Human-centered humanities

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Human-Centered Humanities: Using Stimulus Material for Requirements Elicitation in the Design Process of a Digital Archive

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Abstract. This pilot study proposes the use of so-called stimulus material during interviews for requirements elicitation as part of the design process of a digital archive. Designing complex systems like digital archives is not straightforward as users of these systems have specific needs and tasks that designers need to be aware of before the implementation phase can begin. Stimulus material can support the requirements elicitation to collect domain- and content-specific user tasks and needs, which might get overlooked otherwise. We supplemented semi-structured interviews with observational sessions in which print-outs of historical pamphlets and office supplies were handed to participants to give them the opportunity for in-depth study of the material. We found that the use of stimulus material helps participants to focus on the task at hand and articulate their actions and workflow steps more easily. Via thematic analysis the participants statements were turned into a coding schema that serves as requirements specification for an initial prototype.

Keywords: User Centered Design, Digital Archives, Stimulus Material.

1 Introduction

The dawn of the digital era has given birth to the discipline of digital humanities. One important aspect of this field is the possibility of exploring ancient documents and old manuscripts using computer-aided techniques. More and more platforms provide tools to browse and analyze historical documents, like Da Vinci's digitized Codex Atlanticus [22], or the Impresso project that creates an exploratory search user interface (SUI) for historical newspapers [12]. As the size of such collections is usually large, the systems must provide adequately designed tools to ensure efficient access through searching and browsing. This paper details such an example, where we create a digital archive for 18th-century Danish pamphlets.

A pamphlet is a non-periodical, printed, and unbound book of at least 5 pages in length that handles one or more topics and is easily available for the public. Usually, pamphlets were issued locally and they were popular mainly in Europe in the 17th and 18th century [24]. The collection of pamphlets we are working with originates in Denmark, between 1770 and 1773, during which period the state abolished censorship as

the first country in the world, enabling unrestricted freedom of the press throughout 3 years [16]. The originals have been preserved, digitized and their content transformed into machine-readable text using Optical Character Recognition (OCR). To celebrate the 250th anniversary of press freedom, the pamphlets are to be released to the public in the form of a digital archive in 2020, where the collection will be available and browsable in an online format.

The goals of this pilot project are twofold: First, we uncover the needs and tasks that historians face while working with a collection of historical documents and provide them with an adequate tool in the form of a digital archive that supports them in their tasks and enhances their workflow. Second, our aim is to build the basis for an exploratory SUI that also enables the general public to explore the collection.

We approach these goals by conducting user interviews, where we inquire our participants about the historical background and also observe the way they interact with the pamphlets during research. We used so-called stimulus material, which are "material of a visual, verbal and/or auditory nature used to communicate certain ideas to enable them to be researched, or to stimulate discussion of relevant topics" [21], throughout the interviews that enabled us to stimulate the discussion and communicate certain ideas that might come up. The use of stimulus material keeps participants focused on the current topic while helping them remember details they might have otherwise forgotten [15]. This technique can be used in many different fields like literary studies [26], healthcare [23], or during market research interviews [7]. Our aim is to assess the applicability of its use in the design process of a digital archive, where we use it to facilitate observational tasks and to extract user requirements. Our research question can be phrased as follows: *How can we use stimulus material throughout a user interview to elicit user needs and tasks regarding a digital archive?*

2 Related Work

2.1 Digital History & Digital Archives

Burton defines digital history as historical practices which would be impossible without the usage of computers [5]. One main manifestation of these digitized historical practices is the concept of digital archives or digital libraries. Digital archives are institutionally created and maintained (preferably also thematically organized) databases that contain rich information – texts, pictures, or other media – organized in an intelligent architecture and supplemented with tools for retrieval and utilization [3]. Burton [5] defines digital libraries as online resources that meet the following three criteria:

(1) The platform must contain online, digitized documents with appropriately preserved metadata and formatting;
(2) Apart from resources, the platform must also provide services, such as an organized information architecture, a sophisticated searching and browsing interface, and an adequate customer service (for guidance or feedback);
(3) A digital library must be able to provide something additional compared to the services of a physical library, satisfying particular user needs that a traditional library can not.

In this design project we followed these three steps in chronological order with a special focus on step (2), the creation of the information architecture for the digital platform through which users can access and browse these documents and step (3), the creation of an exploratory SUI which allows to extract meaningful insights from the collection as a whole. The concept of exploratory search is reviewed below.

2.2 Exploratory Search

A primary task for users who work with a digital archive is browsing the collection and searching for various items of interest. Moreover, historians might have the need to get a distant-reading perspective on a collection to see the connections between the various documents and look for hints that may link them together in order to get a coherent overview of a certain topic [19]. Thus they need a system which supports advanced search activities like *comparison*, *synthesis* and *discovery* [18]. These processes can be categorized under the umbrella term of exploratory search [25,20].

Hearst notes that a central part of the information architecture of an exploratory search system is organizing the search results by meaningful groups for a clearer overview [11]. In the case of historical documents, it is convenient that the categories are extracted from the metadata of the document contents [10]. The end result of such a metadata-based browsing structure is a so-called faceted search interface, where the user can partition the result set along orthogonal categories: the facets [27]. Kules *et al.* [14] found out that these facets play a prominent role throughout the interaction between the user and the digital archive, as users utilize these facets to get a clearer overview about the result set, and it also gives them ideas about how to proceed with their exploratory search.

2.3 Projects on Designing Digital Archives

Not many papers detail the workflow of designing a digital archive, however, when investigating relevant projects one can see that there is a strong focus on the technological perspective like back-end infrastructure or programming principles [1,6,8,9]. Considering the scope of our project, we sought examples of practices which detail the requirement gathering phase of such projects.

The project by Lee and Patkin [17] can serve as a methodological example for us regarding requirement gathering. They detail the workflow of collecting end-user insights for an English-learning database using semi-structured interviews, and analysing the data using thematic analysis. The way they constructed the protocol was exemplary, since they did not designate the actual archive to be the main topic of the interviews, but rather tried to inquire about the way pupils go about learning English. Like them we should also focus on the users' workflow, their main problems, needs and goals when undertaking historical research on the pamphlets.

A prominent digital humanities project undertaken by Battershill et al. [2] details the creation of a digital curation platform from the ground up. They give an encompassing overview of the user-research-related stages of such an undertaking, underlining the importance to follow the paradigms of *human-centered design*. We also deemed it desirable to plan our research according this standard because of two reasons. Firstly,

the model uses an iterative approach, which is also desirable in our pilot study in order to refine our method. Secondly, the model emphasizes the involvement of users to understand their tasks and the context of use, which is also one main goal of the project.

3 Methods and Analysis

3.1 Planning the Research

In our project we were following the principles of human-centered design as outlined in the ISO 9241-210 standard [13]. The ISO standard gives actionable recommendations on how to conduct a project where the users' needs are given primary focus. Our methodology is based on this workflow and is detailed in Fig. 1. We will focus on the first two stages: understanding the context of use and specifying the requirements.

Understanding the context of use of the system, in our case, is comprised of two parts. Firstly, in order to not deviate too much from the expectations of the users already acquainted with digital archives, we explored the best practices these kinds of platforms employ through a feature audit. Secondly, to tailor the system for the specific user needs, we conduct user interviews with members of our target group. The aim of this is, on one hand, to gain insight into the historical background of the collection, which is necessary for us in order to organize the documents in a manner that is also useful for history professionals. On the other hand, we want to gather information about the users' work practices when they conduct historical research so we can translate these insights into system requirements. We utilized the stimulus material throughout the interviews to support us in both of these objectives.

After gathering enough information about the context of use, **specifying the user requirements** is done by analyzing the data from both the feature audit and the interviews. We translate the findings into requirements, considering both the general functionalities, and the user-specific requirements arising during the interviews. The requirements gathered from our users are given priority, because they will be more specific in nature than the fundamental requirements. Therefore, we will transcribe the user interviews and conduct a thematic analysis on them to find topics of interest, organize them for easier interpretation and translate them into design decisions.

During a brainstorming phase, we **produce the design solutions that satisfy the user requirements** in the form of prototypes. These ideation artifacts start as individually created sketches, which are discussed together and sorted out in order to find which ones to further enhance in fidelity. With the final interactive prototype being done, we can **test it against the needs of the users** via a usability test session.

3.2 Interview and Observation Session Using Stimulus Material

Since these initial interviews can be considered a pilot study we limited ourselves to a convenience sample. Due to the domain-specificity of the pamphlets participants were chosen from academia, comprising two history professors who have been studying the collection and one student majoring in Danish history. The user interviews were divided into two parts: the first part was a discussion regarding the historical background

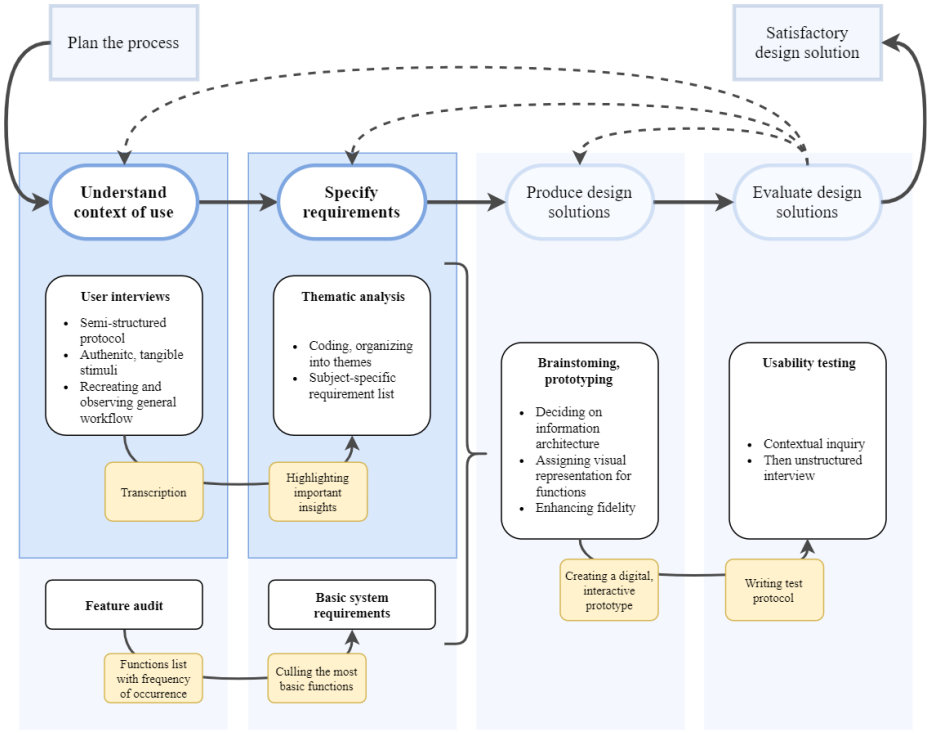

Fig. 1. Human-centered design workflow adapted to our project.

of the pamphlets and an overview of the participant's affiliation with them. The second part comprised the observational task where we inquired about the ways the participant interacts with the pamphlets during work. We video recorded the sessions because we wanted to capture every important notion of physical interaction, which would be impossible to do via sole audio recording [15] (Fig. 2).

Semi-structured Interviews As our prior understanding of the goals, motivations and needs of our users is rather low, we organized the interview to be of a semi-structured nature. We initiated the interviews with demographic questions, followed by a general inquiry about digital archives. We then requested them to navigate to their most used digital archive and asked questions about general usage, e.g. which functionalities they used most frequently and whether they had any noteworthy negative or positive experiences. They noted that "it is very difficult to use them [the digital archives] for anything other than just getting information that you already know might be there", which points to the lack of functions these online resources provide for exploratory research.

Afterwards we shifted our focus towards the topic of the pamphlets. History students got asked bout how such systems help them with historical research assignments. The sample of history professors had the most insight into the historical background of the pamphlets, therefore, we asked them to elaborate on that. We have also incorpo-

rated questions about how they interact with the pamphlets during their work, and the difficulties they encounter during that. These preliminary questions served as a was a warm-up for the observational task that followed, where we utilized the stimulus material to study the user's workflow.

Observation Sessions We composed the stimulus material by printing out the first ten pages of two randomly chosen pamphlets. We handed them over to the participant and asked them to elaborate on the structure and content of them. This was followed by the demonstration of their workflow, where we asked them: "Please demonstrate how you interact with the pamphlets, perhaps reenacting a previous task you have conducted, or imitating how you conduct your current work". Each participant was provided with various office stationery: pens, highlighters, markers, sticky notes, and sticky index tabs. We also allowed them to use their laptop to take notes. We asked them to verbalize what they are doing, and why they are doing it, turning the task into an observational think-aloud session.

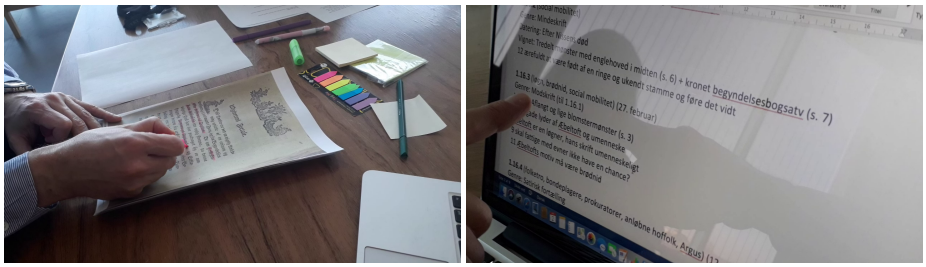

Fig. 2. Snippets from the video recorded interviews showing the observation task (**left**) and the content summary written by one of the participants (**right**).

Thematic Analysis By using thematic analysis, we aimed to find patterns across the feedback of the participants and detail the gathered data in an organized overview. Our model for conducting the thematic analysis was based on the 6-step guide, based on the recommendation of Braun and Clarke [4]. The analysis was built up in an inductive manner, meaning that no preliminary coding schemes had been developed before the interviews took place - thus ensuring our preconceptions will not bias the resulting themes.

We transcribed all interviews and read the transcripts several times, adding non-linguistic details where it was necessary — to note the physical interactions between the participant and the stimulus material. We started defining the patterns by highlighting quotes in the transcripts containing key insights. The quotes we collected act as preliminary codes, which serve as a solid base for the further sorting steps (e.g. the quote "in the pamphlets' case the structure is really easy. It is constructed from the 46 psychical volumes" was labeled under the Code *46 Volumes*). We copied every code and

their accompanying interview quotes into sticky notes and created an affinity diagram, organizing them into groups based on similarity. Quotes that denote the same information were categorized under one code. The groups were labeled with taglines, serving as the preliminary name of the theme. For example, the linguistic problems regarding the pamphlets have been mentioned by all of the participants in various aspects, so it is straightforward to establish that as a collective theme (Theme 1), encompassing codes like multilingualism, or the difficult interpretation of archaic expressions. Due to the high amount of themes we collected, we review the codes again and find out if any of them is an outlier compared to the other codes in the same group, while also eliminated duplicates. To present the outcome of the analysis in a coherent form, we gathered all the information in a structured table (see Table 1) that contains all themes and codes.

4 Results

During the observation sessions, every participant started to inspect the cover page to gather information regarding the origin of the pamphlet and other metadata. They proceeded to note down these down on sticky notes, then turned to the foreword. They noted the clues they are looking for in here, like references to other pamphlets ("It would be quite interesting to know if he's actually mentioning another pamphlet, which this could be an answer to" – Theme 7, Code *Discussion across pamphlets*) or the topic the document elaborates on ("from the words that I can detect in here [...] it is something about [...] a more serious treatise" – Theme 2, Code *Topic*). They proceeded to the main text - which they usually read in its entirety, but we only asked them to examine the first few pages. They used the highlighters to mark sentences or words of interest ("so it's about the government. [*takes the highlighter and marks the text*]" – Theme 2, Code *Topic*) and then use those to write a short summary about the topic, and whether it is a part of a discussion among pamphlet writers ("I would normally just write it down in a document that this is about a certain topic within this agricultural discussion" – Theme 4, Code *Summary*). These summaries comprise an important part of historical research for the participants, as both the experts and the students produced such excerpts to have a clear overview about the document in an understandable format, 'in normal prose'.

Since the connection between the pamphlets seemed important to consider, we asked the participants during the interview to illustrate their workflow when comparing two pamphlets. They used their computer to do this by placing the two scanned pamphlets next to each other to "just read and compare, and underneath I have my word document that I can bring forward to write down my notes" (Theme 6, Code *Document comparison*). Their focus was on finding common topics or references between the two documents. If they also take part in the same discussion, it is also important for our participants to analyze the opinion certain writers have on the topic and about their discussion partner.

Organizing the user requirements as a coding schema revealed many problems, either shared among both user types, or characteristic to a specific participant. All participants voiced their difficulties when interpreting historical texts either due to the archaic language and foreign word usage or the several spelling variations of certain words. Certain topics were only relevant to the experts, specifically the ones which concern

historical details, e.g. the structuring of the collection or the discussions across certain pamphlets. The student, on the other hand, was more concerned about the practicality of digital archives for a school assignment, like linking to external sources or a citable text that is also easy to manipulate.

It is important to note that the needs and problems elicited and organized here focus almost exclusively on content-specific functionalities, that is, functions that enhance interactions only with the pamphlets. This means that general browsing functionalities or requirements for the information architecture are scarcely discussed in Fig. 1. Therefore, it is important that we combine the insights from the feature audit and the interviews to complement the general information architecture of the system with content-specific browsing and document manipulation features. We discussed these requirements, marking off all codes one by one, and brainstorming design solutions for them.

We based the faceted interface on categories defined by the most important metadata participants used (*Author of the pamphlet, Topic, Publication year, Publisher, Genre*, and *Archival index*). Following the best practices uncovered during the feature audit, we display these facets on the main search interface, where participants are also supplemented with functions that enhance exploratory browsing (Fig. 3 top). Query-related suggestions help users find related relevant keywords, and the Word-variations function bundles the same words with different spelling into one query, which is a unique solution for a problem mentioned by all participants. In the detailed document view (Fig. 3 bottom), the digital transcript next to the scanned facsimile alleviates the problems posed by the hard-to-read typeface and enables in-text search, a feature also heavily requested. To address the problem some users face with hard-to-interpret archaic expressions, we attached explanatory annotations to the text to provide a quick explanation about the unknown terms. Just as in many digital archives, the supplementary information attached to the pamphlets describes all the important metadata, but we also added a short summary — resembling the one our participants generally created — that greatly shortens the time for historical research since the user does not have to read through the entirety of text to grasp the essence of it.

5 Discussion and Conclusion

We conducted interviews using stimulus material to extract user requirements, which we organized into a coding schema via thematic analysis. Considering the extensiveness of the coded data, we can state that the interviews were a success in terms of extracting domain-specific user needs.

We observed that providing the experts with print-outs of the pamphlets was a primary aid for them to explain the structural characteristics of the pamphlets (e.g. cover page layout and content format), and without them it would have been troublesome to elicit important details. The stimulus material helped us to identify which metadata is to be incorporated into the SUI, and the participants used them proactively to illustrate their workflow. It also helped them to stay on track during the interviews and to be more articulate about how they work with pamphlets, as they were able to put their actions in an authentic context with the help of the document replicas. The office supplies

Table 1. Coding table listing the themes and the pertaining codes.

Theme	Code
T1: Pamphlet Content and Linguistics	Various languages, like French, German, Latin
	Many word variations with different spelling
	Problems interpreting archaic words, expressions
	Faulty typeface recognition of the OCR
T2: Search facets	Date (year of publishing)
	Printing house
	Title
	Topic
	Genre
	Author
	Multitopicality of pamphlets
T3: Collection structure	Two periods (based on the reign of Struensee): 1770 - 1772; 1772 - 1773
	46 Volumes
T4: Document representation	Lacking OCR - unsatisfactory transcript of content
	Summary (they write themselves)
	Scans are useful for resembling the real collections
T5: Search session facilitation	Supporting the start of the research
	Boolean operators
	Option to search across the whole archive
T6: Pamphlet manipulation	Searching within the document for keywords or topics
	Document comparison
	Difficult navigation within the pamphlet pages
T7: Document linking	Citing the pamphlets
	Discussions across pamphlets
	Connections, references to newspapers and literature
	Linking to other, external archives

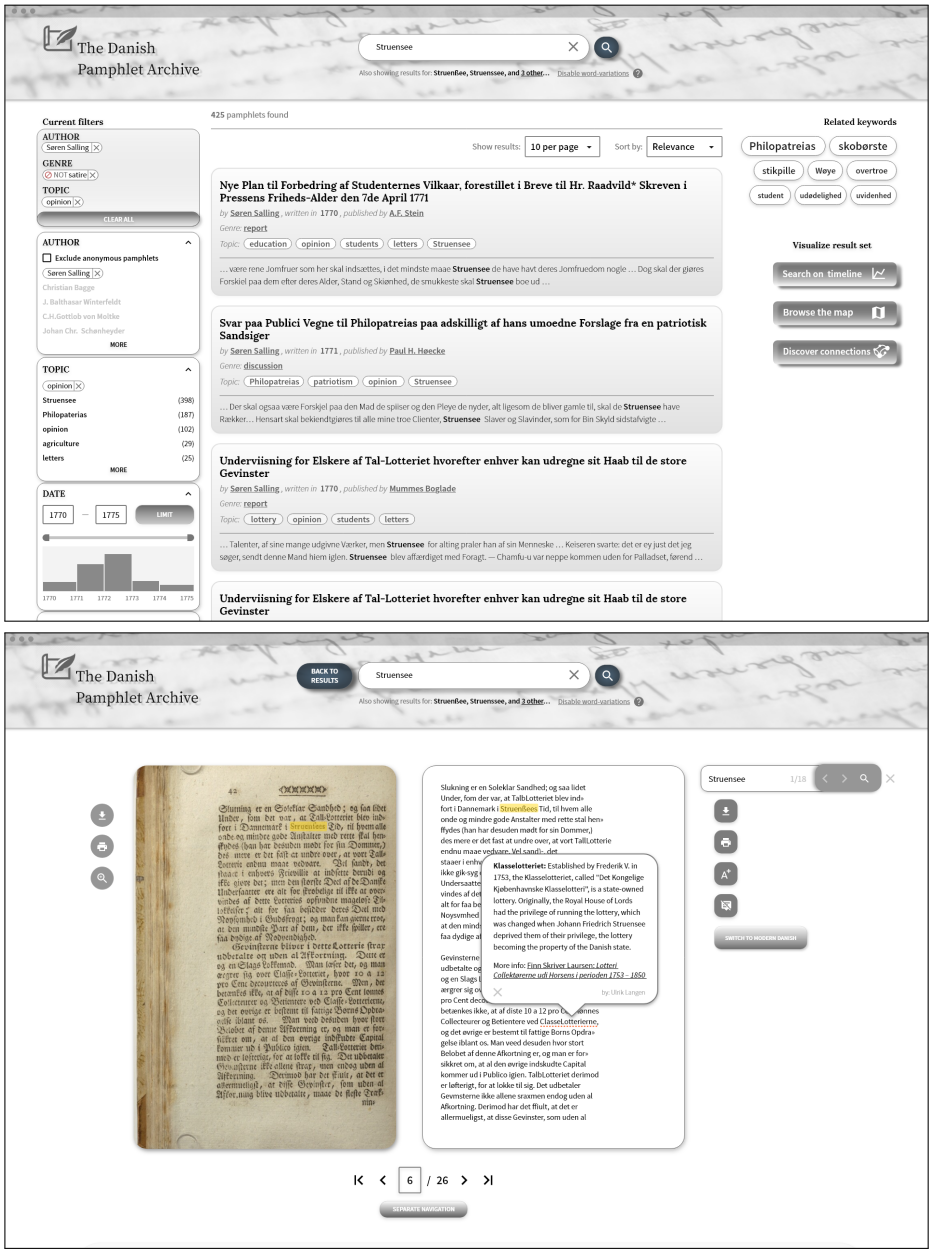

Fig. 3. Sample screens from the prototype of the digital archive, showing the result page (**top**) and the detailed preview page (**bottom**).

they used allowed us to infer information about their interpretation process, e.g. the information they wrote on sticky notes generally served to annotate metadata, while the highlighting of the text rather denoted topics of interest. It would be interesting to see, however, how changing the tools provided for the document copies would change the quality of the information extracted.

We were able to convert these insights into design choices regarding the information architecture, and what cues to display for the users to facilitate their exploratory research. Future work should also investigate the use of text-mining techniques like topic modeling for topic detecting within the collection. Representing the discussion of topics among pamphlet authors in a social network can provide an interesting distant-reading perspective.

Adhering to our project workflow, evaluating the prototype will follow as the next step. Insights from the evaluation phase will trigger another iterative phase of the human-centered design process. As we saw great potential in using the stimulus material for requirement gathering, we will continue doing so, with a wider pool of participants. It is important, however, to couple it with other requirements elicitation methods e.g. a feature audit regarding general functionalities, since the stimulus material will elicit primarily domain-specific and content-specific user needs, which would be incomplete without proper research on established best practices.

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