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ÚSTAV POČÍTAČOVÉ GRAFIKY A MULTIMÉDIÍ

RESEARCH ON USER PREFERENCES FOR Q-SORTING AND THE DESIGN OF A USER-FRIENDLY INTERACTION MODEL

VÝZKUM UŽIVATELSKÝCH PREFERENCÍ PRO Q-ŘAZENÍ A NÁVRH UŽIVATELSKY PŘÍVĚTIVÉHO INTERAKČNÍHO MODELU

BACHELOR'S THESIS
BAKALÁŘSKÁ PRÁCE

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BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF INFORMATION TECHNOLOGY

Bachelor's Thesis Assignment

Institut:	Department of Computer Graphics and Multimedia (DCGM)	163014
Student:	**Pirohová Karolína**	
Programme:	Information Technology	
Title:	**Research on user preferences for Q-sorting and the design of a user-friendly interaction model**	
Category:	User Interfaces	
Academic year:	2024/25	

Assignment:

1. Learn about Q-sorting and the existing digital tools for Q-sorting.
2. Design and develop paper card decks that allow research of the preferences and natural card-sorting patterns of human respondents (cover a sufficient variety of card deck sizes).
3. Iteratively design, prototype, and evaluate physical and digital approaches to card sorting. Formulate different subtasks and sorting circumstances, and assess the suitability of various methods for various tasks.
4. Formulate recommendations for Q-sorting through positive and negative guidelines and recommended approach(es) for Q-sorting.
5. Evaluate the results and suggest ways to continue the project. Create a poster and a short video to present the project.

Literature:

- Tidwell et al.: Designing Interfaces: Patterns for Effective Interaction Design, O'Reilly, 2020
- Steve Krug: Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, ISBN: 978-0321965516
- Steve Krug: Rocket Surgery Made Easy: The Do-It-Yourself Guide to Finding and Fixing Usability, ISBN: 978-0321657299
- JANŮ, Michal. *Webová aplikace pro podporu Q-řazení*. Online, Diplomová práce, vedoucí Adam Herout. Brno: FIT VUT, 2023.

Detailed formal requirements can be found at https://www.fit.vut.cz/study/theses/

Supervisor:	**Herout Adam, prof. Ing., Ph.D.**
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Beginning of work:	1.11.2024
Submission deadline:	14.5.2025
Approval date:	5.5.2025

Abstract

This thesis is concerned with defining recommendations for designing an intuitive user interface for Q-sorting consistent with human behaviour. It combines an analysis of currently available tools with physical and digital usability testing, providing a comprehensive understanding of natural user behaviour and preferences. The research pointed out necessary improvements regarding the pre-sort phase, grid arrangement, or interaction with the interface.

Abstrakt

Táto práca sa zaoberá definovaním odporúčaní pre návrh intuitívneho používateľského rozhrania určeného na Q-radenie v súlade s ľudským chovaním. Kombinuje analýzu aktuálne dostupných nástrojov s fyzickými, ale aj digitálnimi testovaniami použiteľnosti, a tak poskytuje ucelené porozumenie prirodzeného správania a preferencií používateľov. Výskum poukázal na nutné vylepšenia týkajúce sa prebežného triedenia, usporiadania tabuľky či samotnej interakcie s rozhraním.

Keywords

Q-methodology, Q-sorting, subjectivity, sorting approach, user interface, UI, user experience, UX, usability testing, qualitative evaluation

Kľúčové slová

Q-metodológia, Q-radenie, subjektivita, prístup ku radeniu, používateľské rozhranie, UI, používateľská skúsenosť, UX, testovanie používateľnosti, kvalitatívne hodnotenie

Reference

PIROHOVÁ, Karolína. *Research on user preferences for Q-sorting and the design of a user-friendly interaction model.* Brno, 2025. Bachelor's thesis. Brno University of Technology, Faculty of Information Technology. Supervisor prof. Ing. Adam Herout, Ph.D.

Rozšírený abstrakt

Existuje mnoho metód na meranie subjektívnych názorov ľudí na určitú tému, pričom Q-metodológia je jednou z nich. Je špecifická tým, že na rozdiel od populárnych Likertových škál, kde sa jednotlivé výroky hodnotia samostatne, núti účastníkov robiť rozhodnutia o tom, ktoré položky považujú za dôležitejšie, a ktoré za menej dôležité.

Pri Q-radení sa zvyčajne používa tabuľka, do ktorej používatelia umiestňujú jednotlivé výroky. Tá sa riadi spektrom od súhlasu po nesúhlas, pričom stred predstavuje neutrálny postoj. Samotná tabuľka sa môže líšiť počtom úrovní alebo „strmosťou", ale štandardne zodpovedá normálnemu rozdeleniu. V praxi to znamená, že do krajných pozícií možno zaradiť len obmedzený počet výrokov, zatiaľ čo väčšina spadá do stredu. Výsledkom sú jedinečné perspektívy účastníkov, ktoré po analýze odhaľujú spoločné prístupy rôznych ľudí k rovnakej problematike.

Cieľom tejto práce je prispieť k prebiehajúcemu vývoju webovej aplikácie na Q-radenie, ktorej vývoj si postupne odovzdávajú študenti fakulty a spočíva vo formulácii odporúčaní pre návrh používateľského rozhrania, ktoré bude kompatibilné s prirodzeným ľudským správaním.

Práca začína stručnou analýzou aktuálne dostupných nástrojov a zameriava sa na identifikáciu ich silných a slabých stránok. Keďže neexistuje univerzálny štandard pre implementáciu digitálneho Q-radenia, druhá fáza práce je venovaná testovaniu použiteľnosti s využitím fyzických setov kariet a tabuliek. Cieľom je preskúmať prirodzené prístupy k radeniu v rôznych podmienkach a pozorovať, čo proces uľahčuje, a čo ho naopak komplikuje.

Na urýchlenie tohto iteračného procesu bol vytvorený generátor setov kariet, ktorý zjednodušuje vytváranie nových sád podľa potreby, spolu s dizajnovým systémom pre návrh samotných tabuliek, ktorý umožňuje riešenia jednoducho upravovať. V neposlednom rade bola v úvode spomínaná webová aplikácia upravená tak, aby sa mohla použiť pri digitálnom testovaní použiteľnosti, čo viedlo nielen k odhaleniu jej nedostatkov, ale prispelo aj k formulácii konkrétnych odporúčaní.

Kombinácia všetkých týchto fáz poskytla komplexné pochopenie správania a preferencií používateľov pri Q-radení. Kľúčové zistenia odhalili potrebu fázy predbežného triedenia, dôležitosť rozhrania umožňujúceho umiestnenie kariet na presné pozície v tabuľke, nie len do približných radov, a pridanú hodnotu hybridného prístupu, ktorý vyvažuje usmerňovanie používateľa s určitou mierou flexibility. Tieto navrhované odporúčania tvoria pevný základ pre budúci vývoj a zabezpečujú tak pokrok smerom k intuitívnejšiemu a používateľsky prívetivejšiemu zážitku z Q-radenia.

Research on user preferences for Q-sorting and the design of a user-friendly interaction model

Declaration

I hereby declare that this Bachelor's thesis was prepared as an original work by the author under the supervision of Mr. prof. Ing. Adam Herout Ph.D. I have listed all the literary sources, publications and other sources, which were used during the preparation of this thesis.

....
Karolína Pirohová
May 12, 2025

Acknowledgements

I would like to thank my supervisor, prof. Ing. Adam Herout Ph.D., whose insightful guidance shaped this thesis and whose boundless curiosity continues to inspire me. I am also thankful for the reliable help of the faculty's Grammarly EDU access, which made polishing the text slightly easier. Furthermore, I am grateful to my family and friends who, with great patience, sorted every deck of cards I placed in front of them. And a special thanks goes to my sister, who always reminds me that fish do not care if you are cool.

Contents

Chapter 1

Introduction

Q-sorting is a research method that helps understand subjective human viewpoints. It typically involves participants sorting statements printed on paper cards according to how much they agree or disagree with them, creating patterns that are later analysed to identify shared perspectives [4].

This thesis aims to contribute to a project that strives to create a modern interface for digital Q-sorting that eliminates the laborious data collection and the time-consuming process of making physical cards and grids.

My work is mainly exploratory, beginning with a brief overview of currently available tools for digital Q-sorting and highlighting their strengths and weaknesses. To create an intuitive environment, one must understand how people interact with the Q-sorting grid. For this reason, after consulting with my supervisor, I conducted usability tests with physical card decks and various sorting layouts. The premise of numerous testing iterations led me to create tools that helped simplify and automate the research workflow.

Drawing on all the insights gathered, my focus switched back to digital tools, using the implementation that other students continue to improve, which I modified based on my findings. I proceeded with usability testing, gathering more information on the essential features that create a pleasant user experience.

As a result, grounded in comprehensive usability testing and observation, I have formulated recommendations and guidelines for designing a user interface compatible with human natural behaviour – an approach which should be considered standard practice in 21st century digital product development.

Chapter 2

Overview of Q-Methodology

Q-methodology helps to understand how people feel about a particular topic. Unlike the more popular approach of asking participants to rate isolated statements on a scale from 'mostly agree' to 'mostly disagree'. This method encourages participants to make nuanced decisions and to rank statements about others, as only a fixed number of statements can be placed under each level of agreement [5, 4].

The technique has repeatedly proven useful in researching perspectives in various fields, with examples including medical research [11], public opinions [18] and environmental issues [1]. Given its effectiveness, a simple question may arise: Why have most of us never heard of Q-sorting?

Since its initial formulation in 1935 by William Stephenson [17], the Q-methodology has been a target of criticism, often rooted in misconceptions, which is discouraging. Furthermore, the pool of potential researchers considering the method gets even smaller as they encounter drawbacks — using printed Q-sort grids and card decks is burdensome [15].

A possible solution is to use digital tools to conduct usability testing sessions. However, as I will briefly describe later, there is a reason why researchers still prefer to use printed cards instead of software.

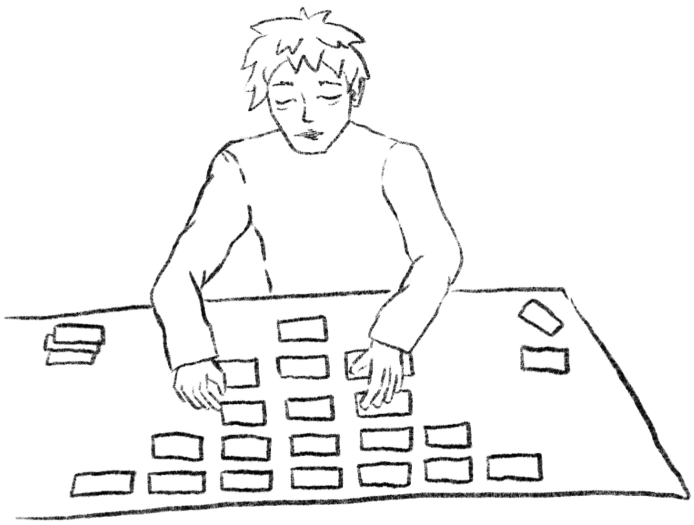

Figure 2.1: An illustration of the process and setup used for in-person Q-sorting, in which the participant places cards into a predefined area usually shaped like a quasi-normal distribution.

A great example of Q-methodology in real life, using printed card decks, is a recent study. In it, individuals with disabilities were asked to sort statements regarding the use of exercise equipment according to their level of agreement [11].

If researchers in this study had chosen the R-methodology approach, for example, Likert scales, the results would typically be reduced to mean scores, causing a loss of qualitative depth. However, attention is on the whole picture using Q-sort, resulting in multiple viewpoint patterns that repeat across participants. These patterns represent shared beliefs that might otherwise be lost when averaging responses. Choosing a proper method with topics like this is necessary as each group represents a different approach to appropriate health services.

2.1 Understanding the Q-Sorting Phases

To apply the Q-methodology in practice, researchers use Q-sorting, in which participants organise a set of statements printed onto paper cards about a topic by ranking them according to preference, agreement, personal feelings, or another condition of instruction (Figure 2.1). The set of statements is called a Q-set and typically consists of statements representing the range of opinions concerning the topic.

At first, participants can be asked to sort statements into two or three piles. This step, called pre-sorting, is optional, and it aims to allow them to familiarise themselves with the set and help during the final sorting activity.

The sorting is typically done using a Q-sort grid consisting of predefined card placements arranged in a quasi-normal distribution, where participants can only place a few statements at the extremes while most fall in the middle. The distribution range (-3 to +3, -4 to +4, etc.) depends on the number of statements in the study.

The final arrangement captures the participant's unique perspective on the subject. Lastly, the participant is usually invited to elaborate on their point of view in an interview, as this is valuable information for interpretation.

Chapter 3

Available Tools for Digital Q-Sorting

The Q-sorting process can either be completed physically, with participants manually sorting printed cards containing statements onto a prepared layout, or using a digital tool.

The physical approach's main advantage is its simplicity. Participants can focus on the sorting process without any distractions. The researcher can immediately explain any questions or uncertainties, ensuring a smooth experience. Additionally, the researcher can better understand the participant's decision-making process by being present throughout the session. Naturally, there are drawbacks: manual data collection is time-consuming and prone to errors, and managing all the necessary printed materials can be pretty tricky, especially when administering the Q-sort to multiple participants simultaneously.

These challenges highlight the importance of digital tools, which can quickly address the previously mentioned issues. That said, the following sections will focus on evaluating the strengths and weaknesses of selected web-based Q-sorting applications that are currently relevant and practical.

3.1 Q Method Software

Q Method Software is an online subscription-based tool that offers free access to a limited software version [14]. Its complex approach allows researchers to conduct and analyse studies smoothly. The interface is intuitive and easy to use, even for first-time users (Figure 3.1). As for study management, it provides plenty of helpful setting options regarding pre-sort, surveys, entry codes, grid distribution, specific notes for each step, and even colour schemes.

Usability Insights:

- ✚ The pre-sort functionality can be turned off in the study settings, and if enabled, participants can decide whether to skip it.
- ✚ During the pre-sort, all cards with statements are displayed simultaneously, giving the participants a comprehensive overview of the deck.
- ✚ Drag-and-drop works smoothly; participants can reorder, replace, and remove cards without extra steps.

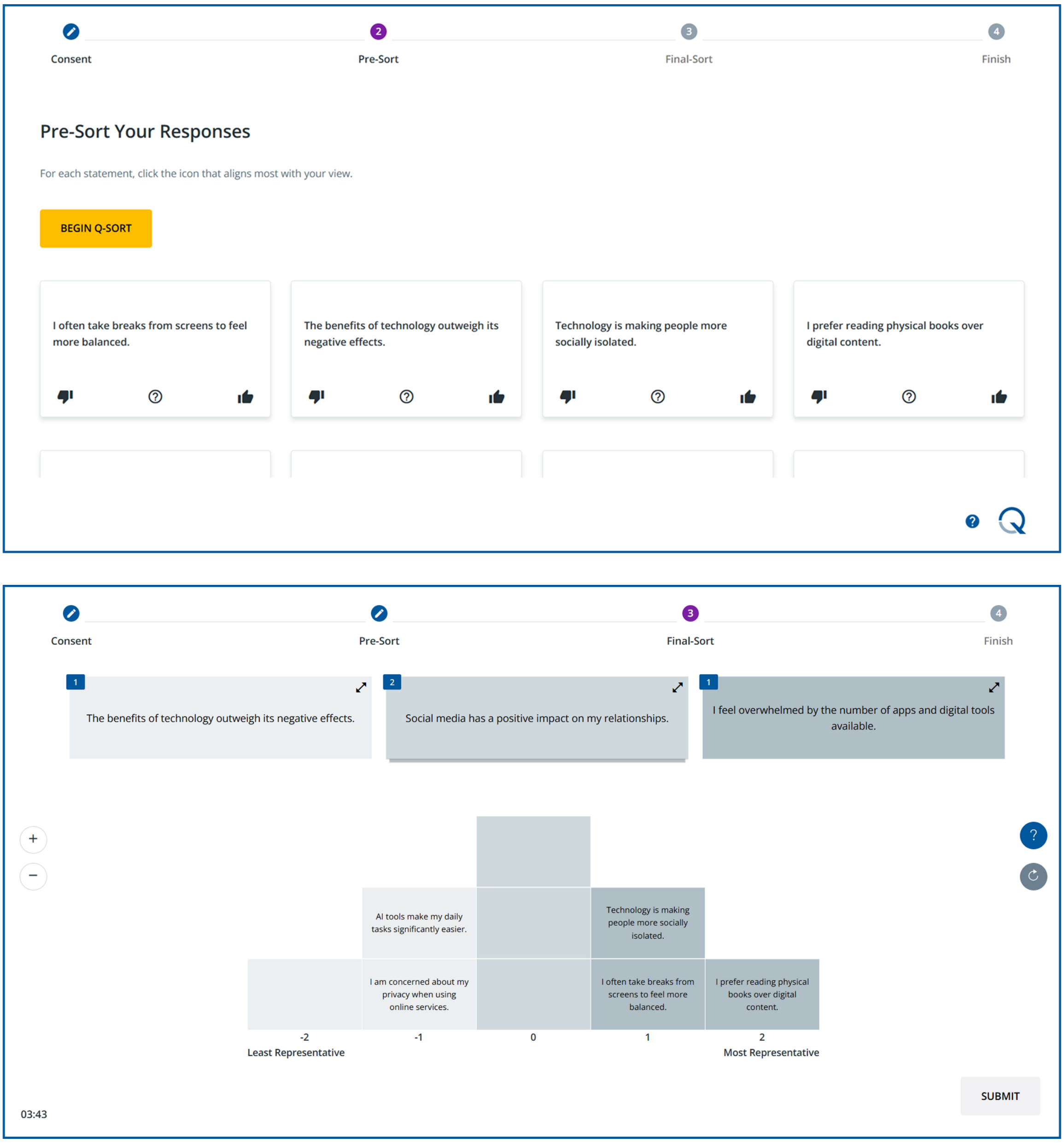

Figure 3.1: Q Method Software is an intuitive tool for conducting Q-sorting studies. **top:** The statements are displayed at once so the participant can better understand the whole deck, making the pre-sort more precise than seeing only one card at a time. Regardless, the participant has the option to skip this step. **bottom:** The coloured decks of previously sorted cards at the top of the page help with the final sorting into the structured grid, which uses the same colour palette.

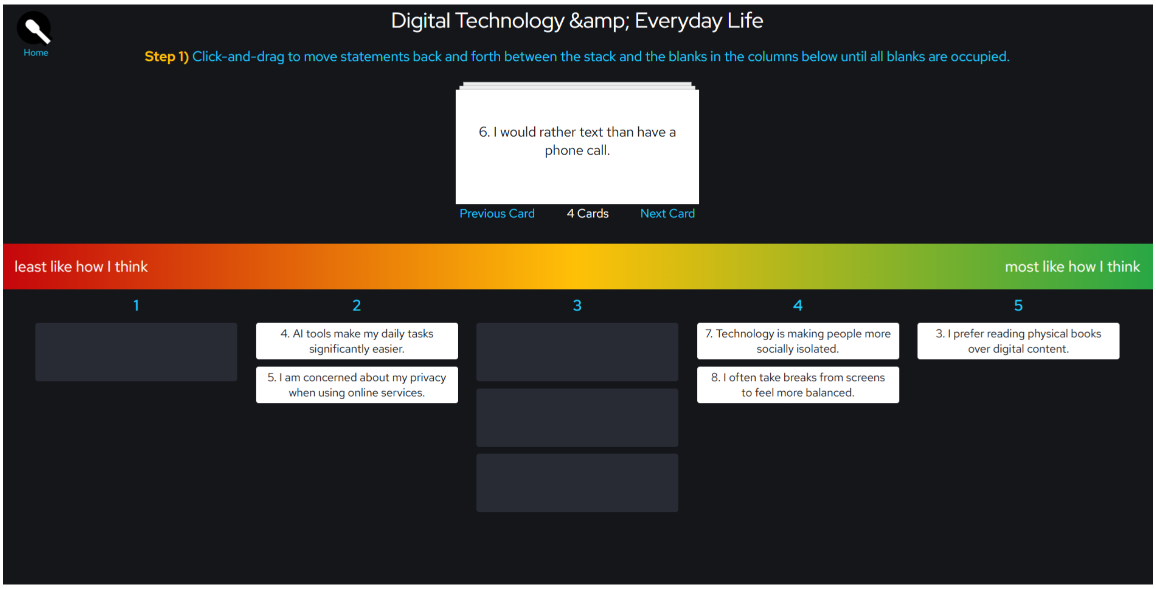

Figure 3.2: Q-Tip software does not enable pre-sorting. However, participants can familiarise themselves with the deck by swiping between cards or placing them directly into the sorting grid and rearranging them as necessary.

- ✚ The layout is clean and minimalistic, highlighting the typical Q-sorting structure.
- ━ The mobile version is well-designed and functional, but readability and sorting interaction during the final sort could still be improved for a smoother experience.

3.2 Q-Tip

Q-TIP, a modern-looking free online tool, stands for Q-Method Testing and Inquiry Platform [2]. It offers a simple dashboard with the option to conduct Q-sorting sessions. The study's setup is straightforward and quick, with a basic set of options, including setting up the grid and providing the condition of instruction, a thank you message or a consent form.

Usability Insights:

- ✚ Statements are easily readable, even with long text.
- ✚ Participants get a pop-up notification when trying to place a card into a column that is already full.
- ✚ Participants can comment on chosen statements about their feelings concerning them or why they have been challenging to place.
- ━ Pre-sort is not an available option.
- ━ Drag-and-drop functionality is quite challenging on mobile devices.
- ━ The statement can not be assigned to a specific spot, only a column.
- ━ It is not possible to view all the cards at once. (Figure 3.2) The participants must review them individually to familiarise themselves with the topic statements.

- The tool is not optimised correctly for smaller screens. Even though the statements are visible and readable, part of the page is cut off and not fully functional.
- If a column is complete, switching cards is not automatic. The participants must manually remove and replace the cards.
- Before submitting the final sort, participants are asked which column contains statements they feel most neutral about. This setting can not be disabled.

3.3 QSortWare

QSortWare is a free web-based tool for performing Q-sorting [19]. Although the interface is slightly obsolete, resembling an outdated database system, it accomplishes the basic functionality (Figure 3.3). Configuring a study is quite time-consuming and not intuitive at first sight, though the available tutorials can help researchers navigate the process.

Usability Insights

- + The layout is the screen divided into multiple columns, so there is enough space to see statements fully. However, its resemblance to a typical Q-sorting layout is not prominent.
- − It is impossible to turn off the pre-sort option in the study settings or skip it during the sorting process.
- − Drag-and-drop feels clumsy as the cards with statements are only clickable by the text part, not the entire card surface.
- − When switching positions in the case of a complete column of cards, the switch is not automatic.
- − The tool is not responsive on mobile devices, as drag-and-drop does not work.

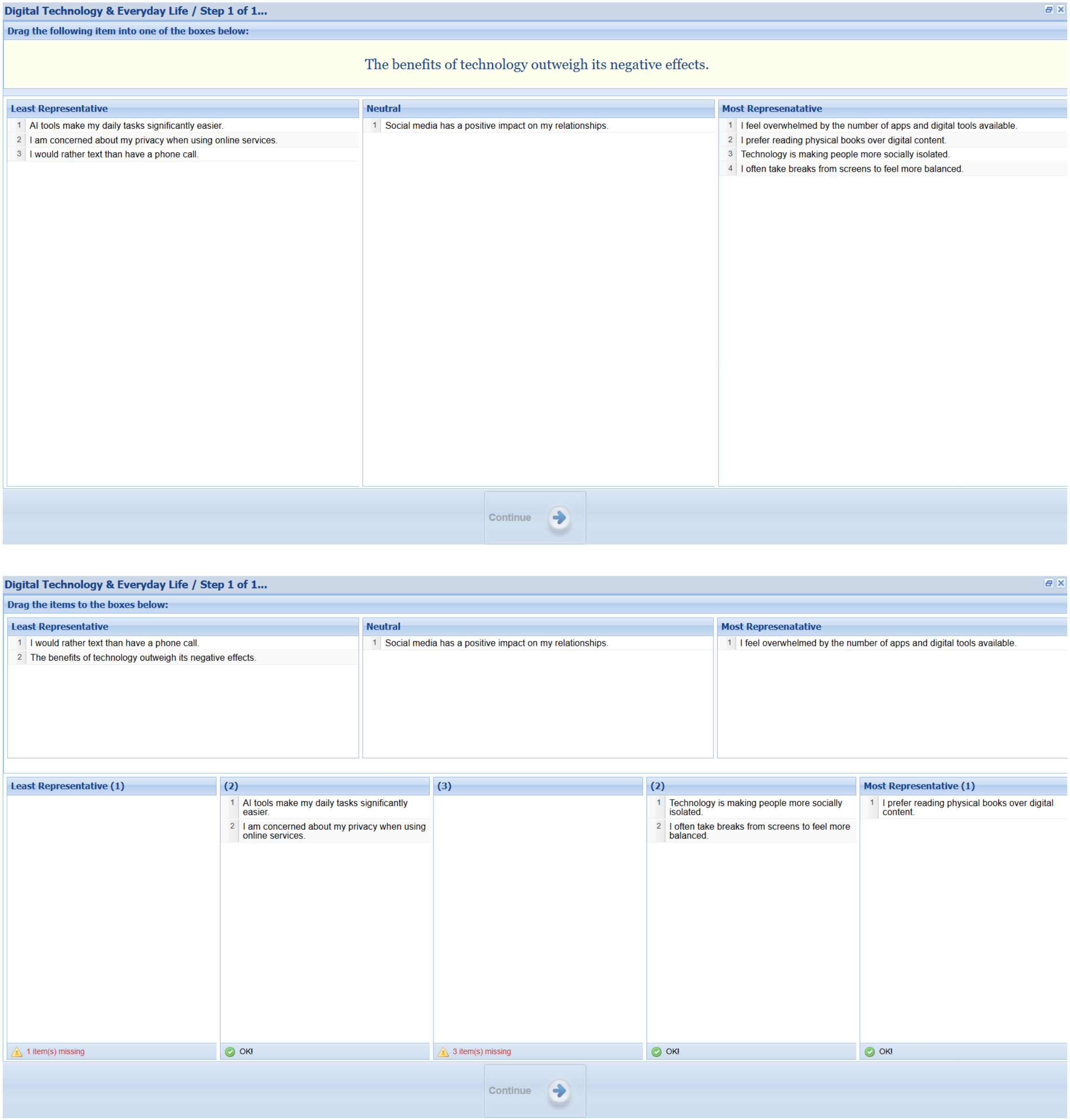

Figure 3.3: QSortWare uses a simple tabular layout. In both the pre-sort (which can not be skipped) and final-sort steps, the screen is divided into columns based on the number of groups the participant sorts into. This arrangement does not offer any colour guidance for the participant. However, it utilises the whole screen space and solves the frequent problem of unreadable, wordy statements.

Chapter 4

Proposed Set of Tools for Q-Sorting Research

This chapter will cover tools I have created or utilised to simplify the research process. The decision to conduct most usability tests using physical tools is relatively straightforward. This hands-on approach aligns well with my goal of analysing natural sorting behaviours while allowing quick adjustments, iterations and experimentation without the delays related to the iterative refinement of digital tools.

A modified approach was implemented in the final usability testing phase, which is described in more detail in Iteration ❽. During this phase, participants first sorted the cards using physical templates and then through a web application. This sequential process enabled users to compare both methods directly, making it easier to identify each approach's strengths and limitations and thereby helping to define practical guidelines for digital Q-sorting.

4.1 Card Deck Generator

As previously mentioned, Q-sorting is simply sorting cards containing statements about a particular topic. I have developed a script to efficiently create new card decks, automating the process of experimenting with various decks without spending extra time making each card manually.

The Card Deck Generator is a Python script that generates card decks with textual information or a glyph scaled to various sizes. It then automatically stacks them into a single, printable PDF file. Each deck has a colourful striped watermark on the back to make it recognisable from other decks, and it is the size of a standard business card.

Structure

The input parameters of textual and glyph decks differ, but the generating process is the same (Figure 4.1). It starts with parsing and validating the input arguments from the command line, followed by generating individual cards. In order to print the whole deck smoothly, the cards are first stacked horizontally into pairs, then vertically, forming a two-by-five grid that fits the standardised size of an A4 paper. At this point, the striped pattern is generated with the colour randomly selected. The watermark either contains the size values the glyph is scaled to or the name of the input file when it comes to textual decks. Once all the pages are ready, they are merged and ready to be printed using duplex printing.

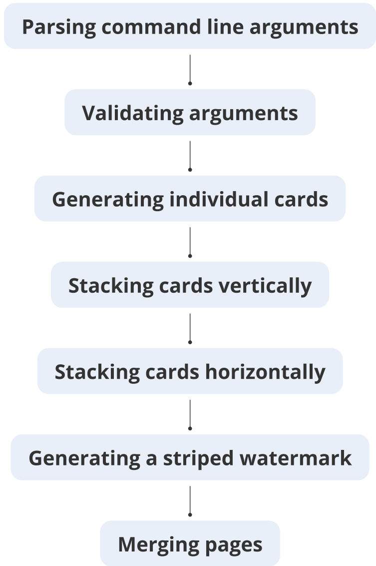

Figure 4.1: The structure of the Card Deck Generator is straightforward. It begins with argument parsing and validation, then generating the cards themselves. The cards are stacked to fit an A4 paper with a watermark for easy distinction from other decks

Numeric Card Decks

The choice to start testing Q-sorting grids using a card deck with numerals in textual form (Figure 4.2) instead of more traditional worded statements was mainly an attempt to make the Q-set as objective as possible, as the testing focused on the grid itself.

The problem was that the participants sorted the cards in a hierarchical way. First, they divided them into groups according to the highest order value (thousands, hundreds, tens, etc.). Then, within each group, they continued to sort according to the lower-order values. Since this sorting method was very different from how statements are sorted, these decks of cards were not used in the future.

It is important to note that the numeric card decks used in the research were not generated with the tool then, as they were merely an attempt to explore the topic of Q-sorting. However, they can be generated the same way as textual decks.

Glyph Card Decks

The glyph card decks were created to address the limitations of the hierarchical sorting approach. Each card consists of a vector glyph scaled to a value from 0 to 100 (Figure 4.3), and participants were asked to sort these cards based on size. Working with different size differences between the cards allowed creating sets in which the individual glyphs' sizes nicely described the template's distribution, but also sets that were intentionally more challenging to sort.

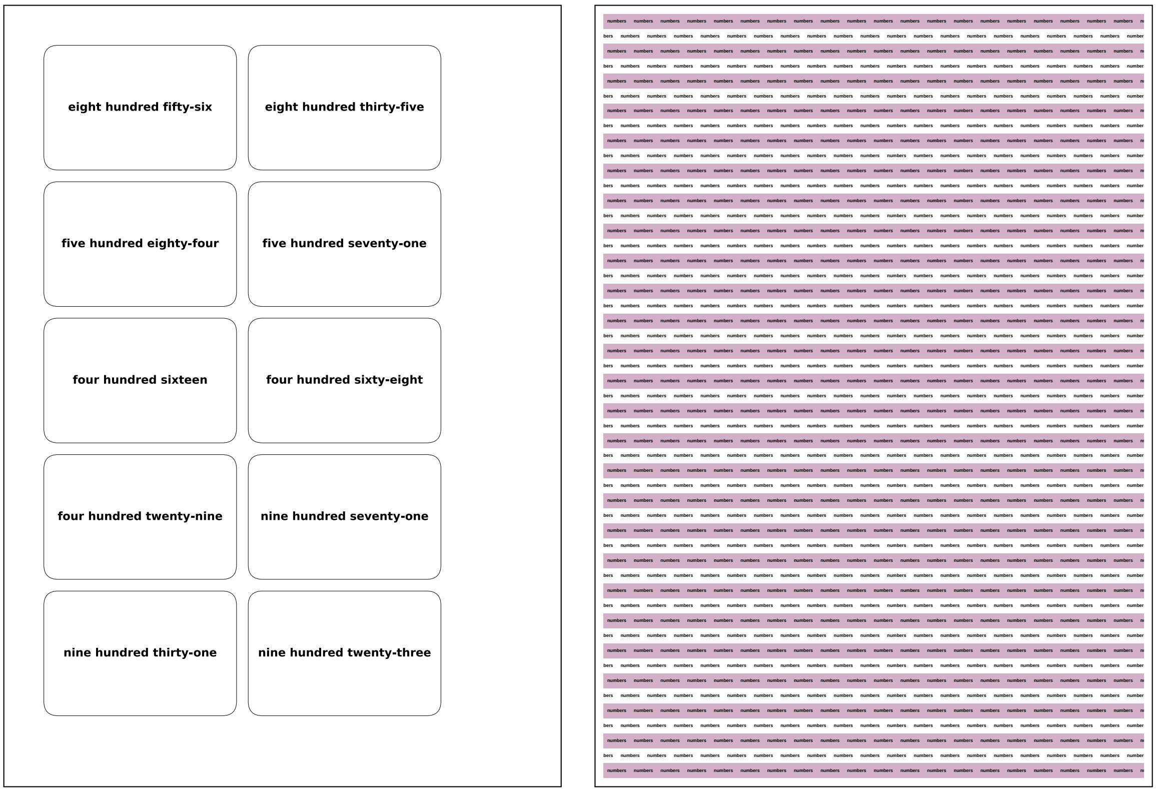

Figure 4.2: A sample from the Card Deck Generator output file, a printable A4 page. **left:** The front side contains generated numeric cards in various sizes. **right:** The reverse side of the deck includes a striped pattern and a watermark (created using the name of the input file) to help quickly distinguish it from other decks.

Usage

To generate a deck of cards containing a glyph scaled to various sizes, the following command needs to be executed:

```
python3 scale.py glyph <fill> <pattern> <output_filename> <scale1> [<scale2> ...]
```

The command includes arguments that define the deck. The fill argument specifies the glyph's fill style, allowing either empty (outline only) or filled (solid). Meanwhile, the pattern argument defines the glyph shape, choosing between a regular circle or a more irregular wavy symbol. Next is the output file's name, output_filename and the sizes to which the glyph should be scaled <scale1> [<scale2> ...].

Jupyter Notebook

In collaboration with my supervisor, I have co-created a Jupyter Notebook that generates normal distributions. This feature is particularly useful for experiments regarding the spread of glyph size. The notebook is connected to the Card Deck Generator, allowing

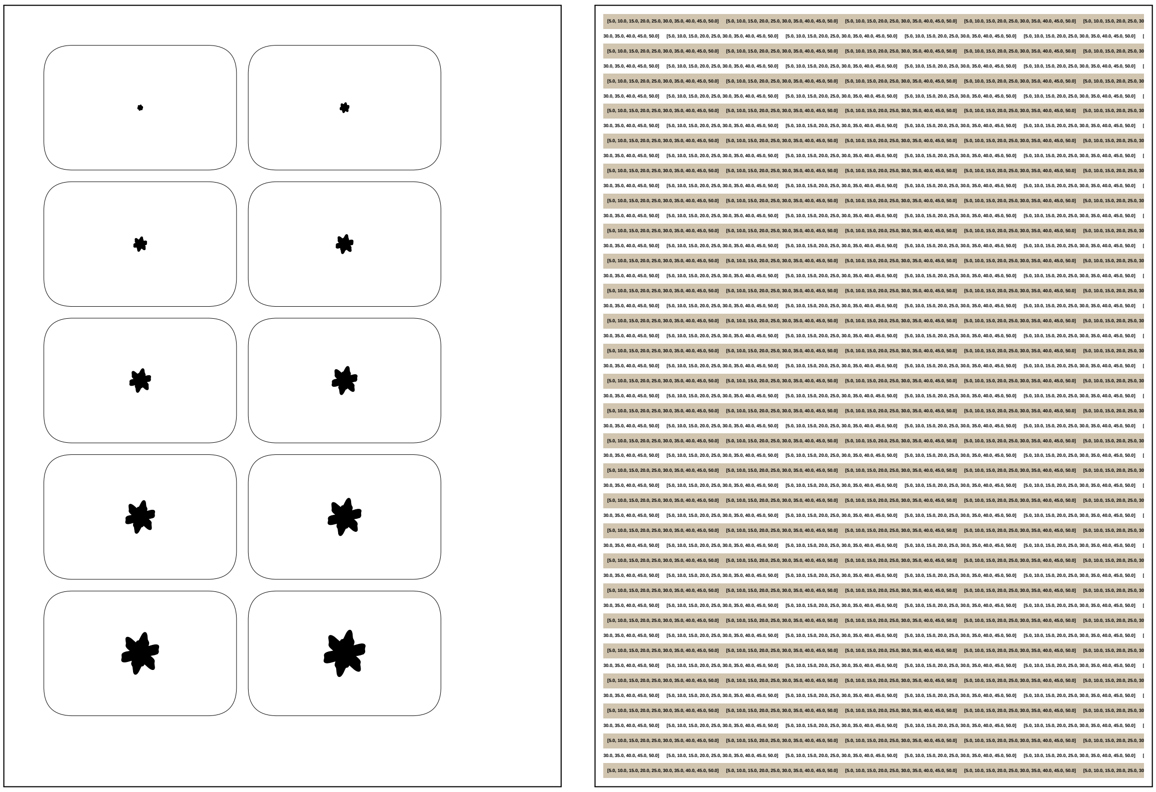

Figure 4.3: A sample from the Card Deck Generator output file, a printable A4 page. **left:** The front side contains generated glyph cards in various sizes. **right:** The reverse side of the deck includes a striped pattern and a watermark (created using the glyph sizes) to help quickly distinguish it from other decks.

smooth, immediate card generation. A preview of the generated card deck allows quick adjustments before exporting.

```
scale = 30
rv = scipy.stats.truncnorm(-50/scale, 50/scale, loc=50, scale=scale)
cards_24sd30 = list(rv.rvs(size=24))
cards_24sd30.sort()
plot_card_sizes(cards_24sd30, nbins=8)
```

The code snippet above generates 24 random values from a truncated normal distribution, a modification of the standard normal distribution restricted to values within a range. In this case, the distribution has a mean $\mu = 50$, standard deviation $\sigma = 30$ and is truncated to interval $[a, b] = [0, 100]$. To use the `scipy.stats.truncnorm` function, the lower and upper bounds must first be standardised using the following formula:

$$z = \frac{x - \mu}{\sigma}$$

Where z represents the standardised value, x is the original value. These values are passed to the function along with the original $\mu = 50$ and $\sigma = 30$, ensuring that the generated values follow the intended truncated distribution. The probability density function of a truncated normal distribution is defined as:

$$f_X(x) = \begin{cases} \dfrac{\phi\left(\frac{x-\mu}{\sigma}\right)}{\sigma\left[\Phi\left(\frac{b-\mu}{\sigma}\right) - \Phi\left(\frac{a-\mu}{\sigma}\right)\right]} & \text{for } x \in [a, b] \\ 0 & \text{otherwise} \end{cases}$$

In this equation, ϕ represents the probability density function, and Φ denotes the cumulative distribution function of the standard normal distribution. As a result, the distribution is centred at 50 but constrained to produce values between 0 and 100. After sampling, the values are sorted and plotted as a histogram (Figure 4.4).

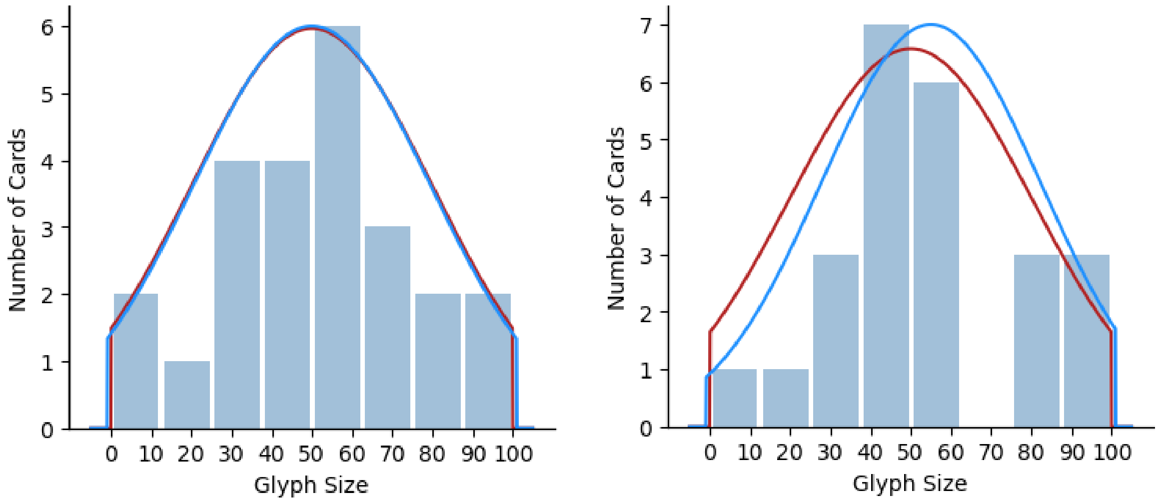

Figure 4.4: A preview of two different truncated normal distributions. In both cases, the red line shows the desired theoretical distribution. Using maximum likelihood estimation, the blue line represents the estimated distribution fitted to the generated data.

Textual Card Decks

During the usability test sessions, I noticed that some participants tended to sort each row of cards within. I have incorporated card decks with actual statements (Figure 4.5) into the research to observe whether this trend is connected to how the sorting grid is arranged or if some participants see the size difference between glyphs more clearly and want the final sort to be exact.

Usage

To generate a deck of cards containing textual information, the user needs to execute the following command:

```
python3 scale.py text <input_filename.txt> <output_filename>
```

The command accepts two arguments. The `input_filename.txt` stands for the path to the input text file, where each line contains one statement, while the `output_filename` defines the name of the output PDF file.

Figure 4.5: A sample from the Card Deck Generator output file, a printable A4 page. **left:** The front side contains generated textual cards. **right:** The reverse side of the deck includes a striped pattern and a watermark (created using the name of the input file) to help quickly distinguish it from other decks.

4.2 Q-Sorting Grid Design Kit

Grids are a focus point of this thesis, as they are essential in organising the sorting experience. The grid usually follows a symmetric quasi-normal distribution ranging from „most agree“ to „most disagree,“ with the middle part representing neutrality or uncertainty.

Unsurprisingly, there are multiple views on approaching the distribution. According to Exel and Graaf, the kurtosis, or how steep or flat the distribution is, should be adjusted depending on the topic's controversiality. They believe that flattening the distribution emphasises the views of participants who are expected to have strong opinions [5]. Brown claims that the distribution shape and scale range are arbitrary and have no significant effect on the statistical analysis. Stating that even if participants sorted statements under free-sort conditions, not employing the entire range of categories, the result of the study would be more influenced by ordering preferences than it would be by distribution preferences [3, 4].

If so, a simple question arises: Is there an approach that could benefit the participants and guide them in following the ideal distribution without limiting them to only predefined placements of an ideal distribution? Can one approach accommodate various levels of investment in a topic?

To explore this further, I have created various grid designs to explore whether a specific sorting grid can confuse participants or, on the other hand, help them during the sorting process.

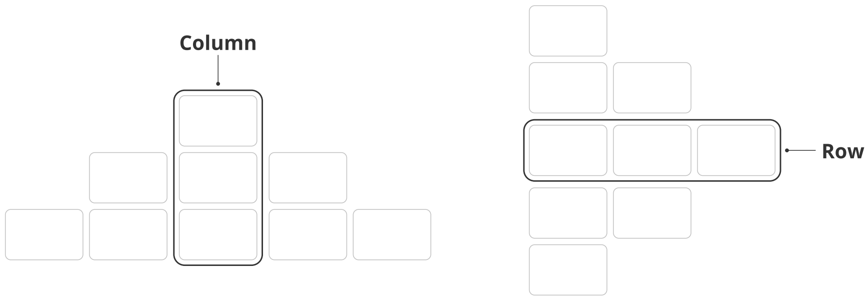

Figure 4.6: A visual comparison between the column-based and row-based approaches, highlighting the alignment difference.

Rather than working with grids in which a column represents each level of agreement, I have focused on an arrangement in which each level is illustrated as a row (Figure 4.6). In that sense, cards sorted into the same group seem visually equal, and the approach also offers greater adaptability for mobile devices in the future.

Over several iterations of testing and modifying, I have experimented with the sorting grid being either strict, keeping cards within fixed boundaries or flexible, allowing cards to interrupt them. Some grids work with grid alignment with predefined card slots, while others allow more loose positioning. In addition, I have experimented with the overall alignment of the grids, testing whether centring or aligning content to the left can influence the sorting experience. Each approach has its reasoning and considerations, which I will discuss in more detail in Chapter 6.

I have developed a simple design system that aims to introduce the Q-sorting grids and reusable components used in the creation process. Due to its creative nature and range of potential variations, I used Figma because of its intuitive interface and flexibility in handling changes. On that note, the system is easy to use for anyone who might continue this research and decide to develop new alternative methods[1].

Components

The design system includes a Card Placeholder (Figure 4.7), a bounding box where participants place cards during Q-sorting. Its goal is to help them understand the structure of the sorting grid and guide them in positioning cards within it. The placeholder size is compatible with the cards generated using the Card Deck Generator.

Figure 4.7: The Card Placeholder component is the core design system piece used to assemble most of the Q-sorting sorting grids.

The component is available in multiple colour variants (Figure 4.8), making it easy to differentiate between various types. The dark-coloured placeholders are used to outline the ideal distribution. In contrast, the light-coloured placeholders represent the possibility of disturbing it and adjusting the borders according to the participant's needs.

[1] https://www.figma.com/community/file/1502567115762784418

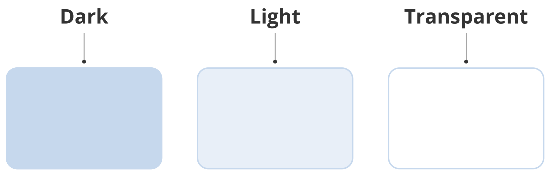

Figure 4.8: The Card Placeholder variants are used to design more flexible Q-sorting grids. The darker placeholders highlight the ideal distribution, while the lighter-toned ones allow participants to adjust it.

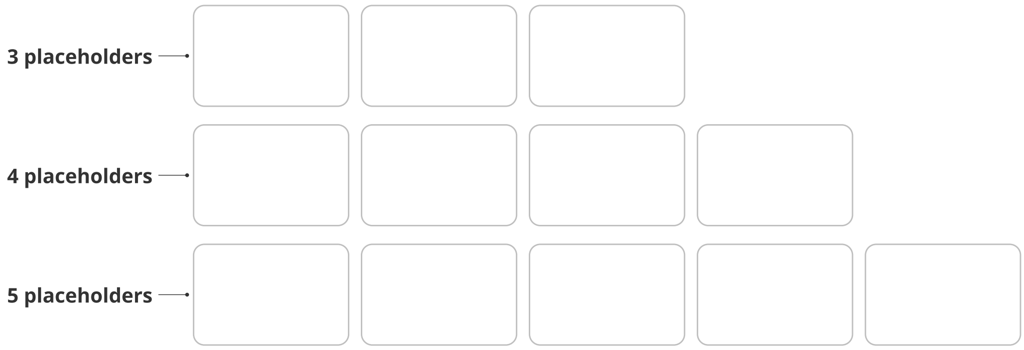

Figure 4.9: A sample of Row variants ranging from 3 to 5 placeholders. The variants were predefined to speed up the grid design process.

Next is the Row component (Figure 4.9), which consists of one or more card placeholders stacked horizontally. To speed up the process of creating a Q-sorting grid, I have made multiple variants, ranging from 1 to 10 cards.

Grids

A part of the system is dedicated to previews of all grids designed and tested during my research, with brief descriptions to help understand the context and reasoning behind their creation.

Printing Instructions

Lastly, I have added easy-to-follow printing instructions and frames in standardised paper sizes to simplify the process for anyone using this tool to test Q-sorting grids physically. Users paste the completed layout into the appropriate frame in the Paper Sizes folder and then export it as a PDF.

4.3 Web Application

As mentioned in this chapter's introduction, users performed card sorting during the final usability testing iteration using physical and digital approaches.

For the digital Q-sorting tasks, I adapted a web application developed initially as a master's thesis by Michal Janů [8] and later enhanced by Vojtěch Pavelka [13], with whom I have been collaborating as he explores the topic further in his bachelor thesis. The application utilises drag-and-drop functionality for card sorting, with datasets and grid configurations defined through JSON files.

To align with my research needs, I implemented several key modifications to match the physical grids' visual appearance. These adjustments included customising the grid colouring to reflect the physical templates from Iteration ❽ (Figure 4.10), incorporating new datasets, refining the colour palette, and various minor visual enhancements.

While working with the application, I also identified certain technical limitations that were considered when conducting the usability testing. For instance, the cards can only be sorted into rows rather than specific positions, with the visual grid serving merely as a background guide. With the left-aligned approach, this design did not cause any issues. However, in response to this constraint, when implementing the centred approach, cards aligned to the centre of each row would occasionally create visual misalignments where cards would overlap multiple placeholders in the underlying template.

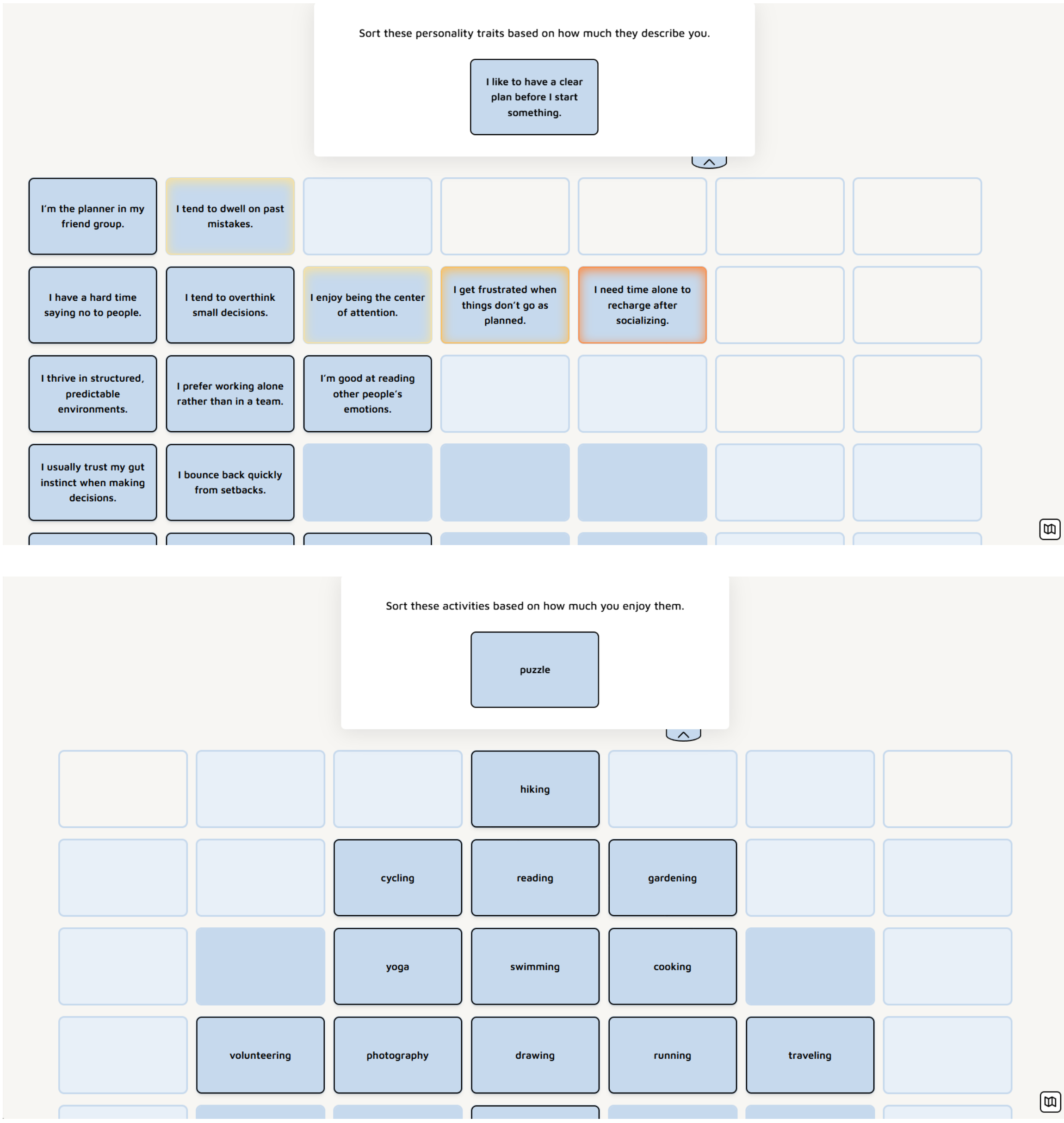

Figure 4.10: A preview of web application modified based on the physical version of **top:** hybrid-left grid (Section 6.6) **bottom:** hybrid-centre grid (Section 6.5).

Chapter 5

Iterative Usability Testing and Data Analysis

Usability tests are a significant part of the process as they helped me get an insight into how people interact with different proposed Q-sorting grids. As defined by Steve Krug, usability testing is *"Watching people try to use what you're creating/designing/building (or something you've already created/designed/built), with the intention of (a) making it easier for people to use or (b) proving that it is easy to use."* [10].

5.1 Approach to Usability Testing

The testing followed standard principles to ensure consistency and that the participants worked under the same conditions. These principles included consistent lightning conditions, adequate space for sorting, minimal visual distractions in the testing area, and standardised instructions in the form of consistent task phrasing.

Regarding the number of participants in a usability test iteration, most researchers in the field follow the statement of usability pioneer Jakob Nielsen, who claims that five users are enough to detect most user problems [12]. This idea was later subjected to further analysis, arguing that five users is a good starting point with a small cost-benefit ratio but may not be optimal for all test types as the cost of missing those problems far outweighs the cost of proper testing [6].

On this note, I opted for 8 per iteration, a sample size large enough to identify issues and patterns with the goal of qualitative improvement while remaining efficient and focused on iteration rather than attempting to prove findings statistically.

5.2 Developing the Usability Testing Script

I used a simple protocol during the initial testing stages, which focused on creating a deck of cards that would make the sorting experience as objective as possible. It consisted of a brief introduction, clear task instructions, and a concise conclusion to wrap up the session. The complete protocol is in Appendix A, though it was always tailored to address the specific research goals of each iteration.

After a few iterations, when the focus shifted to the Q-sorting grids and the usability tests became more complex, I created a more detailed protocol to keep the sessions organised and consistent.

The main difference is that, in addition to the task instructions and introduction outlining how the session will proceed, it also contains checkboxes reminding me to start recording the session or set up the timer for the task, a set of post-testing questions for the participant and a detailed script to follow. The protocol I used as a base for the usability testing is in Appendix B.

5.3 Analysing the Collected Data

To systematically analyse the collected qualitative data, I employed affinity mapping. The method, also known as the KJ Method, was gradually defined in the 1960s by Japanese anthropologist Jiro Kawakita. He had trouble interpreting data collected during his research on Japanese mountain villagers. As Kawakita himself described it, *"With masses of data spread about on my desk, I had been racking my brains to find some way to integrate them when I suddenly realised that depending on the spatial arrangement of the cards, you can see new meaning in them and find ways to systemise the data. That was the first realisation that led to the creation of the KJ Method."* [9].

To use this method in practice, data gathered during usability testing is first written on individual note cards. The next step involves grouping these labels into distinct clusters based on similarities and assigning titles to these groups to help generalise the concepts. Additionally, connections between clusters can be highlighted through visual elements such as arrows or connecting lines for more explicit interpretation before writing a summary [16].

5.4 Usability Testing Iterations

Iteration ❶ : Numeric Card Deck – Testing without Sorting Rules

The initial testing iteration aims to understand better whether the card decks with numbers in textual form are sufficiently objective. To test that, three decks of cards were used, with the titles coming from the colour of the reverse side:

- Blue deck – 20 cards with numbers ranging from 1 to 20
- Yellow deck – 20 cards with random numbers ranging from 100 to 999
- Green deck – 20 cards with random numbers ranging from 1000 to 9999

The testing focuses on observing what sorting methods participants naturally use and whether these methods change when presented with different numerical ranges.

Protocol

The testing session consisted of three tasks, each using a different deck of cards and following a straightforward protocol (Appendix A) to ensure consistency among participants.

> *Your task is to arrange these numbers in ascending order, with the smallest numbers on the left side and the largest on the right.*

Key Outcomes

When sorting the blue deck, participants quickly recognised it as a continuous numerical sequence, allowing them to anticipate the following number and space the layout accordingly. The layouts varied, with some participants arranging the cards in a single long row, while others opted for shorter columns and rows, mainly to display them all at once directly in front of them.

The sorting method has changed with the yellow and green decks, but all participants followed the same process. First, they organised the cards into clusters based on place value hierarchy (thousands, hundreds, tens, etc.), and then they sorted each cluster by comparing the remaining digits. Typically, the layout featured a main row sorted by the first digit, with vertical columns beneath each digit. The remaining cards in each cluster were ordered, with higher numbers placed lower in the column.

Iteration ❷ : Numeric Card Deck – Testing with Sorting Rules

Based on the results of the previous iteration, in which participants naturally pre-sorted cards into nine groups according to the first digit, the idea of limiting the number of groups was introduced. The restriction was implemented to determine whether there is a way to disrupt the consistent pattern of sorting cards based on place values that people follow.

Protocol

In this case, the protocol was slightly modified, and the participants were allowed to create a maximum of three groups.

> *Your task is to arrange these numbers in ascending order, with the smallest numbers on the left side and the largest on the right. You may stack the cards into a maximum of three groups before arranging them in their final sequence.*

Key Outcomes

Some participants laid all the cards in front of them, forming a large group that had to be tediously scanned with every card placement. However, in most cases, they divided the cards into three groups based on the first digit, following the ranges 1-3, 4-6, and 7-9, which allowed them to complete the sorting in an organised way.

Still, the strategy remained unchanged and was based on place value. Since both iterations proved that the method used to sort numeric textual cards is very algorithmic, these decks were not used in future iterations.

Iteration ❸ : Glyph Card Decks – Testing with and without Sorting Rules

Building upon previous findings, the numeric card deck has been replaced with a glyph card deck. Yet, the goal of the testing remained the same: to see if sorting glyphs scaled to various sizes could mimic the more traditional sorting of statements while remaining as objective as possible. The deck consisted of 20 cards, with the glyph of a nautical anchor scaled at equal intervals along a constant distribution.

Protocol

Inspired by the approach of previous iterations, the participants were asked to complete the same task twice. The second time, the number of groups was limited to see if any difference in strategy occurred.

> *Your task is to arrange these glyphs in ascending order based on size, with the smallest glyphs on the left side and the largest on the right.*

> *Now, we'll repeat the same task; however, you may stack the cards into a maximum of three groups before arranging them in their final sequence.*

Key Outcomes

During the first task, most participants had a chaotic sorting experience. They typically placed all the cards in front of them and compared each to the rest before placing it down.

The second task delivered positive results. What was initially considered a limitation turned out to be a helpful suggestion. The participants divided the cards into three groups: small, medium, and large, which resulted in a faster and less complicated strategy. Even when some cards were not correctly pre-sorted, the error usually involved a shift of only one position in the final arrangement.

In both cases, the layout was often a set of rows or columns short enough to be within the central vision field.

Iteration ❹ : Glyph Card Decks – Testing Different Types and Fill Styles

The previous iteration showed that glyph sorting is less hierarchical and more perceptually challenging than sorting numbers in textual form. Even when creating three groups during pre-sorting, the boundaries between these categories are often fuzzy, mimicking the continuous nature of statement sorting.

Based on these observations, two questions emerged: To what extent can the participants distinguish glyph sizes? And, when the differences are subtle, are certain shapes easier to sort accurately by size?

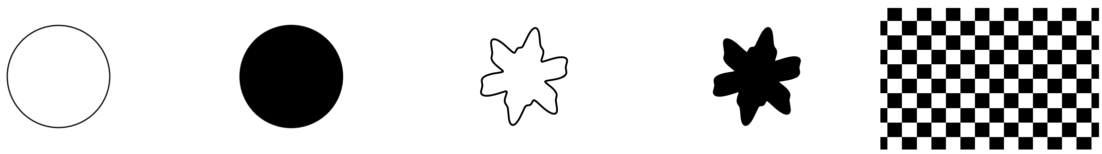

Figure 5.1: The five glyph types used in the size perception tasks. **left to right:** outlined circle, filled circle, outlined sinusoidal star, filled sinusoidal star, and checkered rectangle.

Protocol

In this case, the testing session consisted of multiple short tasks. During each one, the participants were presented with four cards containing one of the tested glyphs (Figure 5.1) but in different sizes or densities. Some comparisons involved subtle differences in glyph size, examining the limits of what is noticeable and what is not (Figure 5.2).

> *Your task is to look at these four cards and point at them in order from smallest to largest glyph.*

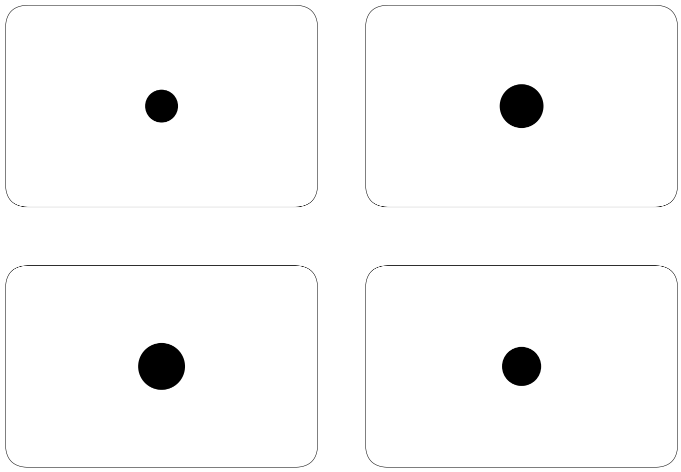

Figure 5.2: Example of a task used to examine the ability to distinguish subtle size differences. Four cards containing identical glyphs were presented in the following arrangement: **top left:** size 20, **top right:** size 27, **bottom left:** size 29, and **bottom right:** size 24.

Key Outcomes

The check pattern, without any exceptions, was rated as very confusing to order by density.

While the circle performed well, the sinusoidal star-glyph achieved the best overall results. This suggests that its numerous curves and lines provided additional reference points for estimating distances. This resulted in more accurate size sorting, even with glyphs that differed by only one scale value.

As for the fill type, based on the results, there was rarely any difference between successfully sorting outlined and filled glyphs.

Upon reflection, the glyph selection was relatively limited in scope. A more comprehensive study testing a broader spectrum of shapes, ranging from simple lines to complex geometric forms, would potentially deliver valuable insights. However, as this particular aspect was not the central focus of the thesis, I proceeded with the sinusoidal glyph design, which worked well enough for my research purposes.

Iteration ❺ : Glyph Card Decks – Testing without Predefined Sorting Grids

This iteration starts a sequence of examinations whose primary goal is to track the users' Q-sorting process and better understand their strategies. With each iteration, the sorting grid will be modified based on the findings regarding what helps the user in the sorting process and what limits or otherwise distracts the user.

No sorting grid was used in this iteration to avoid imposing a bias on participants' natural sorting behaviours. However, unlike in Iteration ❸, where the card arrangement was not constrained, this time, the participants were instructed to shape the final alignment of the cards to resemble the Q-sorting shape.

As for the card decks, two different sets of 24 cards were used during testing sessions, both generated to follow normal distribution. To experiment if it is possible to imitate varying levels of investment that are a natural aspect of sorting statements, one is naturally aligning with a normal distribution (imitating a less salient approach when the knowledge or interest of a participant is lower) while the other one was slightly distorting the distribution(simulating when participants have strong or well-articulated opinions that can oppose the ideal structure of the Q-sorting grid).

Protocol

As mentioned above in Section 5.2, the process of conducting test sessions has changed, and as it now includes more tasks, the need for a more structured protocol has emerged (Appendix B).

In this iteration, participants completed three tasks. The green deck (which is more complex) was used for the first task. The second task was identical, allowing observation of whether participants' approaches changed. For the final task, the deck was switched to the blue deck, which had an ideal distribution. The condition of instruction was identical in all of them.

> *Your task is to arrange these cards by the glyph size – smallest at the top, largest at the bottom. The goal is to create a centred, symmetrical arrangement that's widest in the middle – like a Gaussian curve or the shape of a diamond. Take as much time as you need to sort them accurately.*

The idea of experimenting with a less conventional layout and asking the participants to follow a centred approach was based on my supervisor's natural sorting tendencies. We considered it worth testing with the hypothesis that reducing the vertical distance between extreme positions (top and bottom single-card groups) and the wider middle section could help decrease the cognitive load by minimising excessive eye movement and simplifying visual comparisons.

At the end of the usability testing, a few minutes were devoted to a discussion in which participants were asked these questions:

> 1. *Did your emotions change during the tasks? If so, why?*
> 2. *You have done the same task three times. How would you briefly describe your sorting strategy?*
> 3. *Did your approach change in between the tasks?*
> 4. *Were there any challenges you encountered with the first deck of cards?*
> 5. *Can you compare the sorting experience with the two various decks of cards?*
> 6. *Were there any challenges you encountered with the second deck of cards?*

The protocol of this iteration, the complete version in Appendix B, also became the basis for each future iteration.

Key Outcomes

The most common sorting strategy involved placing the cards in front of them rather than listing through the cards or attempting to create the alignment directly. In half of the cases, utilising some pre-sort strategy was common.

The overall approach across all of the tasks remained essentially unchanged. However, performance metrics shifted. Sorting time decreased by as much as half, mainly because participants became more familiar with the process and had a better idea of how to arrange the cards. Also, if emotional shifts occurred, they were generally toward more positive emotions than negative ones.

As for the alignment itself, approximately half of the participants experienced slight issues with the instructed alignment. They decided to initially use alternative approaches, followed by rearrangement to match the instructed layout, often aligning the cards to the left.

The outcomes confirmed that participants recognised the difference between card decks. The blue deck was considered easier and more intuitive to sort as the sub-groups were clearly defined, in contrast to the green deck, which made them question whether to force the instructed distribution shape or place cards in positions at the expense of disrupting the arrangement.

Iteration ❻ : Glyph Card Decks – Testing with Fixed-Centre Grid, Fixed-Left Grid and Fluid-Centre Grid

Utilising the findings of Iteration ❺, three different grids were created to help users with Q-sorting (Figure 5.3).

- **A fixed-centre grid** with predefined placeholders for cards is aimed at participants who are unsure about the correctness of their alignment.
- **A fixed-left grid**, an additional version of the fixed grid, guides participants who have resorted to a non-centred alignment.
- **A fluid-centre** grid is an attempt to subtly guide the participant in terms of shape and accommodate various card decks without imposing rules on the number of cards in a row.

Protocol

The usability session consisted of three tasks using the same card decks and the instructions as in the previous iteration. However, this time, participants were asked to follow a Q-sorting grid, with the order of grid presentation randomised to reduce bias.

> *Your task is to arrange these cards by the glyph size – smallest at the top, largest at the bottom according to this grid. Take as much time as you need to sort them accurately.*

The post-discussion questions changed as well. With the focus shifted towards grid preferences, the main goal is to understand pain points to improve and adapt the grids iteratively. To achieve this, participants were asked the following questions:

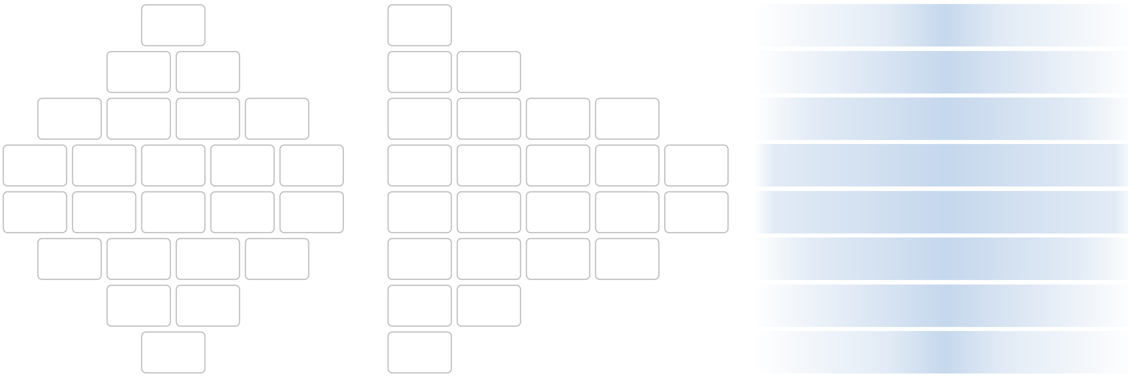

Figure 5.3: Preview of grids used during Iteration ❻ of usability testing. **left to right:** The first two layouts employ predefined card slots (fixed-centre grid (Section 6.1) and fixed-left grid (Section 6.2)), while the last layout (fluid-centre grid (Section 6.3)) relies on subtle visual guidance to support a more flexible interaction.

> 1. *Which grid felt the most natural to work with? Why?*
> 2. *Were there any challenges you encountered with any of the grids?*
> 3. *Is there something you would change to make the grid even better?*

Key Outcomes

The results for the most preferred Q-sorting grid varied depending on which card deck the participants were sorting.

When using the blue deck, the participants preferred fixed grids with predefined card slots, eliminating uncertainty. They preferred the centred layout slightly more. The main reason was that with a left-aligned approach, the participants felt the glyphs should be sorted even within the row itself. Those who naturally tended to sort the deck more organizedly leaned towards the left-aligned layout, while those who did not want to make the task more complicated appreciated the centred approach.

In contrast, with the green deck, preferences were evenly distributed between the fixed-left and fluid-centre grid. The fluid one successfully relieved participants of the stress associated with whether it is more important to follow the ideal distribution shape or stick to their views. Once again, organised sorters favoured the left-aligned approach, aiming to sort the card deck within the rows.

Again, the challenges encountered during usability sessions could be divided into groups based on the card deck. Blue deck sorters felt uncertain and needed reassurance while using the flexible layout, and green deck users had issues following the structured layout because the card deck did not match the card slots.

Based on participant feedback, the most frequent suggestion was to develop a fixed-centre grid where cards align vertically between rows, as participants found it challenging to compare cards that did not form clear columns.

Iteration ❼: Textual Card Decks – Testing with Fixed Refined Centred Grid, Fixed Left-Aligned Grid and Fluid Centred Grid

Employing the outcomes of the previous iteration, the fixed-centre grid was modified to improve clarity, while all other grids were kept unchanged (Figure 5.4). This approach allows for evaluating whether this single adjustment to the centred grid produces different results.

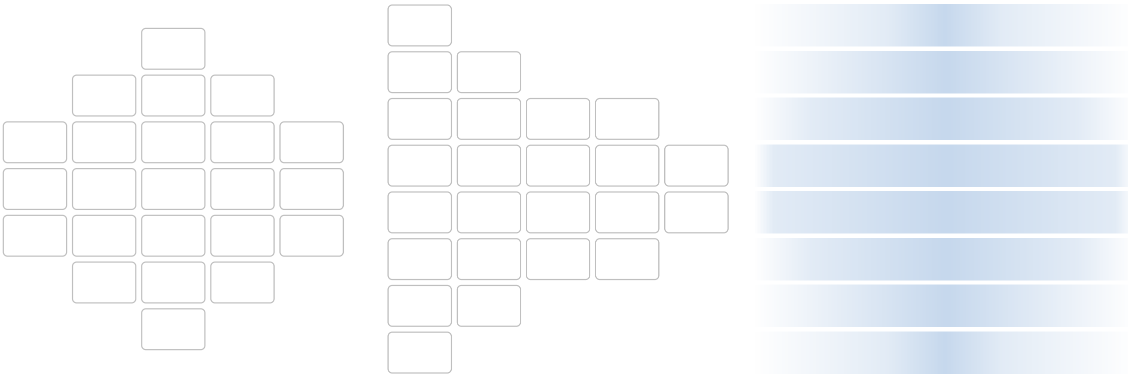

Figure 5.4: Preview of grids used during Iteration ❼ of usability testing. **left to right:** The first two layouts employ predefined card slots (fixed-centre refined grid (Section 6.4) and fixed-left grid (Section 6.2)), the centred grid is updated to align with user needs identified in Iteration ❻. The last layout (fluid-centre grid (Section 6.3)) relies on subtle visual guidance to support a more flexible interaction.

The decision to simultaneously incorporate textual card decks into usability testing is to determine whether sorting cards within the row is a pattern that occurs only for glyphs sorted based on size or applies to testing using statements.

Two sets are made to create a similar experience as with the glyphs: one with randomly chosen fruits and vegetables, where participants are not that expected to have strong opinions that they would have problems obeying the ideal distribution, and another containing a selection of required undergraduate courses at our faculty, where in contrary, the participants are more likely to have established preferences requiring adjustments in the arrangement.

Protocol

Regarding the protocol, compared to Iteration ❻, the participants were asked to first sort the card deck without any layouts to see their natural tendencies. The instruction is adjusted based on the topic of the card deck. In the case of the fruits and vegetables card deck, the participants are asked to sort them based on how much they like or dislike each of them, while with the deck containing subjects, the instruction is as follows:

> *Your task is to arrange these cards based on how difficult you find each school subject. Place the easiest subjects at the top and the most difficult ones at the bottom. Please arrange the cards according to this template. Take as much time as you need to sort them accurately.*

Key Outcomes

Compared to the previous iteration, the fixed-centre layout was the most popular, even among participants whose natural arrangement was aligned to the left. Similarly, as in the earlier iteration, when using the fixed-left grid, participants tended to self-impose an unnecessary constraint of sorting cards within horizontal rows despite no instruction telling them to do so. They expressed that the centred layout freed them from this self-created limitation, allowing them to move cards more fluidly without the perceived need to maintain row-based organisation.

While with the fluid-centre grid, some participants enjoyed the flexibility; many others expressed strong negative feelings towards it as they felt compelled to focus on shaping the layout, making the process laborious and frustrating.

The fixed-left grid was greeted with success only when the participant opted to sort within the row, which was not a frequent pattern with the textual decks. The participants described it more often as too spread out, making it difficult to see all cards simultaneously.

Compared to Iteration ❻, there is no indication that the different textual card decks mentioned above influence which template users use.

Iteration ❽ : Textual Card Decks – Testing with Hybrid-Centre Grid and Hybrid-Left Grid

Based on the results of the last two iterations and feedback from several participants, a hybrid approach emerged that combines the core strengths of previously tested grids, predefined card slots and flexible positioning (Figure 5.5).

This approach features coloured predefined placeholders. Darker colours highlight the ideal card distribution, the same way as in the centred and left-aligned grid. In contrast, lighter colours indicate additional optional placement areas, an approach utilised in the blurred grid.

Figure 5.5: Preview of grids used during Iteration ❽ of usability testing. The grids are created as a combination of fixed and fluid approaches, with the only difference being the alignment: **left:** Hybrid-Centre Grid and **right: Hybrid-Left Grid**.

It aims to explore whether combining the approaches would result in a layout that easily accommodates various user preferences, offering the freedom some participants value without forcing users to focus excessively on managing the arrangement.

Protocol

The usability testing was conducted similarly to the previous iteration. The first difference was that a new deck of cards with randomly generated leisure-time activities was added. The participants were asked to sort the cards based on which activities they generally enjoy and which they do not.

After the post-discussion phase, a second difference was introduced. The participants were asked to perform the task again using the template they had chosen as most natural to work with, this time using the web application introduced in Section 4.3. A set of questions followed the task to reinforce the findings gathered from participant observation during the Q-sorting process and, more precisely, identify the functionalities that must be implemented for a good user experience.

> 1. *How would you rate the digital tool experience compared to physical card sorting?*
> 2. *Did you encounter any challenges while using the digital tool? If so, what were they?*
> 3. *What would you improve in the digital tool to make it easier or more enjoyable?*

Key Outcomes of Physical Usability Testing

Compared to the previous iteration in which the fixed-centre grid was favoured over others, it was often criticised this time. Many participants initially assumed the cards would be sorted from the centre outward rather than from top to bottom before being given the task instructions. Despite this criticism, a few participants still preferred this approach for reasons identical to those in Iteration ❼. Still, they most leaned towards the left-aligned template, which they found straightforward and not at all confusing.

Overall, the hybrid approach achieved positive results across various card decks and different levels of participant investment in each topic. It turned out that even users who had no complaints about the ideal layout and respected the boundaries when sorting one deck had no problem breaking away from the ideal distribution when sorting different card decks – thus achieving the intention behind these grids.

Key Outcomes of Digital Usability Testing

Testing using the web application revealed shortcomings, which made the experience quite frustrating for most participants. The most common problems include the following:

- The sorting grid is not fully visible, and participants must scroll while sorting cards, making it rather tedious.
- The absence of the pre-sort step means that the participants can only see one card at a time, not knowing what to expect and without the chance to familiarise themselves with the card deck, which often results in a more chaotic sorting process.
- The sorting grid itself is not slot–specific. The users were bothered that they could only assign a card to the row itself, not specifically to a particular position.

Overlooking the lack of these features, a few participants have expressed that if the interaction with the application were less quirky, they would prefer digital sorting to physical as one would not have to align every card to its position laboriously.

- Cards randomly disappear and reappear when not precisely placed into a row.
- The feature that allows the participants to create extra rows. Though it was developed to help the participants as they could adjust the sorting grid if it did not align with their natural sorting, it created even more chaos.
- There is no ability to easily and automatically swap two cards.

Regarding layouts, the results suggest that while the combination of fixed and fluid grids successfully accommodated the sorting of various card decks by different participants, the user interface presented challenges. The current approach, where borders are highlighted yellow for the first card disrupting distribution, orange for the second, and so on, confused participants, making them uncertain whether they should force all cards into the darker placeholders. Thanks to their previous experience with paper templates, most participants didn't change their arrangements despite feeling uncomfortable with these signals.

However, to improve the experience, an alternative is proposed. Instead of colouring the placeholder edges, the cards could be recoloured according to their position, ensuring the coloured grid beneath them remains visible.

Chapter 6

Evaluation of Q-Sort Layouts

This chapter provides a brief and structured overview of each Q-sorting grid developed and tested during the research. Each section addresses the motivation behind creating the Q-sorting grid and provides a concise summary of the findings.

6.1 Fixed-Centre Grid

The grid features 24 predefined card slots following the classic bell curve of a normal distribution. The structure is centrally aligned, creating visual harmony while maintaining statistical significance (Figure 6.1).

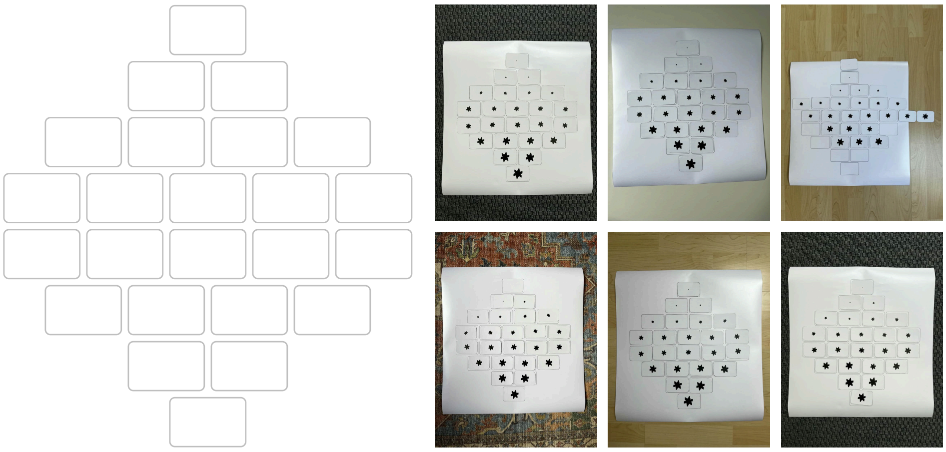

Figure 6.1: The centrally aligned grid consists of 24 predefined card slots arranged to follow a normal distribution.

Motivation

The centred approach was first tested during Iteration ❺ without using a grid. The results showed that half the participants had no issue with the centred shape. Therefore, the decision was made to continue testing it.

This grid was created by observing that participants tend to get unsure when positioning and arranging the cards. The goal was to make the sorting experience less overwhelming.

Findings

During usability tests, the grid brought up mixed emotions among the participants. Key observations from the testing include:

- Predefined card slots helped eliminate uncertainty during the sorting process.
- Unlike the left-aligned grid, the centred approach did not create the impression that cards should be sorted within rows.
- Participants requested a better column alignment to improve visual clarity.
- Some participants found the rigid grid structure limited their sorting needs.

6.2 Fixed-Left Grid

The grid consists of 24 predefined card slots arranged to follow the normal distribution shape more conventionally, anchored to one side, in this case, to the left (Figure 6.2).

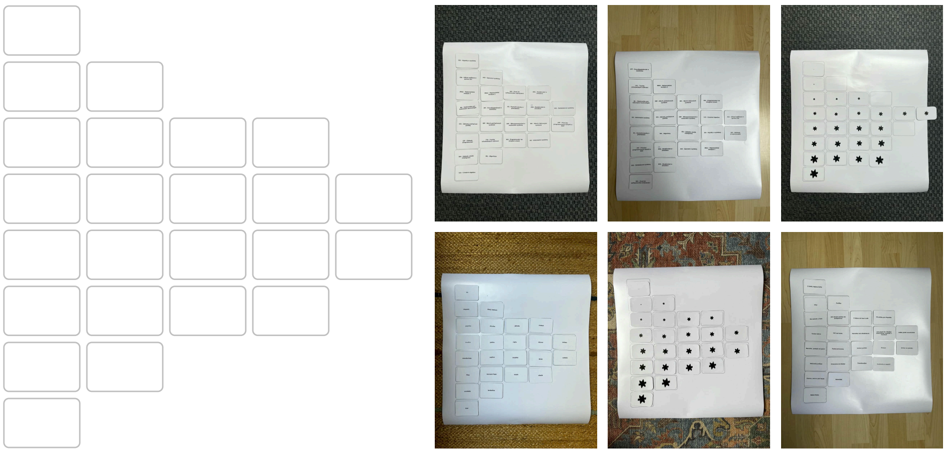

Figure 6.2: The left-aligned grid consists of 24 predefined card slots arranged to follow a normal distribution.

Motivation

The left-aligned layout was incorporated into usability testing for two key reasons: first, it provided a good reference point as a vertical adaptation of the most commonly used Q-sorting grid; second, during Iteration ❺, several participants naturally gravitated toward this approach even when instructed to form a centred layout, making it a user preference worthy of further exploration.

Findings

The grid was used in two iterations using glyph card decks and textual card decks. The overall key discoveries are:

- Predefined card slots helped eliminate uncertainty during the sorting process.

- The grid layout managed to imply row-based sorting: participants who naturally sort this way appreciated the structure, while those unaccustomed to this method perceived it as unnecessary additional work. Interestingly, some participants began automatically sorting within rows using this grid despite not doing so with other layouts.
- Several participants preferred this approach to the centred because the organised and clear visual alignment made it easy to navigate the layout and compare each card with its neighbouring cards.
- Some participants found the rigid grid structure limited their sorting needs.

6.3 Fluid-Centre Grid

Compared to the two previous grids, this one uses a colour gradient instead of predefined card slots to define the normal distribution shape. The darker shade of blue emphasises the ideal placement options, gradually moving towards lighter shades marking the optional ones (Figure 6.3).

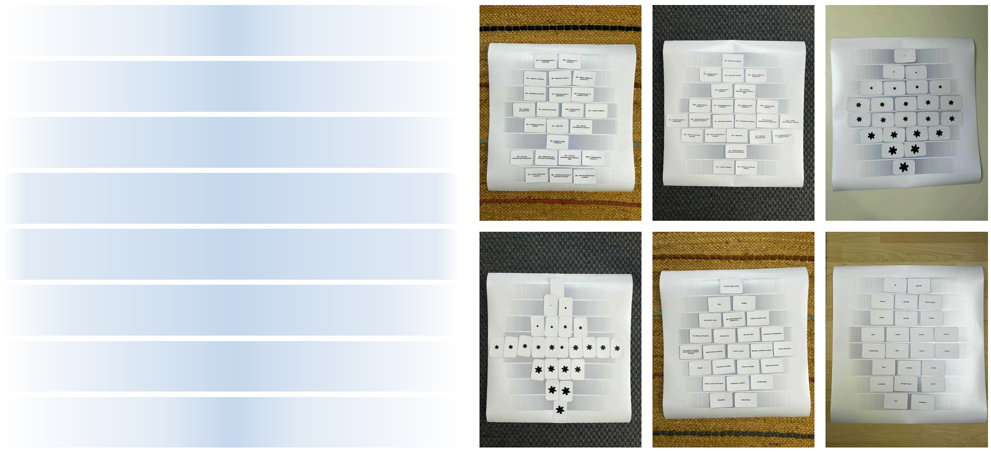

Figure 6.3: The gradient-based grid illustrates a normal distribution, with darker blue indicating ideal placements and lighter shades indicating optional ones.

Motivation

The idea behind the design is based on the results of Iteration ❺. The layout utilises different colour tones to subtly guide the user and thus reduce the stress associated with shaping the resulting arrangement without posing constraints regarding the number of cards per row, giving the participant some flexibility.

Findings

As with the previous grid, two iterations of testing were conducted using this approach, leading to the following key discoveries:

- While some participants appreciated the flexibility and subtle guidance offered by the template, a larger group expressed frustration with it. They frequently commented that the template is not as flexible as it seems, not allowing them to follow their natural sorting process completely and forcing them to spend extra time uncertainly adjusting the arrangement.

- Unlike the left-aligned grid, the centred approach did not create the impression that cards should be sorted within rows; however, two participants expressed that it gave them the impression that cards should be sorted from the middle outwards.

6.4 Fixed-Centre Refined Grid

The grid consists of 23 predefined card slots. Like the fixed-centre grid, these slots maintain central alignment. However, this version arranges the columns vertically to create a more structured and clear layout (Figure 6.4).

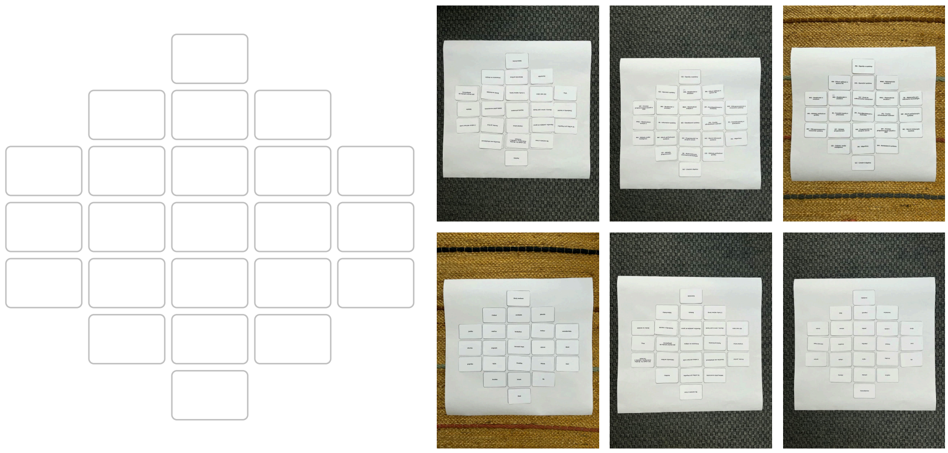

Figure 6.4: The centrally aligned grid consists of 23 predefined card slots arranged in vertical columns for enhanced clarity.

Motivation

The reason for modifying the original centred template was a recurring comment during usability testing, Iteration ❻, regarding how comparing a card with its neighbouring cards is slightly confusing. This finding was further supported by the observation that several participants in Iteration ❺ tended to maintain aligned column and row structures, suggesting a natural preference for more organised layouts among some users.

Findings

Adjusting the column alignment positively impacted user experience. During Iteration ❼ of usability testing, this template received the highest preference ratings, with participants commenting that it was the least demanding of the options. Surprisingly, it was also favoured by users who naturally sort cards aligned to the left. The evaluation revealed several outcomes:

- Participants found it easier to view all cards in context as a complete set.
- The structure accommodated diverse natural sorting approaches.

- Predefined card slots helped eliminate uncertainty during the sorting process.
- Unlike the left-aligned grid, the centred approach did not create the impression that cards should be sorted within rows.
- Some participants found the rigid grid structure limited their sorting needs.

6.5 Hybrid-Centre Grid

The grid combines the structured approach of the fixed-centre refined grid and the more flexible approach of the fluid-centre grid. It consists of 23 predefined card slots in a darker shade of blue, highlighting ideal distribution, with a lighter blue-coloured slot on each side of the row providing optional fields and white card slots surrounding the whole structure, functioning as available but the least ideal placement options (Figure 6.5).

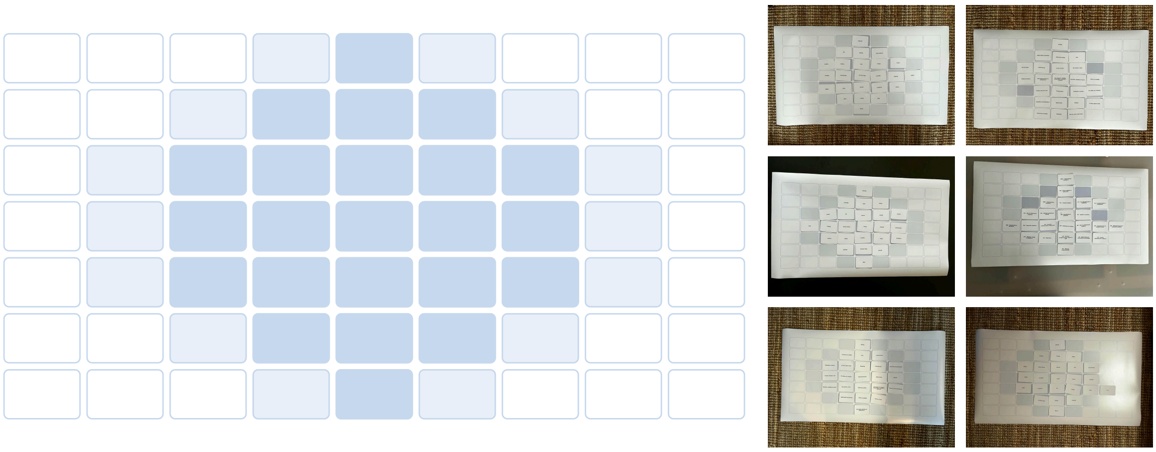

Figure 6.5: The centrally aligned grid of 23 predefined card slots combines a fixed and fluid approach, using colour-coded shading – dark blue for primary placements, lighter blue for optional placements, and white for the least preferred.

Motivation

This template was developed in response to a significant polarity observed during Iterations ❻ and ❼. Participants faced a tricky trade-off: those who chose predefined fields appreciated the structure but occasionally found it restrictive, while those who opted for more flexible arrangements valued freedom but struggled with the resulting lack of structure.

Interestingly, there was a slight correlation between the strength of participants' opinions and their preference: those with firm opinions tended to select the flexible approach, adjusting the distribution if necessary, while those with more neutral attitudes stuck to the predefined structure.

In light of this, the aim was to bridge this gap by combining fixed and fluid approaches into a universal grid that could offer the same sorting comfort regardless of the user's investment in the topic.

Findings

Although, based on Iteration ❼, expectations were set relatively high for the centred approach, the grid yielded interesting findings:

- The hybrid approach proved itself to be suitable both for predefined card slots and for allowing flexible distribution adjustments.
- Many users commented that without clear instructions on how to sort from top to bottom, they would naturally start sorting from the middle out.
- Participants who preferred this grid appreciated that it does not imply sorting within rows, making the process less laborious.

6.6 Hybrid-Left Grid

As with the previous grid, the fixed and fluid approaches are combined, resulting in 24 predefined card slots in a dark blue colour surrounded by optional slots in lighter shades, forming a left-aligned structure (Figure 6.6).

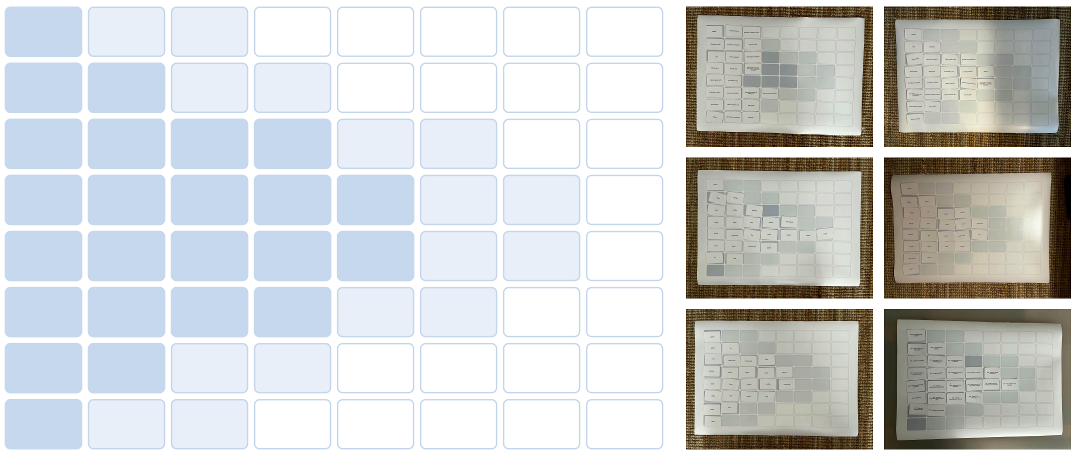

Figure 6.6: The left-aligned grid of 24 predefined card slots combines a structured and flexible approach, using colour-coded shading —- dark blue for primary placements, lighter blue for optional placements, and white for the least preferred.

Motivation

Although participants in Iteration ❼ preferred the centred approach over the left-aligned one after refinements to the centred template, a left-aligned hybrid version was created to verify whether the same preference would persist following this modification.

Findings

Following the hybrid-centre grid evaluation in which participants expressed frustration led to a preference for the left-aligned approach. Key findings include:

- The hybrid approach proved itself to be suitable both for predefined card slots and for allowing flexible distribution adjustments.

- Not everyone who preferred this grid was sorted within rows as expected based on previous findings; only participants with more precise and structured opinions employed did so.

Chapter 7

Final Q-Sort Guidelines & Recommendations

This chapter provides recommendations for designing a proper user interface for Q-sorting. The proposed recommendations are based on three complementary phases, forming a coherent picture of user behaviour.

The first is the analysis of currently available digital solutions in Chapter 3. This approach offers the advantage of learning from previously developed Q-sorting tools, and by rigorously examining what works and what does not, best practices can be identified while avoiding solutions that may be appealing in theory but fail in reality.

Further, the findings from physical user testing (Chapter 5) contributed to a detailed understanding of the users' natural sorting process without any constraints. They also showed how the visual design of the Q-sorting grid can affect this process (Chapter 6).

Last but not least, the digital testing during the Iteration ❽ of usability testing contributed valuable insights. Combining both approaches in one testing session allowed users to directly compare the physical and digital sorting, revealing nuances in interacting with the digital interface that were not apparent in the physical environment. These either confirmed the insights from the previously mentioned analysis or extended them with new perspectives.

7.1 Pre-Sort

Although analysis of existing digital tools on Q-sorting shows a varied approach to the pre-sorting phase, it was demonstrated during user testing that most participants naturally tend to familiarise themselves with the cards before the actual sorting. This process occurs in various ways, from listing through the cards, spreading them out in front of them, and intuitively grouping them into preliminary categories.

Participants explicitly commented on this as a shortcoming in usability testing conducted using a web application that did not offer a pre-sorting phase. They reported that without the possibility of being pre-familiar with the whole set of statements, they often had to retrospectively adjust their sorting because they did not know what to expect next.

Recommendations

Based on the considerations, the optimal pre-sorting interface should include:

- ✚ **Comprehensive card view:** Displaying all cards simultaneously provides participants with a complete overview of the entire set and offers better decision-making.
- ✚ **Intuitive pre-sorting options:** Implementing a streamlined pre-sorting approach. A good inspiration is the Q Method Software (Section 3.1) approach, which has intuitive like, neutral, and dislike buttons on each card.
- ✚ **Flexible process navigation:** Different user preferences should be accommodated by allowing users to bypass the pre-sorting phase entirely or exit midway through the process.

7.2 Q-Sorting Grid

Current tools do not adhere to any universal standard regarding the display of Q-sorting grids. Some applications prioritise readability over visual similarity to a typical Q-sorting normal distribution shape, while others rely on a more traditional look based on physical Q-sorting. However, the grid arrangement often varies even when the layout appears familiar.

Although forced distribution adds value by standardising the process across participants, as stated previously, Brown argues that the specific distribution is less important for research purposes, as analysis focuses on correlation patterns between sorters rather than the distribution of scores itself [3].

A more effective approach has emerged through iterative usability testing — a hybrid grid. This method successfully balances guiding users while providing the option to adjust the distribution if required. As observed in the usability testing, the approach also eliminates the need to create different grids for different levels of investment, knowledge, or interest in the topic, a topic discussed by Exel and Graaf [5]. When participant engagement with the topic is low, a steeper distribution is appropriate, leaving more room for ambiguity and indecisiveness. In contrast, a flatter distribution is suggested for participants with stronger and more articulated opinions.

Recommendations

Based on these findings and considerations, the following recommendations can guide the design and implementation of user-friendly Q-sorting grids:

- ✚ **Predefined card slots:** These decrease the cognitive load of participants by eliminating the need to shape the distribution themselves, which reduces uncertainty about whether they're completing the task correctly.
- ✚ **Hybrid approach:** Combination of dark-coloured predefined card slots displaying the ideal distribution and lighter-coloured card slots indicating optional positions for greater flexibility.

Although the hybrid-centre grid (Section 6.5) tends to naturally imply sorting from the centre outwards, positive feedback from the fixed-centre refined grid (Section 6.4) suggests exploring alternative uses of coloured card slots that would not mislead users.

Drawing from research questioning whether colour affects scale ratings [7], testing an alternative visual approach (Figure 7.1) similar to the centred hybrid design is proposed, with clearly defined rows specifying the sorting direction.

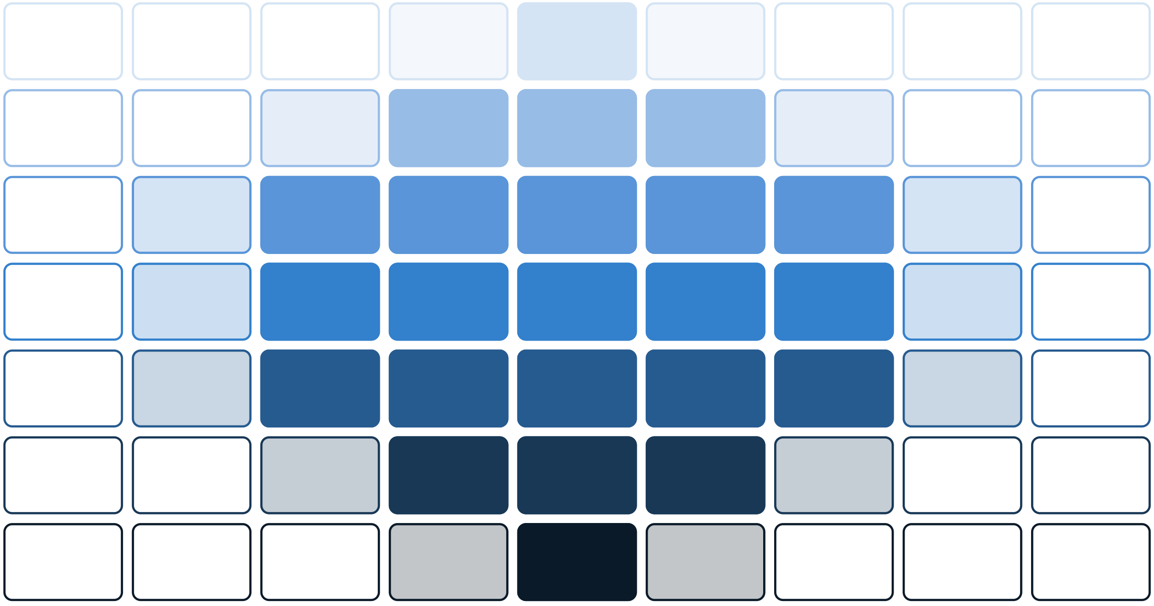

Figure 7.1: A proposed idea for further testing of a hybrid-centred approach to Q-sorting using a colour gradient to define the sorting direction better, thereby narrowing the room for interpretation.

7.3 Q-Sorting

The Q-sorting process itself also deserves a separate section. Current solutions may not always offer a user-friendly experience, yet their variety and different approaches to solutions provide an opportunity to highlight what works and what does not. Combined with usability testing findings and user discussions, it becomes clearer which aspects to focus on when designing a user interface.

Recommendations

The research suggests that a user-friendly Q-sorting interface should include:

- **Fully functional drag-and-drop:** Users appreciate this interaction method but require it to work seamlessly, with automatic position swapping between cards and complete card surface clickability.
- **Precise card slot placement:** Ensuring cards can be placed precisely in these positions rather than general row/column areas, especially when using a grid with predefined slots.
- **Full grid visibility:** The entire grid should be visible at once. If this is not possible, scrolling should be enabled while users place cards, allowing them to move the screen as they drag and position the cards.
- **Multiple card visibility:** Users would appreciate the ability to see more cards from the set they are sorting, not just one, especially if pre-sorting is not available or they skip it. Inspiration can be taken from the Q Method Software (Section 3.1) approach, where the card decks can be expanded to see all cards pre-sorted into it.

While certain elements should be avoided, such as:

- **Impractical sizing:** Overly large cards that result in excessive scrolling. Users appreciate when cards are readable and large when selected from the deck. Still, they can imagine them being smaller when placing them to see the entire sorting grid, thus avoiding additional reordering and scrolling.
- **Unnecessary complexity:** Features such as optional extra rows only add more confusion and shift the responsibility onto the participant, resulting in uncertainty.
- **Misleading highlights:** While highlighting cards placed outside the ideal layout is helpful, using colourful borders often creates a feeling that something is incorrect. Users would prefer a more subtle approach with cards coloured according to the colour of the slot they are placed in, preserving the visibility of the layout guide.

Chapter 8

Conclusion

The main accomplishment of this thesis is defining a set of recommendations intended to guide a user-friendly design of a Q-sorting interface. These include incorporating a necessary pre-sort phase, implementing predefined card slots with precise card placement within these positions rather than general row/column areas, and adopting a hybrid approach that balances structure with flexibility. Their reference point is real user experiences, ensuring their applicability and effectiveness in real projects.

These guidelines were developed based on an analysis of currently available tools and primarily through extensive usability testing focusing on various layouts and visual approaches to grids for Q-sorting as well as a web application developed initially by students from our faculty, which I further adapted to meet the specific needs of my digital usability tests.

Additional tools were created to simplify the research process, which was conducted primarily in physical form. The first is a card deck generator that significantly streamlined the iterative approach of developing various types of cards for usability testing. The second is a concise design system that enables easy customisation of sorting grids to explore different configurations based on user insights.

In terms of future work, since the comparison of left-aligned and centred approaches in this work relied primarily on qualitative research focused on user perception, a natural next step could be a quantitative study verifying whether the centred approach, when properly implemented, truly delivers measurable advantages that would support its broader adoption as a standard solution.

It would also be valuable to see the recommendations implemented in practice through a user interface designed for Q-sorting. This practical application could provide a more intuitive and user-friendly solution, inspiring further research and development.

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Appendix A

Usability Testing Protocol

Introduction

> *Welcome, and thank you for participating in this research study. Today, you will help us understand the natural human approach regarding sorting information. The session will last approximately 15 minutes.*

> *In this study, you'll complete three sorting tasks. Each task involves arranging cards with a number written in textual form. We're interested in understanding your natural sorting process, so there's no wrong way to approach it.*

Task 1

> *Your task is to arrange these numbers in ascending order, with the smallest numbers on the left side and the largest on the right.*

Task 2

> *Now, we'll repeat the same task using a different deck of cards. Please let me know when you're satisfied with your arrangement.*

Task 3

> *Let's do this task one final time, similarly as previously, using a different deck of cards. Take time arranging the cards, and let me know when you are finished.*

Conclusion

> *Thank you very much for your time and thoughtful participation. Your insights will be invaluable for our research.*

Appendix B

Usability Testing Protocol

Introduction

> *Welcome, and thank you for participating in this research study. Today, you will help us understand the natural human approach regarding Q-sorting. The session will last approximately 30 minutes, and our conversation will be recorded for future analysis.*

> *In this study, you'll complete two sorting tasks. Each task involves arranging cards showing the same glyph in different sizes. We're interested in understanding your natural sorting process, so there's no wrong way to approach it.*

Participant Consent Statement

> *Before we begin, I want to confirm that you consent to participate in this study and to have our session recorded. All data will be kept confidential and used only for research purposes. Do you understand and consent to these terms?*

Task-Driven Testing

> *This is a deck of 24 cards. As I said, each card contains the same glyph scaled differently.*

- ☐ Start recording the session.

Task 1

> *Your task is to arrange these cards by the glyph size – smallest at the top, largest at the bottom. The goal is to create a centered, symmetrical arrangement that's widest in the middle – like a Gaussian curve or that of a diamond. Take as much time as you need to sort them accurately.*

- ☐ Start the timer the when participant begins sorting.
- ☐ Stop the timer when the participant completes sorting.
- ☐ Take a photo of the final arrangement.
- ☐ Ask the participant about their experience using the Emotion cards.

Clear Reset:

> *Please step away from the testing area for a moment.*

- ☐ Collect all the cards, shuffle the deck, and arrange it into a neat pile.

> *Please return to the testing area.*

Task 2

> *Now we'll do the same task again. Let me know when you're satisfied with your arrangement.*

- ☐ Start the timer the when participant begins sorting.
- ☐ Stop the timer when the participant completes sorting.
- ☐ Take a photo of the final arrangement.
- ☐ Ask the participant about their experience using the Emotion cards.

Clear Reset:

> *Please step away from the testing area for a moment.*

- ☐ Collect all the cards, shuffle the deck, and arrange it into a neat pile.
- ☐ Replace the card deck with a different one.

> *Please return to the testing area.*

Task 3

> *Let's do this task one final time using a different deck of cards. Take time arranging the cards, and let me know when you are finished.*

- ☐ Start the timer the when participant begins sorting.
- ☐ Stop the timer when the participant completes sorting.
- ☐ Take a photo of the final arrangement.
- ☐ Ask the participant about their experience using the Emotion cards.

Emotion Cards

> *Before we continue, please use these emotion cards (Figure B.1) to express your feelings about the sorting task.*

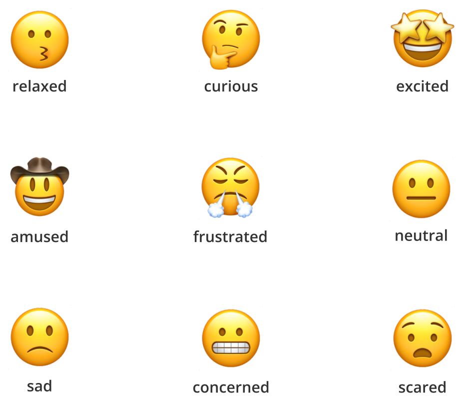

Figure B.1: Emotion cards consist of nine emojis representing emotions such as frustration, excitement, neutrality, etc. They are a simple and effective way to learn about participants' emotions after usability testing.

Post-Testing Discussion

> 1. *Did your emotions change during the tasks? If so, why?*
> 2. *You have done the same task three times. How would you briefly describe your sorting strategy?*
> 3. *Did your approach change in between the tasks?*
> 4. *Were there any challenges you encountered with the first deck of cards?*
> 5. *Can you compare the sorting experience with the two various decks of cards?*
> 6. *Were there any challenges you encountered with the second deck of cards?*

Debriefing

> *Do you have any other thoughts or observations you'd like to share about the experience?*

Conclusion

> *Thank you very much for your time and thoughtful participation. Your insights will be invaluable for our research.*

☐ Stop recording the session.