The “Municipality News” cluster is handled on both pages similar as all items cannot be found grouped together at all and therefore this cluster is not in line with the mental model. This indicates that the developers of both websites saw no need to put the information regarding these topics together. On both pages “News” stands alone, not grouped together with anything. In the Dutch version of these websites at least “Newsletter” would have been grouped together with “News”, but the English version of both websites does not offer the option to subscribe to a newsletter. “Elections” also have their standalone area on both pages which can be found on the Amsterdam website only with the search function and on the Den Haag website under the Header topics. “Safety” information can be found on both websites but also not grouped together with any of the other items of this cluster group as they are in different areas. While Amsterdam has it as part of the “Policy” Topic, Den Haag subordinates this topic under the “Living Area” category. For both pages it could not be found an area about information regarding “Emergency/Alert” which is the only item of this cluster that was not found.

Cluster 3: Bureaucracy

The topics of the “Bureaucracy” Cluster are handled by both websites differently, but nevertheless both are mostly in line with the mental model. Amsterdam’s municipality website has nearly all topics together under the “Civil affairs and municipal services” page and is therefore comparable with the main cluster of the elicited mental model. One exception is the “deregistration” topic as it cannot be found at first glance but by using the search bar it could be found that it is part of the “Moving abroad” subcategory which is also part of “Civil affairs and municipal services”. When visiting this subpage however the header is called “Moving abroad and deregistering”, which is an inconsistency with the label on the previous “Civil affairs and municipal services” page, that made the search for this topic more difficult. Another exception is the “Refugees” topic which is handled without any connections to other topics on its own. Due to current political events, this topic may have been given its own section to make it easier for refugees to find information for offered help options that is stated in this subpage. The only item that could not be found at all is “Divorce”.

Den Haag has also nearly all items of this cluster categorised together, but has it divided in line with the found subclusters. Under the category “Moving and immigration” are all topics of the first subcluster, except “Passport/ID” which has its own category under the name “Passport and identity card”. The items of the second subcluster have each their own page but are categorised together on the homepage under the category “Life events”. However, the two subclusters are connected to each other by suggestions or quick links, which justifies the main cluster.

Cluster 4: Contact

The topics of this cluster are handled by both websites the same. All information can be found together on the “Contact” page except “Vacancies”. Vacancies are handled the same way for both websites as well as they are standing on their own and redirect to an own area that is only available in the Dutch version of the websites. The only difference is that Amsterdam shows the link to the website on the footer of the page under the category “Stay informed”, while Den Haag has it in the Header of the page under the category “The Municipality”.

Cluster 5: Facilities

Items of the fifth cluster can be found grouped together in varying degrees in both websites but with some similarities. Both websites have “Studying” & “Education” grouped together under the page “Education” for Amsterdam, and “Education and studying” for Den Haag. There are no quick links or connections to the other topics which can be found under the page “Leisure” which is also handled from both websites in the same way. Amsterdam’s website has the exception that no information regarding markets or shopping can be found on their “Leisure” page, but also not anywhere else. Generally it can be said that both websites are only partly in line with the mental model as the items “Studying” and “Education” cannot be found structured together with the others at all, indicating that these topics are aimed at a target group who want to know more about education facilities of a municipality, whereas the other items aim for a target group who want to know more about facilities to spend their leisure time.

Cluster 6 Environment

The topics of the last cluster are handled differently by both websites, but nevertheless are mostly in line with the mental model. Den Haag has almost all items grouped together under the page of “Nature & environment” and can be seen in line with the elicited mental model. The only exception is “Energy” which can be found on “Money and debt” page. Amsterdam on the other hand has none of the topics visible on the homepage except “Waste” which is also not linked to any other topic of the cluster. After using the search bar, it could be found out that most topics are grouped together under the “Policy” rubric. There are inconsistencies with the topic about “Waste” as some information are under the “Policy" rubric under “Cleaning and waste” and other information can be found in the “Waste and recycling” topic found on the homepage. Since the description of the “Waste”-card in the card sorting test is more applicable with the information given on the “Waste and recycling” page this item is considered not linked to the other topics in this cluster.

Ambiguity Groups

Among all declared ambiguity groups, the only one that is found on both websites is the “Lost & Found” group. In both websites the same topics are grouped together with the only difference that on the Amsterdam website it can be found in the “Contact” page and on the Den Haag website it can be found under the “Report a problem” page. This ambiguity group is therefore the only one that is similar like most clusters in line with the elicited mental model.

Discussion

The aim of this research paper was to elicit the mental model of users of municipality websites and give recommendations based on the elicited mental model how existing municipality websites could be improved. This could be realised by conducting an open card sorting test. The results revealed six clusters and five ambiguity groups, from which five cluster groups and one ambiguity group could be recognised in the comparison to the existing navigation structure of the Dutch municipality websites of Amsterdam and Den Haag. Accordingly, the main finding is that no significant differences were found between the average mental model and the structure of the websites. This implies that these municipality websites largely meet the expectations of the users.

However, in the process of analysing the websites and comparing them to the elicited mental model, inconsistencies in the structure and used labels were found, which allowed to find suggestions for improvement that will be discussed in the following.

Design Recommendation

After the municipality websites of Amsterdam and Den Haag were analysed in more detail regarding their navigation structure in comparison to the elicited mental model, several aspects of differences between the websites gave rise to design recommendations how municipality websites could be adjusted. These recommendations refer to the English versions only as the Dutch versions differ significantly. For instance, English versions have on average 14,2 menu points, whereas the Dutch versions have on average 27,5 menu points. The absence of information in the English versions may act as a barrier, potentially excluding individuals unfamiliar with the Dutch language. For example, international students which at this time make up 15 % of students at Dutch universities (Statista, 2023) might be affected by this language barrier. Therefore, the first recommendation is to include those missing Information or menu points as well in the English versions.

Another accessibility issue found were inconsistencies in how information are linked. For example, on Den Haag's "Getting there and around" page, suggestions as quick links to similar and related topics such as parking are offered, but not the other way around. Inconsistencies in the user interface are against the third principle of the Web Content Accessibility Guidelines (WCAG) called "Understandable", namely that web pages should have consistent navigational mechanisms and that components of web pages can be identified consistently (Caldwell et al., 2008). Such inconsistencies could be found on both analysed websites. Therefore, another design recommendation is to connect related topics to each other with quick links as suggestions. This method of connecting related topics was only found on Den Haags website and made it possible to recognise topics and links between topics more quickly and easily compared to Amsterdams website. Consistently implementing this method might simplify finding the right page without having to return to the homepage and browsing through other categories.

Comparing the municipality websites of Amsterdam and Den Haag revealed that locating the topics of the cards was simpler on the website of Den Haag. This was attributed to the structured division of topics into subtopics which were comparable with the clusters of the elicited mental model. Such an information structure is called “deep strategy” where hierarchical levels are used, whereas a structure where hyperlinks are listed without any hierarchy is called “broad strategy” (Galletta et al.,2006), which is the case in Amsterdam’s municipality website. Morville & Rosenfeld (2006) support the need for a hierarchical website structure as it helps users to understand how a website is organised, leading to developing a mental model of the site’s structure. Considering that people with a Western background, like the Netherlands, prefer the deep strategy (Juncan, 2013), the second recommendation is for Dutch municipality websites to adopt the deep strategy. From the 10 compared websites three use the deep strategy and seven the broad strategy.

Following this recommendation, Dutch municipality websites that use the broad strategy could adapt a hierarchical structure according to the elicited mental model. This would result in five to six main topics with all subtopics structured according to them. Implementing this standardized structure could offer benefits for website visitors. Mirroring the mental model of users can be a precondition for good usability (Schmettow & Sommer, 2016). When a website layout reflects users' mental models, it enhances usability perception, promoting memorability and quicker navigation in future use (Phillips et al., 2011). Therefore, a standardised design could help users to adjust fast to another similar website (Lynch et al., 1999). The recommendations of a uniform website design with a deep strategy information architecture could be for example important for people who want to move to another municipality. This could be applied to other e-government websites such as GGD, potentially letting citizens benefit to find their way around on these websites easier due to the familiar information architecture.

A further suggestion, complementing the two previous recommendations, is that e-government websites could use the insights of the card sorting test to label topics accordingly to the mental model of the users. Analysing the two municipality websites revealed that some topics of clusters that were handled similarly could be found under different labels. Additionally, the location

of some topics could not be found without the search function as labels did not match the information it contained. This misalignment is a weakness in accessibility, violating the second principle of WCAG, which emphasizes navigability through appropriately labelled components (Caldwell et al., 2008). Inadequate labelling of topics and headings can therefore impact the usability of a website negatively (Nawaz, 2013), as they should reflect their respective content and ideally be identified through the familiarity of its meaning (Morville & Rosenfield, 2006). The labels created by the participants of the card sorting test could therefore be helpful to name topics and headings appropriately and in line with the average mental model.

Limitations

Several limitations became apparent during this research. First it can be argued that the final set of used cards can be adjusted. The representativeness of these cards cannot be guaranteed to match the expectations of all municipality website users which information they expect to find. Firstly, as each person has their own mental models based on experience, the average mental model elicited here is not necessarily representative for every user. Next, the 40 cards were derived from only 10 of the currently 345 municipalities of the Netherlands, possibly excluding countless other suitable cards. Furthermore, it is possible that the chosen number of cards might not have been the most optimal for this study. The sources found in this regard reported various recommendations for the number of cards, which ranged from 30-40 (Card sorting, 2013), up to 60 (Blanchad & Banjeri, 2016), or a broader range of 40-80 cards (Sherwin, 2018). It is possible that a larger set of cards could have resulted in more unambiguous clusters. Moreover, the final selection of cards may not have been optimal. Creating cards with the same words, such as "Parking" occurring in four different cards, may lead to participants grouping them together due to their semantic similarity, impacting the clarity of results (Sherwin, 2018).

Another limitation can be found in the representativeness of the participant sample. This study concentrated on the navigation structures of Dutch municipality websites, but the 41 participants of the final data set were from 9 different countries from which 25 were from the Netherlands. As mental models are based on experience, participants that never used a Dutch

municipality website possibly have only a vague mental model of what information to expect, potentially leading to categorisations of items differing from those who are known to such websites. Schmettow & Sommer (2016) mention the potential that intercultural differences might exist in the mental model regarding municipality topics, organisations, and processes. Petrie et al. (2011) could find such differences regarding news and museum websites. Accordingly, it is conceivable that this might be the case for municipality websites as well. Beyond this no check was conducted whether any of the participants worked at a municipality, which could have a further impact on the elicited mental model as it is possible that employees would organise a municipality website differently than citizens (Schmettow & Sommer, 2016).

A further potential limitation is that websites can undergo changes during the research period. An example is the municipality website of Den Haag. A visible change in the website's footer occurred within a week (Appendix G). While this change did not affect the comparison with the information architecture, less noticeable alterations during the analysis could not be retrospectively assessed. Consequently, it is possible that content changes during the analysis of websites might impact the analysis.

Conclusion

In this study, the average mental model of municipality website users was elicited and compared to existing navigation structures. This revealed that the analysed websites are predominantly in line with the average mental model of users, indicating that there is no need for concern that these websites need major adjustments. However, design recommendations could be found as inconsistencies in the information architecture as well as unclear labelling of topics could be detected. These may improve the usability and accessibility of both websites further.

References

Alshira'H, M. (2020). *The Effects of Usability and Accessibility for E-Government Services on the End-user Satisfaction*. International Association of Online Engineering. Retrieved January 10, 2024 from https://www.learntechlib.org/p/217847/.

Blanchard, S. J., & Banerji, I. (2015). Evidence-Based Recommendations for Designing Free-Sorting Experiments. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2566412

Bussolon, S., Russi, B., & Missier, F. D. (2006). Online card sorting: as good as the paper version. Proceedings of the 13th Eurpoean conference on Cognitive ergonomics: trust and control in complex socio-technical systems, 113-114. https://doi.org/10.1145/1274892.1274912

Caldwell, B., Cooper, M., Guarino Reid, L., & Vanderheiden, G. (2008). Web Content Accessibility Guidelines (WCAG) 2.0. Retrieved from http://www.w3.org/TR/WCAG20/

Card Sorting. (2013). Department of Health and Human Services. https://www.usability.gov/how-to-and-tools/methods/card-sorting.html#:~:text=Best%20Practices%20for%20Card%20Sorts,especially%20for%20a

DigiToegankelijk. *Dashboard DigiToegankelijk*. Retrieved December 29, 2023 from https://dashboard.digitoegankelijk.nl/

Esmeria, G., & Seva, R. (2017). *Web Usability: A Literature Review*. https://www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2017/SEE/SEE-I-013.pdf

Flavián, C., Guinalíu, M., & Gurrea, R. (2006). The role played by perceived usability, satisfaction and consumer trust on website loyalty. *Information & Management*, *43*(1), 1–14. https://doi.org/10.1016/j.im.2005.01.002

Galletta, D. F., Henry, R. M., McCoy, S., & Polak, P. (2006). When the Wait isn't So Bad: The Interacting Effects of Website Delay, Familarity, and Breadth. Information Systems Research, 17(1), 20-37.

Gemeente Amsterdam. (2020). *Home*. English Site. Retrieved October 8, 2023, from https://www.amsterdam.nl/en/

Homepage utrecht.nl | Gemeente Utrecht. (n.d.). Retrieved October 8, 2023, from https://www.utrecht.nl/

Huang, Z., & Benyoucef, M. (2014). Usability and credibility of e-government websites. *Government Information Quarterly*, *31*(4), 584–595. https://doi.org/10.1016/j.giq.2014.07.002

ISO. (1998). Ergonomic requirements for office work with visual display terminals (vdts)–part 11: Guidance on usability. ISO Standard 9241-11: 1998 (Vol. 55).

Jones, N., Ross, H., Lynam, T., Perez, P., & Leitch, A. (2011). Mental Models: An Interdisciplinary Synthesis of Theory and Methods. *Ecology and Society*, *16*(1). https://doi.org/10.5751/ES-03802-160146

Juncan, L. (2013). Website Globalization Strategy: A Cross-Cultural Analysis of Website Structure.

Katz, M. A., & Byrne, M. D. (2003). Effects of scent and breadth on use of site-specific search on e-commerce Web sites. *ACM Transactions on Computer-Human Interaction*, *10*(3), 198–220. https://doi.org/10.1145/937549.937551)

Lewis, J. R. (2018). The System Usability Scale: Past, Present, and Future. *International Journal of Human–Computer Interaction*, *34*(7), 577–590. https://doi.org/10.1080/10447318.2018.1455307

Lynch, P. J., Horton, S., & Horton, S. (1999). Web style guide: Basic design principles for creating web sites. Universities Press.

MAGUIRE, M. (2001). Methods to support human-centred design. *International Journal of Human-Computer Studies*, *55*(4), 587–634. https://doi.org/10.1006/ijhc.2001.0503

Morville, P., & Rosenfeld, L. (2006). *Information architecture for the World Wide Web: Designing large-scale web sites*. " O'Reilly Media, Inc.".

Ntouvaleti, M., & Katsanos, C. (2022). Validity of the Open Card Sorting Method for Producing Website Information Structures. *CHI Conference on Human Factors in Computing Systems Extended Abstracts*. https://doi.org/10.1145/3491101.3519734

Optimal Workshop (2021). *Card sorting 101 - Similarity matrix*. Retrieved January 22, 2024, from https://www.optimalworkshop.com/learn/card-sorting-101-similarity-matrix/

Oulasvirta, A. (2004). Task demands and memory in web interaction: a levels of processing approach. *Interacting with Computers*, *16*(2), 217–241. https://doi.org/10.1016/j.intcom.2003.12.004

Perdomo, E. G., Cardozo, M. T., Perdomo, C. C., & Serrezuela, R. R. (2017). A review of the user based web design: usability and information architecture. *International Journal of Applied Engineering Research*, *12*(21), 11685-11690.

Petrie, H., Power, C., Cairns, P., & Seneler, C. (2011). Using Card Sorts for Understanding Website Information Architectures: Technological, Methodological and Cultural Issues. *Human-Computer Interaction – INTERACT 2011*, 309–322. https://doi.org/10.1007/978-3-642-23768-3_26

Phillips, E., Ososky, S., Grove, J., & Jentsch, F. (2011). From Tools to Teammates: Toward the Development of Appropriate Mental Models for Intelligent Robots. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *55*(1), 1491–1495. https://doi.org/10.1177/1071181311551310

Righi, C., James, J., Beasly, M., Day, D., Fox, J., Gieber, J., Howe, C., & Ruby, L. (2013). Card sort analysis best practices. Journal of User Experience, 8(3), 69–89.

Roth, S. P., Schmutz, P., Pauwels, S. L., Bargas-Avila, J. A., & Opwis, K. J. I. w. c. (2010). Mental models for web objects: Where do users expect to find the most frequent objects in online shops, news portals, and company web pages? , 22(2), 140-152. https://doi.org/10.1016/j.intcom.2009.10.004

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-sorting-definition/

Statista. (2024). *International students in the Netherlands*. Statista. Retrieved January 10, 2024 from https://www.statista.com/topics/10029/international-students-in-the-netherlands/#topicOverview

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.

Velleman, E. (2018). *The implementation of web accessibility standards by Dutch municipalities : factors of resistance and support*. https://doi.org/10.3990/1.9789036546690

Wentzel, J., Müller, F., Beerlage-de Jong, N., & van Gemert-Pijnen, J. (2016). Card sorting to evaluate the robustness of the information architecture of a protocol website. *International Journal of Medical Informatics*, *86*, 71–81. https://doi.org/10.1016/j.ijmedinf.2015.12.003

Wojdynski, B. W., & Kalyanaraman, S. (2016). The three dimensions of website navigability: Explication and effects. Journal of the Association for Information Science and Technology, 67(2), 454–464.

Wood, J. R., & Wood, L. E. (2008). Card Sorting: Current Practices and Beyond. *Journal of Usability Studies*, *4*(1), 1–6. Retrieved September 19, 2023, from https://uxpajournal.org/wp-content/uploads/sites/7/pdf/JUS_Wood_Nov2008.pdf

W3C (2012). *Web Accessibility Basics*. Retrieved December 29, 2023 from https://www.w3.org/WAI/EO/wiki/Web_Accessibility_Basics

Appendices

Appendix A – Final Selection of Municipality Websites

Common items present in the following websites with varying navigation structures have been listed below.

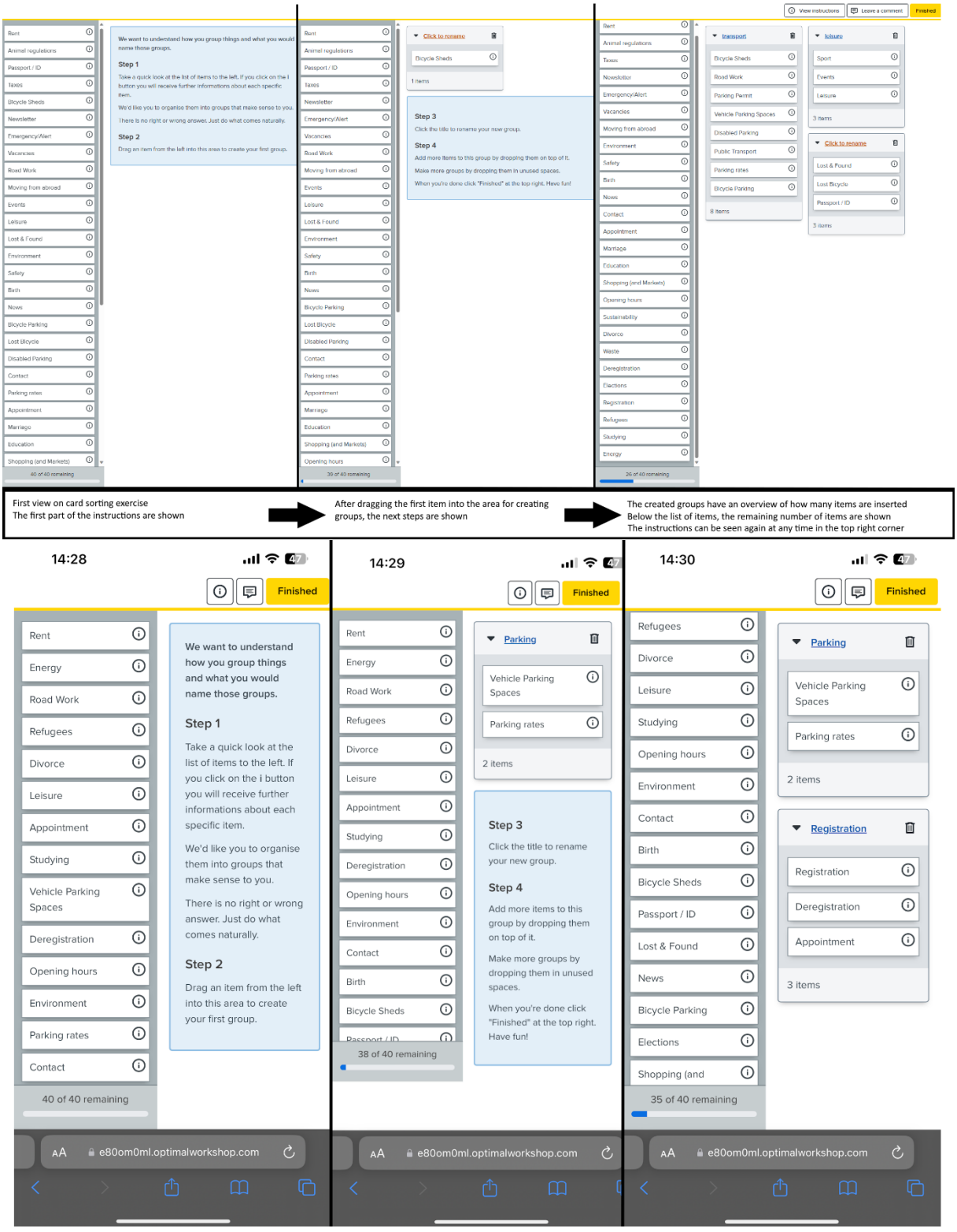
- https://www.amsterdam.nl/
- https://www.tilburg.nl/
- https://www.breda.nl/en
- https://www.delft.nl/
- https://www.utrecht.nl/
- https://gemeente.groningen.nl/
- https://www.gemeentemaastricht.nl/
- https://www.denhaag.nl/
- https://www.nijmegen.nl/
- https://www.enschede.nl/en

Appendix B – Final Set of Cards

#	English label	Description
1	Taxes	Information on property taxes, income taxes, and local tax regulations, including payment methods and deadlines.
2	Refugees	Resources and support services for refugees, including information on housing, legal assistance, and community integration.
3	Vehicle Parking Spaces	Maps and guidance on available parking spots and parking garages.
4	Parking Permit	How to obtain parking permits, including eligibility criteria and application processes.
5	Road work	Updates on ongoing and planned road construction projects, traffic detours, and maintenance schedules.
6	Lost Bicycle	Reporting and recovery of lost or stolen bicycles, with tips on bike security.
7	Bicycle Sheds	Information on secure bicycle storage facilities and how to access them.
8	Leisure	Information on recreational activities, cultural events, and leisure opportunities
9	Disabled Parking	Guidelines and permit application procedures for disabled parking spaces.
10	Energy	Information about the current energy price situation
11	Lost & Found	Report and inquire about lost or found items
12	News	Updates on local news, events, and important announcements in the municipality.
13	Emergency/Alert	Notifications and instructions in case of emergencies
14	Vacancies	Listings of job vacancies and career opportunities within the municipality.
15	Birth	Information on birth certificates, registration, and related services.
16	Public Transport	Resources and opportunities for public transportation services, including buses, trams, subways, and commuter trains.
17	Marriage	Marriage licence requirements, application procedures, and related information.
18	Passport/ ID	Passport and identification card application, renewal, and document-related services.
19	Sport	Information about sports facilities, athletic programs, and recreational sports opportunities

20	Divorce	Resources and information on divorce processes and legal requirements
21	Safety	Information about safety regulations such as camera surveillance or areas with a ban of drugs
22	Shopping (and Markets)	Details about local markets, shopping districts, and consumer services
23	Parking rates	Current parking fee structures and rates for different parking zones.
24	Events	Listings of upcoming events, festivals, and cultural activities in the municipality.
25	Deregistration	The process and requirements for cancelling or changing your residence registration
26	Waste	Guidelines on waste disposal, recycling, and hazardous waste management.
27	Environment	Initiatives, conservation tips, and information on local environmental efforts.
28	Registration	Requirements and details as to how to register as a citizen of the municipality
29	Rent	Rental property listings, tenant rights, and rental assistance programs.
30	Animal regulations	Information on pet licensing and animal regulations such as fishing permits
31	Elections	Information on upcoming elections, voter registration, and polling locations.
32	(Opening) hours	Operating hours of municipal offices, services, facilities,
33	Contact	Access to contact information for various municipal departments and services for inquiries, complaints, or assistance.
34	Sustainability	Initiatives, programs, and resources aimed at promoting environmental sustainability
35	Studying	Information about different study opportunities and related topics
36	Education	Finding schools for different levels of education
37	Bicycle parking	Guidelines and locations for bicycle parking facilities in the municipality.
38	Moving from abroad	Report your move, getting information about what needs to be done as a new citizen
39	Newsletter	Subscription to a newsletter for receiving regular updates on municipal news, events, and important information
40	Appointment	Scheduling appointments for municipal services such as legal consultations, permit applications

Appendix C – Comparison Card Sorting Study on Personal Computer & Mobile Device



Note. Comparison of conducting the card sorting study on a personal computer (Top) and a mobile device with the iOS operating system (Bottom).

Appendix D – Informed Consent

Contact Details

For any questions or further information you can contact the researchers Tasneem Ramchand and Can Erdogan under the following emails: t.ramchand@student.utwente.nl & c.erdogan@student.utwente.nl or their Supervisor Marlise Westerhof under the email m.w.westerhof@utwente.nl.

Taking part in the study

- I have read and understood the study information, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.
- I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.
- I understand that taking part in the study involves categorising cards into groups.

Use of the information in the study

- I understand that information I provide will be used for student reports and perhaps for a journal publication or conference report.
- I understand that personal information collected about me that can identify me, such as my name will not be shared beyond the study team.
- I understand that the study will follow anonymous data collection to minimise the threat of a data breach, and protect my identity in the event of such a breach.

Future use and reuse of the information by others

I understand that the de-identified information that I provide will be erased within the next 6 months.

Appendix E – Purpose & Instructions of the study shown to Participants

We are researching how information on dutch municipality websites can be best organised to help users find the information they are looking for more easily. To gain valuable insights on how these websites should be structured we do a **card sorting study**.

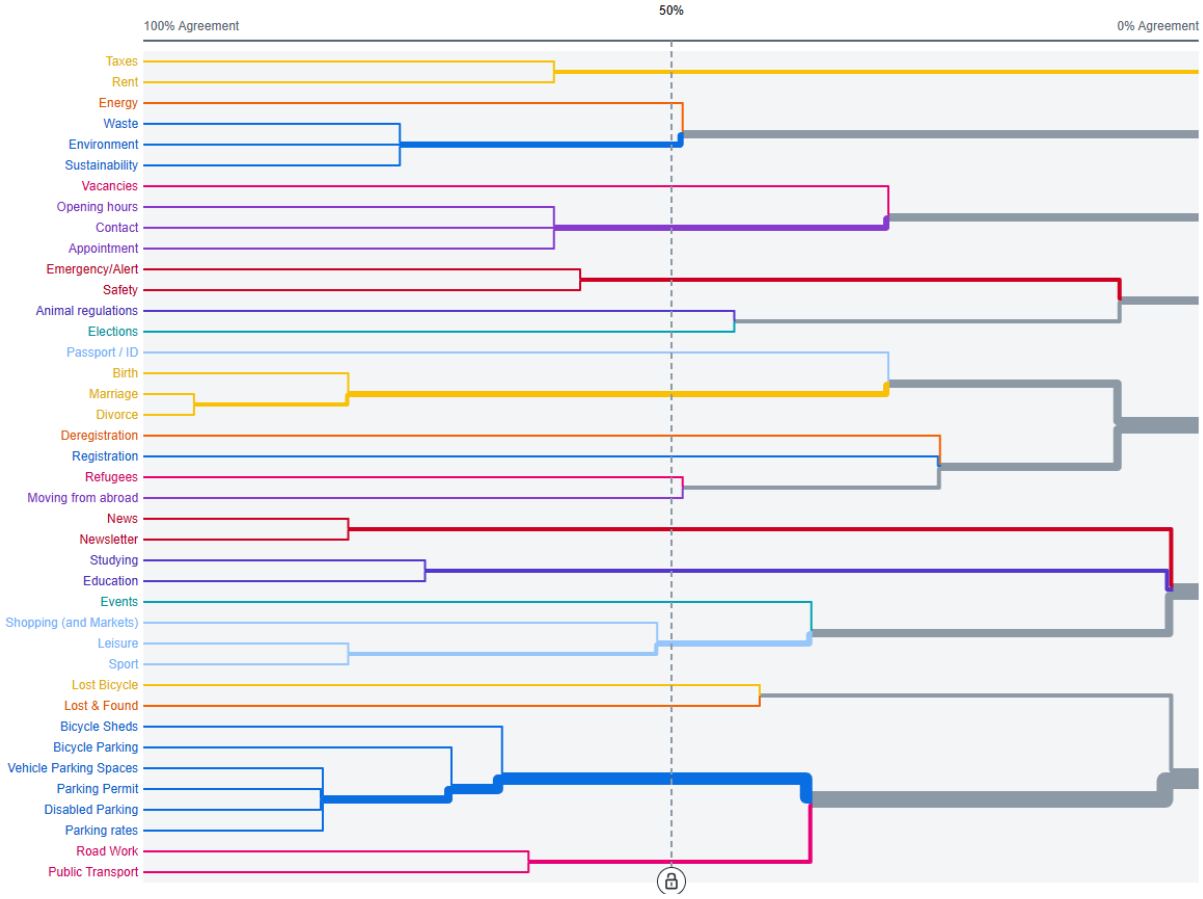
Instructions

On the following page you will be presented **40 items with brief descriptions** which represent information that can be found on municipality websites.

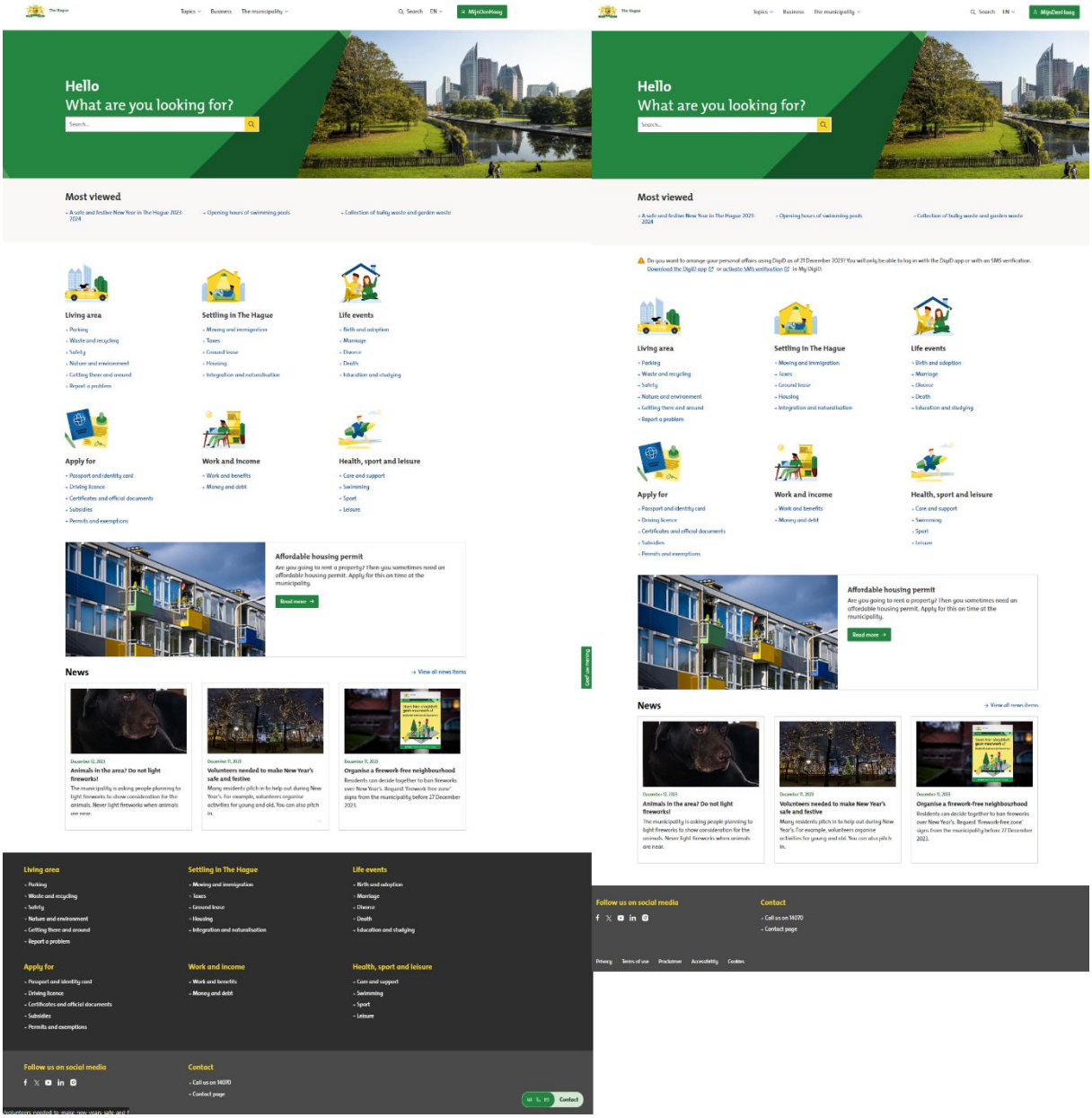
Your task will be to group those items together in a way you would expect to find the information grouped together on a municipality website. **There are no right or wrong answers** as we want to know more about your personal expectations. **Try to create meaningful groups**, and **if you think that some cards can't be grouped together at all you can create a group called others** where you can put those cards in. On the other hand **if you have the feeling that a card could be put in several groups, decide for the one you think it fits best in.** The study takes about 10-20 minutes.

The specific Instructions on how to create groups and drag the items in will be shown on the following page.

Appendix F – Actual Agreement Dendrogram



Appendix G – Changes in the website structure during the research



Note. The footer of the website changed - comparison of the versions from 13.12.23 and 19.12.23