



# When Browsing Gets Cluttered: Exploring and Modeling Interactions of Browsing Clutter, Browsing Habits, and Coping

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## ABSTRACT

In this paper, we investigate *browsing clutter*, which refers to cluttered experiences of users due to buildup of disorganized browser elements and information. We studied what users experience as clutter, what behaviors and factors contribute to the clutter, and what users do when they experience clutter through an interview study ( $N = 16$ ) and an online survey study ( $N = 400$ ). Based on our studies, browsing clutter includes the amount of tabs and windows, content of the web pages and interactive elements, navigation, and search process. We identified sources of browsing clutter from task characteristics, such as importance and complexity, to user habits, such as multitasking and tab closing. To reveal the dynamics of browsing clutter, we modeled how browsing clutter is predicted by specific browsing habits and coping strategies. Our model demonstrates how individual forms of clutter are interrelated and altered by behavior. We discuss how browsing clutter relates to information overload.

## CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**.

## KEYWORDS

Browsing clutter, Web browsing behavior, Information overload, Coping

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## 1 INTRODUCTION

Currently, over 5 billion internet users spend more than 40 percent of their waking hours online [41]. Many work and leisure activities reside in online browsing. As online tasks have become diverse

and complex, cluttered experiences associated with information overload during browsing have emerged and caused difficulties to browsing [51, 55, 72, 75].

Cluttered experiences that users have while browsing online have been studied from many perspectives. Commonly, these experiences are studied as information overload (e.g., [29]) or technology overload (e.g., [38]). In the context of browsing, one proposed aspect is tab overload. A survey by Kulkarni et al. [42] discovered that half of their participants perceived tab overload as a problem. Another recent study uncovered pressures that drive users to keep and close tabs [15]. Towards addressing the issue of tab overload, past academic and commercial efforts describe and suggest various solutions, such as third-party browser extensions [11, 16, 42, 53, 69, 73] and built-in browser features [36]. Other suggested approaches include changing one's attitude, for instance, by practicing self-acceptance for accumulating tabs [9, 81]. Another proposed aspect of cluttered browsing experience is web clutter, which refers to unwanted or distracting web content, such as advertisements [33] and information waste [2]. In addition to traditional browsing, web browsers are increasingly used as interfaces for other software, such as email or social networking services (SNS), which have also been studied as source of overload for users (e.g., [23, 44, 62]). However, examining the phenomenon beyond clutter caused by tabs and web content is needed to extensively understand users' experiences.

It is still unclear how different forms of clutter during browsing are experienced by users, although plenty of research has been dedicated to studying the overloaded experiences of users browsing and plethora of concepts have been proposed to designate the phenomena. Moreover, as web browsing is interactive, cluttered experiences are likely to influence users' behavior.

This paper deepens the understanding on the cluttered browsing experience by addressing the following research questions:

- RQ1** What do participants experience as clutter during web browsing?
- RQ2** What behaviors, preferences and factors influence the participants' experiences of clutter?
- RQ3** What do the participants do when they experience something as clutter?

We define *browsing clutter* as a group of associated experiences of clutter that users have while using browsers. The experiences of clutter are characterized by users feeling overwhelmed and stressed due to the accumulation and disorganization of browser elements and information. These experiences are associated as instances of information overload. However, as discussed later, there are



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differences in how information overload is experienced in different settings (e.g., having too many tabs, or seeing too many ads). In our study, we examine the interactions of those experiences and how they interact with user behavior and coping strategies to better understand the overall phenomenon of information overload during browser usage. With this conceptualization, this study aims to help users and researchers to understand the complex phenomenon present in experiences of clutter during online browsing.

By conducting 16 semi-structured interviews and an online survey of 400 participants, we explored users' perceptions of *browsing clutter* to discover its forms and sources, including how users cope with it. Our results show that browsing clutter consists of several forms: the amount of tabs and windows, web content and interactive elements, navigation, and the search process. We found that browsing clutter is closely related to user habits and task contexts. Browsing habits, such as multitasking or cautious tab closing, and task characteristics, such as complexity and importance, account for browsing clutter. Meanwhile, users have adapted to challenges faced with browsing clutter by adjusting their behavior and attitudes. For example, by creating external constraints and adopting avoiding attitudes, users attempt to cope with browsing clutter.

The benefits of our approach are the following. First, we start from a broad context of how people use browsers in general, without prescribing the browsing experience as a problem. We discuss all the challenges users perceived as clutter during browser use and conceptualize clutter based on their experience. Second, we include participants with varying views on the browsing experience. Third, we model the dynamics behind the phenomenon. By focusing on different forms of clutter that users experience, we can highlight the commonalities and differences of behaviors that contribute to and how users cope with the different forms of clutter.

We studied the dynamics and sources of *browsing clutter*, aiming to find approaches to reduce the cluttered experiences of users. As modern browsing environments and tasks are complex, so are the users' cluttered experiences. By understanding the interactions between different forms of cluttered experiences and browsing behaviors, we can identify the root of the problem and be able to design effective solutions to reduce browsing clutter.

The major contributions of the paper are as follows.

- We propose a typology for experiences of clutter, which we call *browsing clutter*, by exploring what users perceive as a cluttered browsing experience.
- We explore users' browsing habits and identify three potential sources for browsing clutter: browsing tasks, multitasking-related browsing behavior, and tab accumulating habits.
- We explore how users cope with browsing clutter and categorize their strategies into two types: emotion-focused and problem-focused.
- Further, we provide quantitative measures of browsing clutter and model how certain browsing habits and coping strategies affect the browsing clutter.

## 2 BACKGROUND AND RELATED WORK

How users browse the internet has been researched since the mid-1990s. Browsing habits and web browsers have considerably changed since then. In 1995, browsing was often completed in a

single session that lasted for 25.5 minutes [14], while in 2005 it was 5.3 sessions per day with a 30-minute cut-off [31]. In 2021, the average time spent on the internet reached approximately 7 hours per day [40].

Along with more time spent on the internet, user needs, tasks, and devices of browsing have changed, which have had an impact on the users' experiences online. Web browsers are used as a platform for many services in addition to information retrieval and search. People use browsers on multiple devices, from laptops to mobile phones.

The internet has become more interactive, ubiquitous, and social than it was in the 1990s. Challenges have also emerged. Research on information overload and cluttered experiences of users' digital technology use have also revealed how the developed technologies have had negative effects on users' lives. To understand cluttered browsing experiences of users and how browsing has changed, the following sections review research on what users do online, their browsing habits, and information overload associated with browsing experience.

**What users do online.** The browsing task is an essential factor in understanding both users' intentions and actions for achieving their goals. Many studies have focused on characterizing browsing tasks related to information retrieval (e.g., [12, 19, 50]). However, as browsers are used for diverse types of activities, browser usage is no longer limited to information retrieval. Apart from searching for information, collaborating [49] and digital information management [10, 35] have become essential use cases for browsers. This section discusses the main browser activities centered on information retrieval, digital information management, and online collaboration.

As the core function of the browser, information retrieval has received much attention from the research community. Centered on information retrieval, Byrne et al. [12] categorized web tasks into six classes: use information, locate on page, go to page, provide information, configure browser, and react to environment. In a study specific to knowledge workers, Sellen et al. sorted online activities into six categories: finding, information gathering, browsing, transacting, communicating, and housekeeping [65]. Although studies have updated browsing categorization over the years, some common factors are suggested to understand browsing tasks. For instance, Kellar et al. examined the impact of web-based information-seeking tasks on users' browsing behavior and identified three factors influencing the usage of navigation mechanisms: task session, task type, and individual differences [39].

Managing information within the browser has become an important function for the browser. As users are exposed to richer data than ever, the browser facilitates not only finding information but also saving and re-finding the information. Jones et al. [35] observed how users manage web information for re-use and concluded that users utilize diverse methods for maintaining information, such as bookmarking, pasting URLs, and retrieving history. Several considerations were brought up to understand how different methods' influence on users' choices, including portability (whether a saving method keeps the information portable), accessibility (whether information can be assessed from multiple places), and reminding (whether the method can remind the user about the relevance of

a web page later on). Later, it was concluded that there is a need for multiple methods for information management co-existing to fulfill users' diverse needs [10]. Patterns of browser feature usage have also been investigated, specifically with bookmark usage [1, 4] and browsing history [71], while usage of both features has been observed to decrease over the years [52]. The decreasing trend of traditional means of information management, such as bookmarking, reflects users' shift to evolving tabbed browsing [15, 52].

Currently, online collaboration can be considered as one of the major browsing tasks. Since a decade ago, users started to use web intensively for collaboration work, as revealed in a study by Morris [49], and now web-based browsing facilitates easier document sharing, streaming video watching, remote meetings, and studying. This evolving diversity of browsing tasks reflects web technology evolution. Similarly, cloud computing has allowed for work and leisure to move from desktop to web [48]. It enables people to collaborate more easily and information to be more accessible.

Web browsing is often a continuous process where diverse web activities are executed in parallel, and they interplay with each other. To understand the browsing experience, it is crucial to understand for what purpose people use browsers and what are the dynamics of how browser functions serve users' diverse browsing needs.

**How users browse.** Browsing behavior has been analyzed extensively by grouping users through behavior or user characteristics; however, simply categorizing user behavior sometimes fails to understand the dynamic nature of browsing behavior. Based on longitudinal search logs, White and Drucker [80] classified users into two extremes, navigators and explorers. Within this spectrum, navigators are seen to be more consistent in their searching strategies, that is, they follow a more direct path from query to problem resolution. User demographics have also been considered as categorization criteria by Weber and Jaimes [77], who analyzed query logs and identified differences in search behavior across demographic groups in terms of searching topics. For example, baby boomers were found to be more interested in finance-related topics, whilst white males search more about business and home-related topics. Regional search differences were also found to correlate with the local industries, such as gambling-related queries near Las Vegas. In contrast to segmenting users into groups, Crichton et al. [22] suggested viewing browsing as a broad spectrum of mixed user behavior instead of single or discrete clusters of shared habits. By disproving the existence of an average internet user, they provided a new angle for understanding browsing behavior as a continuous and dynamic process.

Another thread of browsing behavior research centers on certain working styles and studies related browsing behavior. From these, the most common working style in web browsing is multitasking [45]. The 2006 study by Spink et al. [67] identified that 81% of the two-query sessions included multitasking. Similarly, in 2010, Dubroy and Balakrishnan [24] reported that half of their participants used tabs for multitasking.

Browsing patterns associated with multitasking needs have been extensively studied, among which revisitation has received much attention. The changes in revisitation patterns are seen to reflect the trend of multitasking and browser function development, such

as tabbing. Previously, the increasing revisitation revealed that going back and forth between pages relates to multitasking. In recent years, multitasking is still a trend while the revisitation rate has decreased, which is seen to be replaced by the emerging use of tabbing function [78]. The early work of Tauscher and Greenberg [71] in 1997 found that revisiting browsing pattern accounted for 58% of the visited pages. Since then, revisitation has been identified as a prevalent behavior, and the revisitation rate was updated in McKenzie and Cockburn's work to 81% [20]. The calculation of revisitation rate was updated with tabbed browsing taken into account by Zhang and Zhao [82]. They reported revisiting rates of 39.9% using the conventional approach and 59.6% when tabbed browsing was included in their calculation method. The same underestimate of revisitation activities in the conventional approach was also noted by Weinreich et al. [78], who argued that opening a link in a new browser area, that is, a tab or a window, circumvents the need for backtracking. The change in revisitation patterns, that is, the shift from traditional backtracking to tabbing, indicates that users increasingly utilize tabs to revisit web pages instead of backtracking.

To understand the emerging phenomenon of cluttered browsing, it is necessary to investigate how browser features serve user needs, as well as how users adapt themselves to the tool features. A comprehensive view of how users browse should be developed to understand how cluttered experiences emerge.

**Information overload and cluttered experiences.** The increasing capacity of everyday technologies to store data has impacted user behavior and experiences. Much prior research has focused on the overwhelming experiences of users while they interact with information. Many of these studies argue that the disorganized, stressful and cluttered experiences of users are due to the technologies they interact with. Here, we discuss relevant topics for web browsing experiences.

Information overload is a widely used but fairly abstract concept. Graf and Antoni [29] define it as "a state of being overwhelmed by information, where one perceives that information demands exceed one's information processing capacity". In a recent meta-analysis on information overload, they found that information overload occurs in many contexts (e.g., different professions) and that it contributes to several negative consequences, including stress, avoidance of information, fatigue, and decrease in performance and satisfaction [29].

Some studies have situated information overload in more specific contexts. For example, Dabbish and Kraut [23] investigated email overload, which refers to "email users' perceptions that their own use of email has gotten out of control because they receive and send more email than they can handle, find, or process effectively." In their study, email overload was influenced by increased volume of received email but moderated by email management tactics. Furthermore, Cho et al. [18] found that use of both high synchronous communication channels (e.g., instant messaging) and low synchronous (e.g., email) predicted increase in experienced communication overload, while the effect was greater for the low synchronous channels. In contrast, technology overload [38] refers to a situation in which additional technology begins to interfere users' productivity. Further, it involves three dimensions, which

combine different overloading experiences: information overload, communication overload, and system feature overload. Lee et al. [44] examined social networking services (SNS) and found that all three dimensions are significant stressors, which influence users' fatigue in using SNS. Another study on SNS [62] concluded that the number of friends significantly affects perceived tweet overload, while the number of received tweets did not have this effect. What is common to all of these concepts is that they refer to overwhelming experiences of users when their information processing capacities are exceeded.

Another concept that refers to information overload-like experiences is digital hoarding. It is defined as "accumulation of digital files to the point of loss of perspective, which eventually results in stress and disorganization" [70, 76]. Sweeten et al. [70] investigated users' digital hoarding behaviors and found that significant reasons for hoarding were insufficient time and lack of motivation. The negative effects of hoarding included impaired productivity and negative emotions, such as stress and anxiety. Furthermore, Vitale et al. [76] found opposing tendencies in hoarding, such that users have tendencies to hoard because of reasons such as emotional attachment to the data or burden of organizing and managing the amount of data. At the same time, users tend to minimize the amount of data they store or interact with to avoid the negative effects caused by accumulation of files.

In context of web browsers, one identified form of cluttered experience is tab overload, which refers to a feeling of having too many open browser tabs [15, 16]. The utility of tabs to the task and the ease of opening them can lead to tab overload. A recent study by Chang et al. [15] identified pressures to close tabs, such as limited attention and screen space, and pressures to keep tabs open, such as using them as reminders or avoiding costs of re-finding a page.

Apart from tabs, web page contents and their layout can also influence overload experiences. Overload of unnecessary or unusable information displayed on web pages increases the information waste and burden of the browsing experience [2]. Others point out to digital clutter, which influences information overload [74]. Advertisements and pop-ups are also reported as sources accounting for clutter and stealing users' attention [7, 30, 37]. Web pages are dynamic, which makes information retrieval challenging to users, as it is difficult for users to go back to the exact same page location [78].

Moreover, challenges caused by devices have been also studied, among which the mobile devices have received much attention. Currently, many people use mobile devices to browse the internet, which has led to research on mobile browsing experiences. For example, Shrestha [66] evaluated the usability of browsing on mobile devices and desktops, and concluded that users' performance and experience is worse on mobile devices due to the difficulty of browsing long narrow content.

Various similar concepts and studies show that overwhelming and cluttered experiences are common to users. Although there are many concepts that all refer to similar experiences, we see that they have commonalities and differences. In the most abstract sense, they all seem to concern information overload, that is, negative experiences (mainly stress) caused by information demands exceeding

information processing resources. However, differences result from the diversity of contexts in which information overload appears.

**Summary.** Many studies have investigated information overload that people experience in the digital world. Studies point to different forms of clutter experienced by users while web browsing, such as tabs, ads, pop-ups, and the sheer amount of information available through the web. At the same time, many studies point to the changes in how people use browsers, such as changes in browsing tasks, devices, and usage of browser functions. It seems that users can experience information overload in diverse ways, and many changes in web browsing behaviors could account for it. However, the overall phenomenon how users experience clutter during browsing is still unclear.

In this paper, we examine how users experience clutter while web browsing. We explore the forms and sources of clutter within the context of web browsing and the strategies users adopt to cope with it. Our study consists of two stages. In Study 1, we interviewed 16 participants to explore and conceptualize a qualitative understanding of what users experience as clutter during web browsing and what do they do in those situations. In Study 2, we collected quantitative survey data informed by the results of Study 1 to further understand and model interactions between different forms of cluttered experiences and users' browsing behaviors.

### 3 STUDY 1 METHOD: INTERVIEW

Our study began with an initial question about how people experience and perceive clutter while browsing online, and what browsing behaviors contribute to it. We chose the method of semi-structured interview for its flexibility in combining theory-laden question design with collecting data that is grounded in participants' experiences [26].

To select participants, we conducted an online screening survey ( $N = 53$ ). We invited participants based on inclusion criteria of spending more than 10 hours on browser weekly and residing in Finland, regardless of whether browsing clutter is a problem for them. A convenience sample of 32 participants were invited, and 17 of them agreed to participate in the interview. The screening survey was advertised using Facebook advertisements and the university's official channel in LinkedIn.

We balanced our interview sample ( $N = 16$ ) by gender. Following the university research guidelines, participants were provided with an information sheet and data privacy notice, and a signed consent was obtained before each interview. The demographic information of interview participants is demonstrated in Table 1.

**Interview procedure.** Semi-structured interviews were conducted remotely using a video conferencing tool (Microsoft Teams) from late July to August 2021 by the first author. Each interview lasted for 60-75 minutes and was compensated with a €20 electronic gift card. Out of 17 interview responses, one interview was excluded because it turned out that the participant rarely used a web browser. All interviews were audio recorded and resulted in 1193 minutes of audio in total, which were manually transcribed by the first two authors for interview coding.

Participant	Gender	Age group	Occupation	Education	Browser	Operating system	Weekly browsing hours
P1	Non-binary	30-39	Postdoc in Computer science	Doctor's degree	Chrome, Firefox	Linux	20-30h
P2	Male	18-29	Postdoc in Computer science	Doctor's degree	Chrome, Firefox	Mac OS, Windows, Linux	>50h
P3	Female	30-39	Software engineer and part-time CS student	Master's degree	Chrome	Mac OS	40-49h
P4	Female	30-39	Computer science master student	Bachelor's degree	Chrome	Mac OS	>50h
P5	Female	18-29	Ph.D student in Computer science	Master's degree	Chrome, Safari	Mac OS	10-20h
P6	Male	18-29	Data analyst	Master's degree	Microsoft Edge	Windows	40-49h
P7	Male	18-29	Ph.D student in Industrial automation	Master's degree	Chrome, 360 Secure Browser	Windows, Mac OS, Linux	>50h
P9	Male	40-49	Ph.D student in Material science	Master's degree	Chrome, Microsoft Edge	Mac OS, Windows	10-20h
P10	Female	30-39	Currently unemployed	Master's degree	Chrome, Safari	Mac OS	40-49h
P11	Female	30-39	Business marketing student	Bachelor's degree	Chrome, Safari	Mac OS	20-30h
P12	Female	60+	Writer	Bachelor's degree	Chrome	Mac OS	20-30h
P13	Female	40-49	Sustainability designer	Master's degree	Chrome, Firefox, Opera	Windows	30-40h
P14	Male	30-39	Ph.D student in Design	Master's degree	Chrome	Mac OS	10-20h
P15	Male	30-39	Business IT professional	Master's degree	Chrome, Microsoft Edge	Windows, Linux	30-40h
P16	Female	30-39	Fashion designer	Master's degree	Firefox	Mac OS	10-20h
P17	Male	30-39	Development manager	Master's degree	Chrome, Firefox, Safari	Mac OS, Windows	>50h

**Table 1: Demographic characteristics of interview respondents (N=16). P8 was excluded because the participant rarely used a web browser.**

The interview questions covered predefined topics, including general browsing behavior, browsing tasks, and cluttered experiences during web browsing. Each interview topic was covered by one to three scripted questions and follow-up questions to uncover participants' reflections on their web browsing experience and strategies. For example, we explored participants' web browsing behavior using questions, such as "How often do you clean up your tabs and windows?" and "When do you close the unnecessary ones?"

**Qualitative analysis.** The qualitative data analysis of the interviews primarily followed the thematic analysis methodology [8]. The initial research questions that the analysis sought to answer were RQ1) "What participants experience as a clutter during web browsing?", RQ2) "What behaviors, preferences and factors influence the participants' experiences of clutter?", and RQ3) "What do the participants do when they experience something as clutter?" The coding procedure combined inductive and deductive approaches. This approach was chosen because our research questions were exploratory by nature, and we were interested in all forms of cluttered experiences by participants and the meanings they gave to those experiences. Meanwhile, our analysis was also informed by prior literature, as reviewed in the Background and Related work section.

Initially, the first two authors independently coded two different interviews. After this step, they discussed their codebooks to agree on the high-level code categories and proceeded to code the remaining interviews independently. During the coding process, they had a series of daily meetings to discuss and agree on the evolving code categories and refine the common codebook.

Finally, the first two authors together generated themes based on recurring patterns of meaning across the participants. To generate themes that answer the research questions, the codes were interpreted against contexts, actions, and consequences of experiences of clutter that were present in participants' descriptions.

For example, after coding the transcripts, codes representing context, such as "have many tabs" along with others, and consequences, such as "negative emotion" or "lose control of browsing task" along with others, were interpreted against RQ1 to generate the theme

"too many tabs experienced as clutter." The same procedure was applied to all the research questions.

We did not set any criteria for the frequency of occurrence for the themes, but rather tried to identify diverse yet distinct, meaningful answers to the research questions. The semi-structured interview guideline is described in Appendix E. In the following sections, we report results based on the subset of the interview data.

## 4 STUDY 1: RESULTS

This section presents the themes generated from 16 semi-structured interviews that covered topics of challenges and overall feelings of users interacting with their current browser, general browsing behavior, browsing tasks, and working preferences regarding multitasking (See Figure 1 for an overview of the themes). We present the themes that are associated to same research question together by sections.

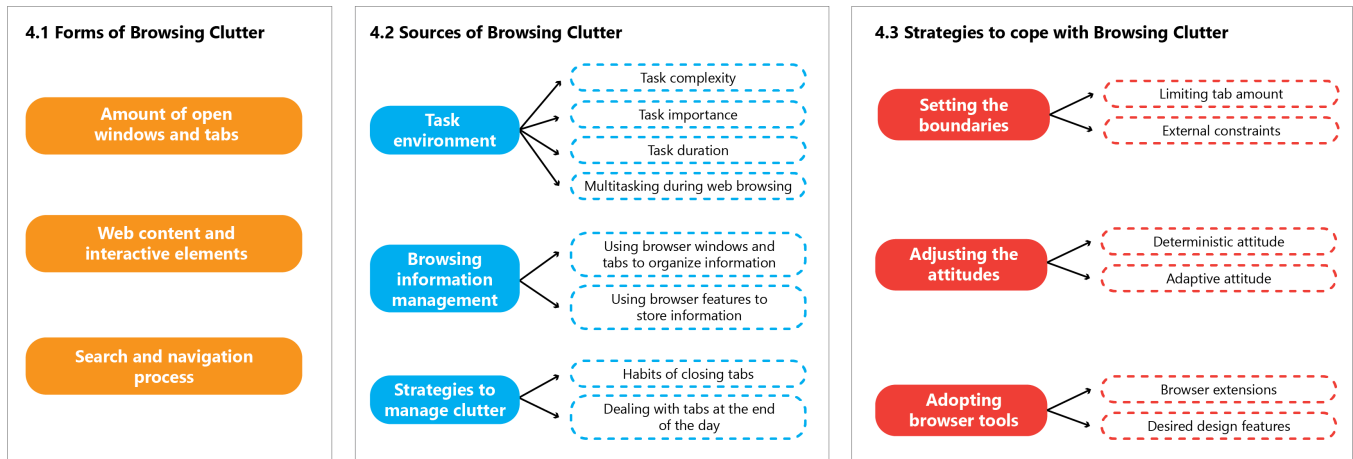
### 4.1 Forms of browsing clutter

Interview participants often referred to the recurring negative experiences related to clutter, which we conceptualized and categorized into three forms: the amount of open tabs or windows, web content and interactive elements, and navigation and information searching process.

**4.1.1 Amount of open windows and tabs experienced as clutter.** Browsing clutter was often perceived as an excessive number of browser windows or tabs. On a typical day, a majority of participants (13/16) had one or two open browser windows, and between 10 and 20 open browser tabs. Only two participants experienced extremes: P14 had a minimalist approach that keeps the amount of tabs below three, and P1 had around 400 open tabs at a time.

It was common for the participants to have an approximate number of tabs after which they started to feel uncomfortable (P1-7, P10, P12). We define this number as the *tab limit*. Participants described that they feel annoyed or stressed once the number of browser tabs surpasses this limit.

Even when participants did not explicitly refer to a tab limit, they reported deterioration of their browsing experience when the visual cues become unclear (e.g., the title becomes too small to read



**Figure 1: Forms, sources, and coping of browsing clutter.** Based on our interviews, we conceptualize cluttered experiences into three forms. We identify several sources of browsing clutter. Finally, we show how users deal with browsing clutter in their daily lives.

or only the favicons are shown), or the moment when they lose track of the big picture of tasks they are working on (P13, P15, P17).

In addition to tabs, windows can contribute to the clutter by allowing more tabs to be opened into multiple windows:

*“It can also end up with just having two windows but too many tabs [on] each [window], and then three windows with too many tabs [on] each [window].” – P1.*

**4.1.2 Web content and interactive elements experienced as clutter.** Web content and interactive elements were mentioned as contributing factors to the browsing clutter and negative feelings that arise during web browsing. Such elements include distracting visual and audio elements that prevent participants from locating the answers they are looking for.

Within the web content, too many ads on a website was one of the common cases that distracted sensemaking process (P1, P2, P5, P6, P12, P14). For instance, P14 described feeling confused by ads on web pages and having difficulties in distinguishing them from actual content on the page. Other web page elements contributing to browsing clutter included sudden sounds from websites for which they cannot find the source, pop-up notifications, cookies that they have to accept, automatically jumping page for online meetings, and disorganized information on web pages (P3, P10, P12, P14, P16).

In some cases, even useful interactive elements created the opposite effect. Participants expressed that visual cues, such as tab favicons, titles, and position in the tab bar, are helpful to locate the right tab among open tabs. However, they can also become a problem when users had several tabs open with the same favicons (P15, P17).

**4.1.3 Search and navigation process experienced as clutter.** Half of our participants described the web search as an iterative process. The process starts with the first general query, which is then narrowed down to a specific term, as users gather more

information. One of our participants compared this process to a puzzle:

*“I cannot be sure that the correct information is there, but I can piece [it together], basically it’s like a mosaic, it’s like a puzzle from many smaller information pieces. [...] I cannot be very sure that I will find everything that I need, but I might find the direction,” – P13.*

During this search process, various challenges interfered sense-making and lead to the browsing clutter. Some mentioned web searching challenges, such as getting side-tracked by other topics along the way, forgetting how to trace back to the tab they started from (P1, P2, P5, P15), and having too much or contradicting information to evaluate (P1-3, P5, P6, P11, P13, P14, P16, P17).

Navigation can also be challenging. For example, participants mentioned having difficulties in attempting to re-find information in a complex website hierarchy (P17), or forgetting open tabs and navigating among them not knowing “where the tab is and why the tab is there” (P1, P2, P5, P15).

## 4.2 Sources of browsing clutter

Our participants described their browsing tasks, behaviors, and browser usage in relation to perceived clutter experience. This section summarizes how these factors contribute to browsing clutter.

**4.2.1 Task environment contributes to browsing clutter.** The browsing tasks were often mentioned in relation to the browsing experience and perceived clutter. From the interviews, we thematized the following characteristics of browsing tasks: complexity, importance, and duration. Most of the participants also reported that they needed or preferred to multitask, which has an effect on the clutter they experience.

**Task complexity.** Complex browsing tasks were often initiated with ill-defined problems, that is, either the starting position, the

allowable operations, or the goal state was not clearly specified, or a unique solution could not be shown to exist [21].

Tasks that are ill-defined problems require searching, evaluating, and synthesizing new information. Such complex tasks are usually associated to creative work (P9, P16) and rapid growth of tab amount (P2, P4) due to information gathering:

*“There are moments that they grow quite exponentially, like up to 20, 30. [...] I have a problem and I start to open several tabs to search for solutions to my problem or better way to implement something and so that’s the moment where it grows a lot.” - P2.*

On the contrary, searches for tasks that are not ill-defined can be evaluated quickly and associated tabs closed immediately. Examples of such tasks include debugging with assistance of Stack Overflow (a question and answer platform) (P6, P7) and finding instructions for specific topics, such as information on university applications (P10) or a cooking recipe (P5, P14).

**Task importance.** Participants were more cautious about closing tabs associated to important tasks, such as work or research (P4, P9, P13). In contrast, web pages related to less important tasks, such as entertainment, could be easily closed (P2, P4, P5):

*“In work or research, definitely autonomy [to close tabs] is important, but for casual things, I don’t think I’ll need very much autonomy,” - P4.*

The importance of tasks was also mentioned when participants discussed browsing on different devices. Mobile devices were usually used only for casual browsing for some participants (P4, P9–11, P13, P16–17), and such casualness made participants less worried about opening and closing web pages.

**Task duration.** Tasks can take from seconds to months to complete, and the life cycle of task-relevant tabs can range accordingly. For small tasks, such as looking for a specific answer, tabs were evaluated quickly, and the decision to keep or close them was made quickly (P3–P6, P9, P15–P17). When tasks required more time, the tabs associated to them stayed open longer until participants processed or saved the important information (P2, P5, P9, P13, P17). In addition, there were long-term projects, which lasted from weeks to months (P16).

**Multitasking during web browsing.** Almost all participants shared the need to work on concurrent tasks during browsing (P1, P3–7, P9–11, P14–17). Such needs include parallel work requests, spontaneous task switching, or interruptions. Furthermore, as a working style, most interviewees (13/16) multitasked during web browsing, which often involved switching between tabs back and forth, and consequently facing browsing clutter. Six participants (P4, P7, P11, P13, P15–16) reported that they always multitasked, the other seven participants did so occasionally. For people who multitask occasionally, multitasking can be triggered by interruptions, such as emails or calls (P3, P6). Multitasking also happens when new ideas emerge from the search unrelated to the current project (P2, P9).

For multitasking during browsing, users relied both on the tabs and windows but also cognitive resources, such as working memory

and attention (P15, P16). This created clutter, as *“The mind doesn’t switch as fast as the tabs can be switched”* (P15).

#### 4.2.2 Information management habits contribute to clutter.

The participants use browsers for several functions besides finding information. Notably, participants use the browser to organize their task-related information and to store web pages for varying periods of time. The way participants use their browser for information management influences the clutter they encounter.

##### Using browser windows and tabs to organize information.

Organizing browser windows and tabs acts as a popular way for information management. Approximately half of the participants used multiple windows to organize tasks (P1–3, P5, P9–10, P13, P16). Some participants used different windows to distinguish between personal and work-related browsing (P9, P10, P12, P15, P17), and others divided windows by topics (P3, P5, P7).

Ordering tabs was another common organizing technique. Participants tended to order tabs from left to right based on usage frequency (P3, P5, P7, P10, P14, P16) or group tabs by topics (P4, P6, P11, P13).

However, those strategies of organizing could have the opposite effect and increase instead of reducing browser clutter. For example, P1 reported opening new windows but then filling each with too many tabs.

**Using browser features to store information.** Half of the participants (P1, P3–4, P7, P9, P13, P16) use tabs as a space for temporary saving their web pages. This approach is usually adopted when performing complex tasks that are not well-defined, and users utilize tabs as the place to park their thoughts until they conclude the task. In this case, the tab is seen as a temporary option compared to bookmarks that seem as a way of saving more important information and for longer term:

*“For the searching tabs they are temporary tabs. I do not want to save all the temporary tabs in the folder as the bookmarks,” - P7.*

The use of bookmarks was described mainly as a way to save important information, while one participant used it as a way to get rid of excessive tabs:

*“I use bookmarks sometimes I’m just like OK, save all of those tabs to bookmarks and then I’ll just close the window to get rid of the hundreds of tabs,” - P1.*

However, transferring multiple tabs into bookmark was not always seen as a productive approach to the overall browsing experience. Participants described that the web pages they save tend to become irrelevant or useless afterwards:

*“Cause probably most things are going to be too out of date, anyways [not] worth going back to,” - P1.*

**4.2.3 Users have strategies to manage clutter.** The participants discussed different habits in terms of what do they do to their unnecessary tabs and when do they close them. As the number of tabs was experienced as clutter, their habits of managing the open tabs was associated to clutter.



**Tab closing habits.** We identified two common patterns related to closing tabs: 1) closing tab(s) when the task is completed, and 2) reactive closing, which is triggered by certain circumstances.

The first pattern was more common (13/16), and it heavily depended on the task. Tabs related to simple tasks could be closed quickly (P1, P3, P6–7, P10–11, P14). However, if a tab contains information that requires reading and digesting, it can be saved for longer reflection (P1, P3, P6, P7, P10, P11, P14), even for months (P16).

The second pattern, reactive closing, was mentioned by nine participants (P2–4, P7, P10–12, P16, P17). In some cases, closing tabs would be triggered by reaching the tab limit (Section 4.1.1) (P1–3, P5, P10–11):

*“When I really catch myself opening 15 or 16 tabs, I go back and, see what tabs I can close” -P4,*

Some participants described reactive closing as a cycle of opening new tabs until their amount reaches a tipping point. Sometimes, it can be triggered by negative emotions (P3, P5, P15):

*“I feel like it’s easier for me to have the tabs open until I get to a point where it just starts to be annoying, and then normally what I would do is I would close the whole window once I stopped working. And then the next time that I start working [...] I just open a new window, and then I start accruing new tabs again, until I get frustrated and close the whole window again,” - P3.*

Users’ habits seem to be combinations of these two patterns and vary from person to person. For example, even if the task was not complete, the number of accumulated tabs could exceed users’ tab limit and forced them to start closing open tabs.

These two patterns were interlinked. Although reactive closing is seen to be triggered by clutter, clutter sometimes emerges in the process of completing tasks.

**Dealing with tabs at the end of the day.** Cleaning up the browser when work is done declutters browsing spaces. Conversely, leaving the working space unvisited potentially contributes to clutter.

Two general strategies were identified: seven participants (P6–7, P9, P11, P13–14, P17) usually shut down their computers, and the other nine (P1–5, P10, P12, P15–16) left the browser open and continued from where they stopped the next day.

Most participants (P1–2, P6, P10–14, P17) would review the tabs at the end of the day and made sure there were no tabs open without a reason, regardless of whether they will shut down the browser.

Hoarding tabs and leaving them unvisited at the end of the day was also common. Unvisited tabs could include tabs they had previously opened and forgot about them (P3), the tabs that no longer served their task (P7, P15–16), or the tabs for which they did not have time (P4, P9).

### 4.3 Strategies to cope with browsing clutter

Many of our participants (P5, P10, P13, P15–P17) explicitly shared that their behavior had changed over the years, and reported some adaptive behavior to browsing clutter. In other words, they had adopted certain strategies to cope with browsing clutter, to prevent

it from emerging or to reduce its negative effects when it emerges. We observed the following strategies: setting the boundaries, adjusting the attitudes, and adopting browser tools designed to help managing browser resources. Next, we present these strategies in detail.

#### 4.3.1 Setting the boundaries to cope with clutter.

**Limiting tab amount.** Seven participants mentioned that when browsing they would intentionally limit the amount of open tabs and browser windows (P2–4, P7, P12, P14, P17):

*“I try to keep the open tabs within like 11 or 12 so I can actually read what’s going on in each of the tabs.” - P4.*

Sometimes, the limiting happened unconsciously:

*“I’m realizing that unconsciously I’m regulating the amount of tabs that I have open. [...] I’m not like saying like, OK, it’s time to organize, I’m just automatically looking through the tabs,” - P12.*

Limiting the amount of tabs is highly associated to closing tab habits, which we presented in Section 4.2.3.

**External constraints.** External constraints were mentioned as the conditions that would prevent users from accumulating tabs. One such constraint was work deadlines. Some participants described that deadlines make them more focused and, hence, decrease the tab amount (P15–16). However, the effect of external constraints vary from person to person. For example, the time pressures showed opposite effect for five other participants (P5, P10–11, P13, P17) who saw a growing trend of accumulated tabs with a tight deadline.

**4.3.2 Adjusting the attitudes to cope with clutter.** Taking certain attitudes towards browsing clutter experience was mentioned as one of the strategies that helped coping with it. We asked participants if they had ever tried to improve their browsing experience. Four participants (P4–6, P10) expressed an almost deterministic attitude about the amount of tabs they usually have, stating that there is nothing they can do to change the amount of tabs growing, or that it is related to the nature of their tasks. In contrast, other participants had an adaptive attitude to either prevent the amount of tabs from growing or adapt to losing information (P5, P9–10, P15–16):

*“So maybe now I’ve been trying to be more chill about this for a few years. And then if I really need it, I will search for it again,” - P5.*

Three participants (P3, P5, P7) reported to have gotten used to browsing clutter, or that it was not an important enough problem for them to actively search for a solution:

*“Yeah, of course it’s a problem, but it depends on the case. It’s not a very urgent problem, it’s not that serious.” - P7.*

**4.3.3 Adopting browser tools designed to help managing browser resources.**



**Browser extensions.** When asked whether participants had tried any tools to help them manage their tabs, seven participants (P2-7, P11) explicitly stated that they had not looked into the matter and only three participants (P1, P10, P15) named specific tab management browser extensions, such as SessionBuddy [11] or the Tree Style Tab [69].

However, all three participants noted that these tools did not help them enough when compared to the extra effort required to utilize them, so they had stopped using them at some point in the past. As P10 put it:

*“it was like a new skill to, not skill, but like another things to remember to do, and to return it. And I give up” - P10.*

Other participants (P11, P13, P15) shared similar attitudes towards tab management tools although they had not tried any solutions yet. P11 stated that *“[It] feels like, it’s extra work to reduce the work in a way.”*

**Desired design features.** When asked about desirable features of such tools in a hypothetical scenario, participants often mentioned functions, such as grouping tabs according to topics (P2-7, P10, P11, P14, P15), selecting and closing several tabs at once (P15), ordering them by visit frequency (P12), or scrunching unused tabs into one higher level tab or column (P4, P17). Other mentioned features included drag-and-drop options to open a page in new tab (P7), having working spaces with default number of open pages (P16), or various graphic visualizations of tabs, such as tree or network (P1) or *“balls in a basket”* (P16).

#### 4.4 Follow-up survey study

Based on the interview results, we found that the participants experienced three forms of clutter during browsing: amount of tabs and windows, web page contents and interactive elements, and search and navigation process. We call these experiences *browsing clutter* since they all refer to the common context of experiencing clutter, yet they are distinct from each other. More formally, *browsing clutter* designates a group of associated experiences of clutter that users have while using browsers. The experiences of clutter are characterized by users feeling overwhelmed and stressed due to the accumulation and disorganization of browser elements and information. The experiences are associated as instances of information overload.

To further understand the dynamics behind browsing clutter, that is, how clutter is experienced and how different groups of factors influence the cluttered experience, a follow-up study was conducted. In Study 2, we investigated experiences of clutter by running a survey study. We operationalized the themes identified in Study 1 as factors that we intended to measure using Likert-scale survey items. The browsing clutter forms and the browsing habits that we generated as themes in Study 1 informed the survey design directly. Furthermore, as we found that participants in Study 1 showed strategies similar to coping strategies [6, 25] in their ways to manage the cluttered experiences, we also decided to measure coping strategies using the Brief COPE inventory [13].

The scope of the following study was to extend the findings by modeling them quantitatively. With quantitative models, the

interactions between browsing clutter forms and user habits could be better understood.

#### 4.5 Limitations

As a limitation, Study 1 was conducted during the COVID-19 pandemic, which has affected information work and browsing behaviors making people rely more on digital devices [63].

### 5 STUDY 2 METHOD: ONLINE SURVEY

To further understand browsing clutter, we conducted a survey study ( $N = 400$ ) which was informed by the results of our interview study. We had two research questions: RQ1) What is the structure of browsing clutter? and RQ2) How browsing habits and coping strategies affect browsing clutter?

#### 5.1 Participants and data quality

We collected data through the Prolific platform. The survey was released with the Webropol survey software and was open between 24th of June to 11th of July 2022. All respondents consented to data privacy and processing procedure following the university guidelines. Participants were selected based on the Prolific pre-screening question asking whether they used laptops or desktops on a daily basis. When the survey answers were successfully submitted to the system, we reviewed attention check questions, time used for filling the survey, and arbitrary answers to inspect data quality.

In total, we received 400 valid survey answers, which were used as the dataset for further analysis. Table 2 demonstrates the basic demographic information of our survey participants.

#### 5.2 Survey design and item generation

Our survey design process consisted of three stages. First, the first two authors brainstormed the items separately, followed by three rounds of discussion and iteration. Next, the survey was reviewed by the other two authors and two other researchers to ensure sufficient motivation and communication clarity. Finally, we conducted a pilot test with 18 participants from social channel connections to pretest the survey length (20 minutes on average) and identified flaws in the questions. During each stage, minor revisions were made to improve the answerability and clarity.

Our survey consists of five sections. The first three sections were designed to investigate users’ experience of browsing clutter, their browsing habits, and coping strategies to clutter using Likert-scale items (1–7). Section four has open-ended questions on users’ perception of cluttered experiences, and section five focuses on user portrait questions. A complete survey description can be found in Appendix.

The first three sections consist of *Browsing behavior* - how frequently people use the web browser in certain ways (19 items); *Browsing clutter* - how frequently people experience cluttered situations (19 items); and *Coping strategies* - how users cope with the cluttered browsing experience (24 items). Items for the first two sections, browsing behavior and browsing clutter, were generated from interview coded themes. Reverse coding was adopted for some items in the first two sections to ensure answer consistency. Items on coping strategies were adapted from Brief COPE inventory [13]

**Table 2: Demographic characteristics of survey respondents (N=400).** Our sample is balanced between males (50%) and females (47.8%) with age groups of 18-24 (53.8%) and 25-34 (36.5%) as the majority. Most of the participants have a Bachelor's (51.3%) or High school degree (28.5%). The majority of participants reside in Europe (56.3%) or Africa (26.0%). The majority of participants are students. Occupations were categorized following the International Standard Classification of Occupations [54]; groups with more than 10 people are reported.

Attribute	Range	Sample size
Gender	Male	200
	Female	191
	Nonbinary	5
	Prefer to self-describe	4
	Prefer not to answer	0
Age	18-24	215
	25-34	146
	35-44	25
	45-54	9
	55 +	5
Education	Less than a high school degree	7
	High school degree or equivalent	114
	Bachelor's degree	205
	Master's degree	62
	Doctor's degree or higher	3
	Others	8
Continent of residence	Europe	225
	Africa	104
	North America	55
	South America	13
	Asia	3
Daily usage of web browser	<2 hours/day	10
	2-4 hours/day	80
	4-6 hours/day	95
	6-8 hours/day	90
	8-10 hours/day	80
	>10 hours/day	45
Occupation	Student	181
	Business and administration associate professionals	36
	Information and communications technology professionals	30
	Unemployed	28
	Science and engineering professionals	22
	Legal, social and cultural professionals	20
	Teaching professionals	16
	Business and administration professionals	10
	Other occupations	57

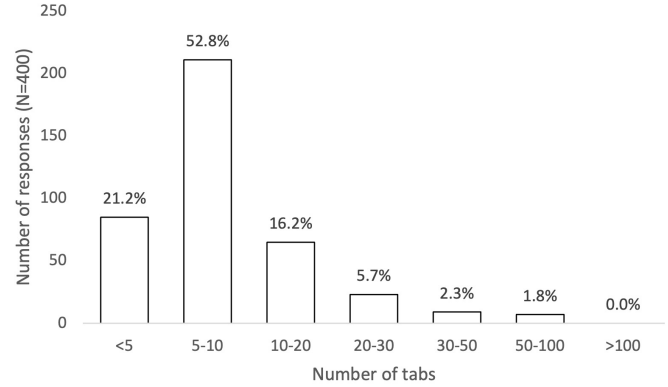
with minor changes. The list of items for sections one, two and three can be found in the Appendix A–C.

Section four consists of questions on how people perceive clutter affecting their lives and how serious was the problem in their view. Section five supplements the user profile through basic demographic and browser usage questions.

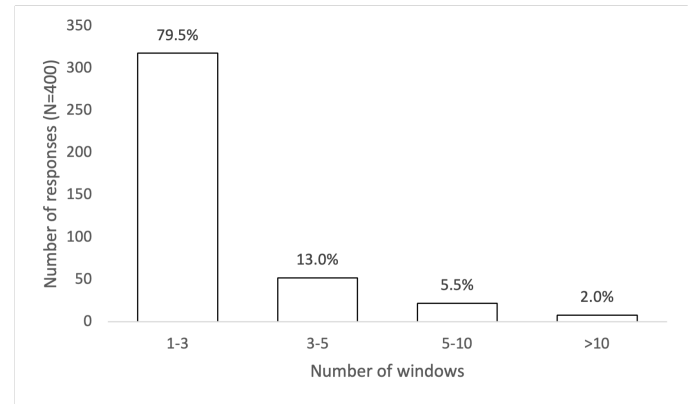
The sections progress from concrete questions to more abstract ones; logically, later sections would require reflection on previous ones. Within each section, the order of items was randomized to minimize the order effect of items.

## 6 STUDY 2: RESULTS

Our results show that browsing clutter consists of four intercorrelating forms. Several browsing behaviors and coping strategies predict an increase in browsing clutter. Most participants perceive browsing clutter as a minor problem, but there are differences in experiences of negative emotions compared to those who perceive



**Figure 2: Number of open tabs during web browsing.** The majority of participants have commonly 5–10 tabs open.



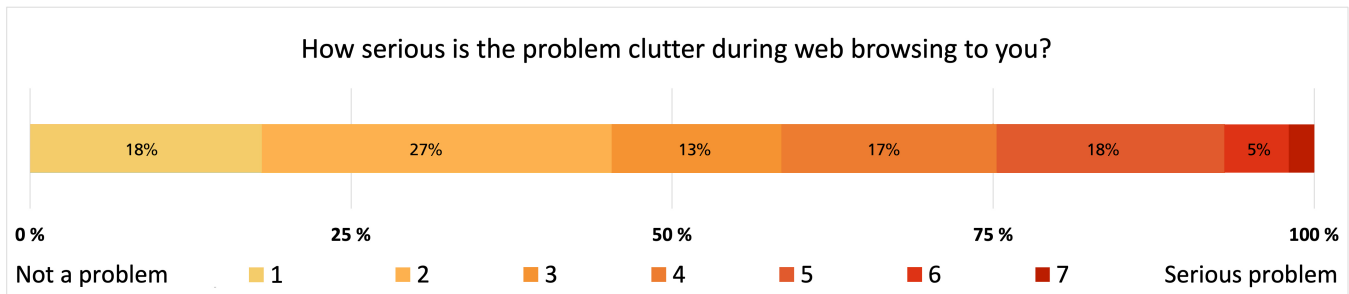
**Figure 3: Number of open windows during web browsing.** The majority of participants have commonly 1–3 windows open.

it as a serious problem. Further, browsing clutter often occurs in contexts of work-related and research tasks.

This section presents the results of our online survey analysis in three parts. We first present descriptive results that outline how our participants use web browsers and how they perceive the problems with clutter during web browsing. Second, we uncover the structures of browsing clutter, browsing behaviors, and coping strategies using exploratory factor analysis. Third, we use multivariate regression with factor scores from step two to model what behaviors and coping strategies affect browsing clutter. The quantitative data analysis for the survey was done using R.

### 6.1 Web browser usage

Survey participants were asked about the primary browser they use. Among all browsers, Google Chrome dominated as a respondents' choice with a rate of 87.3%, followed by Microsoft Edge at 26.5%, Mozilla Firefox at 26.5%, Safari at 15.5%, Opera at 12.0%, Internet Explorer at 8.3%, DuckDuckGo at 2.3%, and others at 9.5%.



**Figure 4: Users’ perception on the seriousness of browsing clutter. Most participants reported clutter to be a minor problem for themselves. This can be seen from the cumulative percentage of scores 1–4 covering over 75% of the answers. The scale used is 1–7 representing from not a problem to serious problem.**

Figures 2 and 3 show the number of tabs and windows users have open on average during web browsing. The majority of people usually have 5–10 tabs (52.8%) and 1–3 windows (79.5%) open.

We asked the participants what are their common purposes of using tabs. The options presented were from literature [24]. The most popular answer is to use tabs for “multitasking” (60.5%), followed by using tabs as a “short-term bookmark” (46.8%), as “task reminder” (45.0%), to “open links in the background” (45.8%) and to “compare results and go back and forth” (47.3%). Some participants (31.5%) also use tabs to “mark frequently used pages”. When asked about the behavior of starting a new browsing session, 45.8% of the participants reported that they will start with a fresh browser without any open tab, while the others will continue with a new tab following where they left (45.5%), or start with a new browser window but leave the opened web pages behind (8.7%).

## 6.2 Perceptions of browsing clutter

Participants were asked to rate the seriousness of browsing clutter as a problem for themselves on a 7-point Likert-scale. Figure 4 illustrates that 18% of participants do not regard it as a problem at all (Likert-scale 1), the majority (57.2%) rate it as a mild problem (2–4) and near one-fourth (24.8%) rate it as a somewhat or serious issue (5–7).

Following the seriousness rating, participants were asked “How does cluttered browsing affect your daily life?” and “What are the situations where you experience clutter in web browsing?” as open-textfield questions. Answering the open-ended questions was optional; hence, the number of responses associated with the codes does not sum up to 400.

**How does cluttered browsing affect users’ daily lives?** We received 363 answers for the “How does cluttered browsing affect your daily life?” question. We divided answers into two groups – people who regard browsing clutter as a mild or not a problem (rating  $\leq 4$ ; number of answers: 270) versus a relatively serious problem (rating  $> 4$ ; number of answers: 93) – with the goal to compare whether clutter has a different effect to participants with different perceptions of browsing clutter. In the mild problem group ( $n = 270$ ), many participants did not perceive the clutter as a problem at all (180/270). They reported rarely experiencing cluttered browsing, or that the situation does not influence them much. As

we focused on how the clutter occurs to users, we only coded those who considered clutter as a problem as relevant answers ( $n = 90$ ).

We coded the open-ended answers with an inductive approach. We kept the coding procedure open without searching with pre-defined themes, and the codes were not informed by study 1. The coding procedure starts with familiarization of all answers from both groups. Then, initial codes were generated. During this phase, codes were shared in both groups for answers with shared meaning (e.g., There were respondents mentioning “feeling stressed” due to clutter in both group and the same code “Stressed” were applied). We then searched for themes separately from answers in both groups.

Although clutter is perceived as a problem at different levels of seriousness, similar consequences of the cluttered browsing experience were identified in both groups. Clutter is thematized as influencing users through two aspects: 1) causing problems that challenge browsing and 2) arising negative emotions. Figure 5 demonstrates the code groups for these two themes with occurrence frequencies. In addition to the same themes, the two groups also show similarities as well in terms of experience and frequency. However, people who perceive it as a more serious problem reported more concrete challenges, such as hardware problems (e.g., computer crashes), and information that is hard to navigate.

**What are the situations where users experience clutter in web browsing?** For the question of “What are the situations where you experience clutter in web browsing?”, we applied the coding procedure to 354 answers that we received.

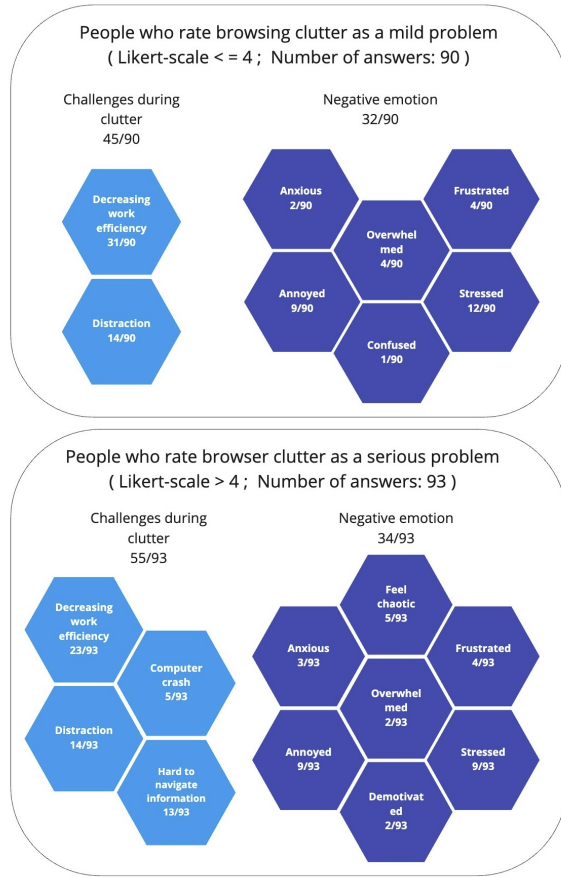
Our survey respondents reported situations of experiencing clutter around task attributes including search topic, time pressure, task workload, and task type. More demanding tasks are seen to be associated with clutter. For example, tasks that are more complex than just a simple fact-finding search will easily lead to accumulation,

*“when I was doing research for projects or for a paper. Then the tabs start looking like stacked up ants, and you can’t really differentiate between the tabs.”*

Moreover, clutter is also experienced as interface-level visual chaos, where users reported:

*“When the content of the web page I’m consulting is all stack in an unorganized way.”*

### How does cluttered browsing affect your daily life?



**Figure 5: Generated themes: browsing clutter affects people through browsing challenges and negative emotions. Participants answers were coded separately between groups that reported minor vs. serious problems with browsing clutter. Both groups reported negative emotions associated to cluttered situations, while the group with serious problems reported more effects that clutter has on their lives. The generated themes are represented here as clusters of codes.**

Such unorganized content and unwanted content on the display, such as ads, contribute to the cluttered experience.

Based on those self-reported situations, two themes were generated: “Clutter is experienced under demanding tasks” and “Clutter is experienced as interface-level visual chaos”.

### 6.3 Structure of browsing clutter

The main focus of our analysis was to explore what is the structure of browsing clutter (that is, the three forms in Section 4.1) based on participants’ responses to our survey, and how browsing clutter is related to browsing behaviors and habits, and coping strategies towards it. To answer these questions, we used exploratory factor analysis (EFA) [68] following a similar procedure that has been applied in studies for understanding how and why people use certain

technologies [34, 46]. In this paper, we used EFA to estimate latent structures (browsing clutter) and to reduce dimensions and account for multicollinearity of variables (browsing behaviors and coping strategies). For all the analyses, we used the full dataset ( $N = 400$ ) with no missing values.

For all sections, we followed the procedure by Stevens [68]: We first tested the adequacy of our data for factor analysis using the Kaiser-Meyer-Olkin factor adequacy test, which gave good results ( $\geq .80$ ), and Bartlett’s test of sphericity was statistically significant ( $p < .001$ ). We then evaluated the appropriate number of factors for our models using scree plot and parallel tests with an eigenvalue of 1 as the decision criterion. When the appropriate number of factors was found, we applied factor analysis with the principal factor method and rotation depending on the section we were analyzing. We used oblique “Promax” rotation for browsing clutter variables, because we assumed that factors would correlate, as they did. For browsing behaviors and coping strategy variables, we used orthogonal “varimax” rotation, because we wanted to use the extracted factors as predictors in multivariate regression, and thus wanted to avoid multicollinearity.

We iteratively excluded items from factor analysis models that had loading values lower than 0.30 and cross-loading to more than one factor greater than or equal to 0.30. Finally, we evaluated the models based on the overall fit using the Tucker-Lewis index of factoring reliability ( $TLI$ ) ( $\geq .90$ ), root mean square error of approximation ( $RMSEA$ ) ( $< .06$ ), and interpretability of extracted factors.

After the best models were decided, we interpreted the factor meanings based on the common themes in the items factorized. These resulting models are presented next by sections. The item loading matrices for browsing clutter, behavior, and coping sections are reported in Tables 4–6.

**6.3.1 Browsing clutter.** Based on the exploratory factor analysis, our data consisted of four distinct factors with moderate factor correlations of .27 – .50. The intercorrelations suggest that while the factors are fairly independent dimensions, they still affect each other. The overall model shows an acceptable fit ( $TLI = .93$ ,  $RMSEA = .05$ ) [79] to our data. The details of browsing clutter EFA are reported in Tables 3 and 4.

	Navigation	Ads & Pop-ups	Amount	Search
Navigation	1.00			
Ads & Pop-ups	0.30	1.00		
Amount	0.28	0.27	1.00	
Search	0.50	0.38	0.39	1.00

**Table 3: Browsing clutter factor correlation matrix. All the factors correlate with each other moderately.**

We labeled the factors as *Navigation*, *Ads and Pop-ups*, *Amount*, and *Search* reflecting the forms of browsing clutter identified in Study 1. *Navigation* represents experiencing difficulty with navigation within and across web pages, which includes interaction with browser features, such as tabs and windows, as well as evaluating the information found in relation to the ongoing tasks. *Ads and*

*Pop-ups* represents distractions caused by unnecessary browser elements, such as ads within web pages or browser pop-ups. *Amount* represents the experience of having open too many browser interfaces, such as tabs or windows, for them to feel manageable. *Search* represents experience of having difficulties in information search task execution because of sidetracking and getting lost.

**6.3.2 Browsing behaviors.** The analysis shows that our data consists of five distinct groups of behaviors. We labeled them *Organizing*, *Multitasking*, *Accumulating tabs*, *Cautious tab closing*, and *Working spheres within browser*. The model had an acceptable fit to data ( $TLI = .90$ ,  $RMSEA = .05$ ) [79]. Table 5 reports the details of browsing behavior EFA.

We labeled the factors based on the themes that were present among the interrelated items in factors. *Organizing* behavior includes behaviors where participants actively organize different browser resources to help them use those resources. *Multitasking* factor represents behaviors that show tendency to work on multiple tasks simultaneously. In *Accumulating tabs* group, the items represent habit of opening web pages into tabs while actively not closing the ones that have become redundant. *Cautious tab closing* group includes items that represent a habit of actively checking if open pages are still needed and closing unneeded ones. In *Working spheres within browser*, the items discuss the habit of using browser windows to organize different aspects of the tasks that the windows are used for, such as whether they are personal or work-related and whether they are for different tasks. The idea of working sphere was based on González and Mark [27] who studied how people divide their work into thematic working spheres.

**6.3.3 Coping strategies.** The coping strategy items were taken from Brief COPE [13]. Carver [13] uses exploratory factor analysis to evaluate the structure of the coping reactions based on the inventory items. Thus, we used EFA to evaluate, what higher-level structures our data would support. Overall, our model fit ( $TLI = .79$ ,  $RMSEA = .09$ ) was below recommended cutoff criteria [79], but as the internal consistencies of the factors were acceptable ( $\alpha > .70$ ), we considered the EFA model acceptable. Table 6 reports the items and factor loadings of coping section.

Based on our exploratory factor analysis, we extracted four factors that we labeled *Active action*, *Social support*, *Reframing*, and *Avoidance and negative expression*. *Active action* group consists of items that represent participants employ active actions to change the stressful situation. *Avoidance and negative expression* group includes items where participants try to avoid the stressful situation by denial or by turning to other activities, or they express negative feelings to others or towards themselves. In *Reframing* group, the items represent attitude where participants reframe the situation into something else than stressful, such as a funny situation or something that has to be accepted. In *Social support* group, the items discuss participant seeking support and comfort from other people.

## 6.4 Modeling what predicts browsing clutter

To examine whether our survey data confirms the interrelation of browsing behaviors, coping strategies and browsing clutter, we used multivariate regression models with browsing behavior factors

and coping factors as the predictors, and browsing clutter forms as the dependent variables. Factor scores from EFA models were used to represent each variable.

Our results show that certain browsing habits and coping strategies are related to increase or decrease of browsing clutter. The results of regression analyses are presented next by sections and further details are listed in Tables 7–9. All the models were statistically significant ( $p < .001$ ).

**6.4.1 Does browsing behavior predict browsing clutter?** We wanted to know whether browsing behaviors (BB) would predict browsing clutter (BC).

To test whether our data would support these hypotheses, we used multivariate regression. The details of which browsing behaviors predict browsing clutter are reported in Table 7.

The results show that *Multitasking* (BB) predicts increase in *Amount* and *Search* (BC), while *Accumulating tabs* (BB) predicts increase in *Navigation*, *Amount* and *Search* (BC). *Cautious tab closing* (BB) predicts decrease in *Navigation* and *Search* (BC).

Among all the behaviors, only *Working spheres within browser* (BB) predicts increase in all forms of browsing clutter. *Organizing* behavior (BB) did not have statistically significant ( $p > .05$ ) relation to browsing clutter factors.

*Multitasking*, *Accumulating tabs*, and *Working spheres within browser* (BB) act as increasing factors in relation to browsing clutter, while *Cautious tab closing* (BB) decreases it.

All the regression coefficients are low ( $< .40$ ), and the model effects are low ( $adj.R^2 < .20$ ), indicating that these browsing behaviors account for only some of the variance in browsing clutter.

However, a clear exception is *Amount*, which has a relatively high effect ( $adj.R^2 = .40$ ) and *Accumulating tabs* with a regression coefficient of .54, indicating that behavior explains cluttered amount of tabs and windows moderately. Nevertheless, this is logical, since accumulating tabs and windows results in increased amount of tabs and windows. Thus, this shows that our model is consistent with the meaning of the used factors.

**6.4.2 Does coping strategy predict browsing clutter?** Next, we wanted to know how coping strategies (CP) would affect browsing clutter (BC). To test whether coping strategies would predict increase or decrease in browsing clutter, we used multivariate regression with coping factor scores as the independent variables, and factor scores from browsing clutter as the dependent variables. The details of which coping strategies predict browser clutter are reported in Table 8.

The results of the interrelations between coping and browsing clutter are more dispersed than those of browsing behaviors. *Social support* (CP) predicts increase in *Navigation*, *Ads and Pop-ups*, and *Amount* (BC), while *Avoidance and negative expression* (CP) predicts increase in all the browsing clutter variables. *Reframing* (CP) predicts increase only in *Amount* (BC).

However, all the statistically significant coefficients are low ( $< .40$ ) meaning that each behavior has low impact on browsing clutter and each model has low adjusted R-squared value ( $< .20$ ), indicating that models explain only some variance of browsing clutter.

**6.4.3 How is browsing clutter related to perceived seriousness of the clutter to the users?** We wanted to analyze whether

Factor group: Browsing clutter			
Factors (Cronbach's alpha)	Survey items (Items marked with (*) are reverse coded)	Item mean (SD)	Loading
Navigation (0.709)	I feel it's easy to find the section of useful information within a web page (*)	3.02 (1.22)	0.582
	It's difficult for me to locate the window I need from existing opened browser windows	2.65 (1.48)	0.547
	It's easy for me to locate the tab I need from existing opened tabs in the tab bar (*)	2.65 (1.32)	0.524
	It's difficult for me to navigate/switch between web pages when I need content from multiple pages	2.86 (1.52)	0.514
	I can handle the amount of tabs I have open (*)	2.44 (1.37)	0.492
	Browsing makes me exhausted	2.80 (1.54)	0.380
	I find the answer(s) I want within several search queries (*)	2.92 (1.29)	0.376
	It's difficult for me to decide if I have found a satisfying answer to my question from the search results	3.60 (1.58)	0.312
Ads & Pop-ups (0.847)	I get distracted by pop-ups	3.12 (2.01)	0.880
	I get distracted by ads	2.86 (1.89)	0.864
Amount (0.786)	I have too many tabs open	3.96 (1.86)	0.843
	I have too many browser windows open	3.34 (1.89)	0.755
Search (0.704)	I get sidetracked from what I was searching for	3.67 (1.63)	0.721
	Exciting content on web page distracts me from my main task	3.61 (1.73)	0.659
	I forget what I was searching for in the first place	2.65 (1.49)	0.597

**Table 4: Survey items and item loadings for browsing clutter factors. The factors represent latent variables that we identify as different forms of cluttered browsing experience. The survey items associated to factor are treated as the observed variables used to extract the latent factors in EFA. We labeled the factors as *Navigation*, *Ads & Pop-ups*, *Amount*, and *Search* according to the theme that is present in a group of items. Cronbach's alpha values ( $\alpha > .70$ ) suggest good internal consistency for the factors. The item means represent the mean score of each individual item in our survey data. Items with a loading below .30 were excluded iteratively from the factor model.**

reported browsing clutter experience would predict seriousness of the browsing clutter experienced by the participants. We fitted a multivariate regression model with reported seriousness as dependent variable and browsing clutter factor scores as independent variables. Table 9 lists the details of the regression analysis.

The results show that *Navigation*, *Ads and Pop-ups*, and *Amount* positively predict perceived seriousness of the problem. This means that the more participants suffer from browsing clutter, the more serious problem the clutter is for them.

## 6.5 Limitations

Our survey data relies on participants' self-reports and thus is vulnerable to biases due to retrospection, self-evaluation, and self-selection to participate in the study. However, we did our best to minimize such effects by following good research practices.

Our exploratory results are preliminary. Due to the focus on understanding clutter, the results may highlight behaviors that have increasing effects on browsing clutter.

## 7 DISCUSSION

This paper presents two studies: an exploratory interview study and a quantitative survey. In our interview study, we investigated how people use web browsers and how they experience clutter during web browsing. In our survey study, we investigated what are the forms of browsing clutter and how browsing behaviors and

copied strategies contribute to them. By investigating overloaded experiences of users with interview and survey studies, we were able to discover different forms of clutter, how clutter emerges from behavior, and how users deal with it.

Our main findings were that users' experiences of clutter during browsing have different forms, which intercorrelate moderately. We identified certain browsing habits influencing the cluttered experiences and modeled the correlations between behavior and cluttered experience perception. In addition, we identified the strategies applied by users to cope with cluttered experiences. Our results highlight that to understand users' experiences of clutter during browsing, it is essential to study beyond clutter of tabs or ads. Browsing clutter consists of several related problems to browsing that need to be understood together.

### 7.1 Proposing browsing clutter – What users experience as clutter?

Web browsers are used for managing and assisting users in different work contexts in addition to traditional web searching where the browser is only used for information retrieving. Many browser functions and extensions have been developed to serve such evolving needs. However, features desired by users are different (see Section 4.3.3), and a simple add-up of isolated functions does not produce a smooth browsing journey. To understand the problems

Factor group: Browsing behaviors			
Factors (Cronbach's alpha)	Survey items (Items marked with (*) are reverse coded)	Item mean (SD)	Loading
Organizing (0.685)	I organize my bookmarks	4.01 (2.18)	0.447
	I organize my tabs	4.61 (1.90)	0.857
	I change the order of open tabs to help me locate them later	4.82 (2.00)	0.647
Multitasking (0.676)	I work on multiple tasks at the same time	4.98 (1.55)	0.774
	I focus on one task at a time (*)	4.20 (1.60)	0.598
	I switch between different tasks	5.35 (1.36)	0.551
Accumulating tabs (0.615)	I will keep tabs open until I feel there are too many	4.26 (2.07)	0.731
	I tend to close unnecessary tabs constantly (*)	3.02 (1.76)	0.514
	I close tabs associated to a certain task immediately once I finish it (*)	2.71 (1.59)	0.465
	I open web pages to look at them later but never revisit them	3.60 (1.74)	0.387
Cautious tab closing (0.511)	I will check if I still need the tab before closing it	5.68 (1.48)	0.630
	I will close the browser window without checking it (*)	5.15 (1.73)	0.582
	I keep open all tabs that I see as potentially relevant	5.60 (1.44)	0.367
	When I'm done with web browsing, I will go through all the tabs that are open	3.95 (1.95)	0.315
Working spheres within browser (0.453)	I use different browser windows within the same browser to distinguish tasks	4.12 (2.12)	0.504
	I use different browsers to distinguish my work and personal browsing activities	3.17 (2.23)	0.432

**Table 5: Survey items and item loadings of browsing behavior factors. We aimed at reducing the dimensions of our variables with EFA to use the factor scores in regression analysis. We labeled the groups as *Organizing* behavior, *Multitasking*, *Accumulating tabs*, *Cautious tab closing*, and *Working spheres within browser*, since these are the common themes among the groups of items. Items with a loading below .30 were excluded iteratively from the factor models. Internal consistencies of the factors ( $\alpha = .45 - .69$ ) were below the common acceptable cutoff. This might imply that behavior factors do not measure unidimensional behaviors. However, as factor loadings and overall fit of the model ( $TLI = .90$ ,  $RMSEA = .05$ ) were good, we considered the factors acceptable for dimension reduction.**

faced by users, it is crucial to consider the broader context beyond single browser functions, such as tabbing.

We call *browsing clutter* a group of associated experiences of clutter that users have while browsing online, which are characterized by users feeling overwhelmed and stressed due to the accumulation and disorganization of browser elements and information. We conceptualized four forms of *browsing clutter* from the interview study and the EFA model of our survey items: 1) *Amount of tabs and windows*, 2) web page elements such as *Ads and Pop-ups*, 3) *Navigation* within and across web pages, and 4) *information Search*. Notably, 3) and 4) were thematized as one theme in the interview study, while they were divided into separate forms based on EFA analysis.

In the EFA model that resulted from our data analysis, the browsing clutter factors correlate with each other moderately. We interpret this as an indication that the forms of browsing clutter interact with each other, although they are also relatively independent since the analysis produced distinct factors. Thus, solely focusing on one form of browsing clutter misses the interaction effects of other forms. The interactions of browsing clutter forms might be understood as arising from common capacity limitations of human cognition, while browsing clutter itself represents instances of more general information overload.

Our results indicate that users' cluttered experiences during browsing consist of several forms, which reflects similar findings of overload experiences from other studies. Many prior studies

designate quantity as one dimension of overload (e.g., quantity of information in information overload [29], volume of emails in email overload [23], and the number of tabs in tab overload [15]), which closely relates to the amount of tabs and windows in our study. Web contents have been researched less, but ads and popups as one type of interactive elements (e.g., [7, 30, 37]) have been associated with clutter in previous studies. Search and navigation have been extensively investigated in HCI (e.g., [17, 43, 56, 78]), with commonality that search and navigation place demands on users' information processing. Our study supports the understanding that overload experiences emerge during search and navigation as the demands exceed the information processing capacity. Overall, we can observe that browsing clutter instantiates information overload that occurs in the context of browsing. To the best of our knowledge, different forms of browsing clutter have not been studied together in prior research, which is the main contribution of our work.

With four interacting factors, it is clear that browsing clutter is a complex phenomenon combining different aspects of human-computer interaction: navigation and search require planning and executing task-related actions by the users (e.g., concurrent multitasking [61]), while tabs and browser windows, as well as browser elements such as pop-ups, provide resources (e.g., externalizing mental models [15]) and demands (e.g., visual clutter [59]) for users' cognition. Browsing clutter might be characterized as a trade-off outcome to the dual nature of browsing elements and processes,



Factor group: Coping strategies			
Factors (Cronbach's alpha)	Survey items	Item mean (SD)	Loading
Social support (0.908)	I try to get advice or help from other people about what to do	2.92 (1.87)	0.838
	I try to get help and advice from other people	2.96 (1.90)	0.817
	I seek comfort and understanding from someone	2.63 (1.74)	0.787
	I seek emotional support from others	2.29 (1.64)	0.760
Avoidance and negative expression (0.798)	I criticize myself for the situation	2.87 (1.76)	0.780
	I blame myself for the situation	2.91 (1.82)	0.689
	I give up the attempt to cope with it	2.68 (1.61)	0.539
	I turn to work or other activities to take my mind off things	3.92 (1.75)	0.486
	I give up trying to deal with it	2.50 (1.50)	0.450
	I turn to entertainment to get my mind off things	4.20 (1.82)	0.445
	I deny that it happens	2.25 (1.45)	0.429
	I express my negative feelings	3.28 (1.80)	0.367
Reframing (0.705)	I make fun of the situation	3.90 (1.85)	0.733
	I make jokes about it	3.91 (1.93)	0.716
	I learn to live with it	4.47 (1.72)	0.531
	I accept the reality of the fact that it happens	4.90 (1.54)	0.396
	I say to myself "this is not a problem"	3.95 (1.80)	0.345
Active action (0.731)	I take action to try to make the situation better	5.16 (1.51)	0.695
	I try to come up with a strategy about what to do to the situation	4.82 (1.59)	0.669
	I concentrate my efforts on doing something about the situation	4.83 (1.62)	0.612

**Table 6: Survey items and item loadings of factors of coping strategies.** We aimed at reducing the dimensions of variables to use them in regression analysis. We labeled the factors as *Social support*, *Avoidance and negative expression*, *Reframing*, and *Active actions*. Items with a loading below .30 were excluded iteratively from the factor model. Internal consistencies of the factors ( $\alpha > .70$ ) were acceptable.

**Table 7: Multivariate regression: relationship between browsing clutter forms and browsing behavior ( $N = 400$ ).** *Working spheres within browser* has a statistically significant positive relationship to all browsing clutter variables. *Cautious tab closing* habit has a statistically significant negative relationship to *Navigation* and *Search*, while *Accumulating tabs* habit has varying relationships for *Navigation*, *Amount*, and *Search*. *Multitasking* has a statistically significant positive relationship to *Amount* and *Search*. The statistically significant behaviors predict changes in browsing clutter. The overall models explain 4%–40% of variance among browsing clutter factors.

Browsing behavior (IVs)	Navigation	Ads and Pop-ups	Amount	Search
Organizing	-.040	-.005	-.070	.044
Multitasking	-.049	.043	.221***	.191***
Accumulating tabs	.148**	.092	.539***	.259***
Cautious tab closing	-.313***	-.012	.015	-.166**
Working spheres within browser	.176**	.026***	.289***	.229***
	$F(5, 394) = 10.94, p < .001, adj.R^2 = .11$	$F(5, 394) = 4.57, p < .001, adj.R^2 = .04$	$F(5, 394) = 54.07, p < .001, adj.R^2 = .40$	$F(5, 394) = 16.49, p < .001, adj.R^2 = .16$

$p < .001^{***}, p < .01^{**}, p < .05^{*}, p < .1^{.}$   
Columns report regression coefficients ( $\beta$ )

**Table 8: Multivariate regression: relationship between browsing clutter forms and coping strategies ( $N = 400$ ).** *Avoidance and negative expression* strategy has statistically significant positive relationship to all the browsing clutter forms, while *Social support* has for all of them except *Search*. *Active action* has a statistically significant negative relationship only with *Navigation*, while *Reframing* has a positive relationship only for *Amount*. Increases in statistically significant coping strategies predict increase in browsing clutter forms, except for *Active action*, which predicts decrease. The models explain 6%–17% of the variance among the browsing clutter factors.

Coping strategy (IVs)	Navigation	Ads and Pop-ups	Amount	Search
Social support	.147***	.245***	.114*	.032
Avoidance and negative expression	.307*	.189***	.180***	.386***
Reframing	-.049	.035	.120*	.071
Active action	-.229***	.084	-.024	-.066
	$F(4, 395) = 21.79, p < .001, adj.R^2 = .17$	$F(4, 395) = 12.26, p < .001, adj.R^2 = .10$	$F(4, 395) = 6.95, p < .001, adj.R^2 = .06$	$F(4, 395) = 20.51, p < .001, adj.R^2 = .16$

$p < .001^{***}, p < .01^{**}, p < .05^{*}, p < .1^{.}$   
Columns report regression coefficients ( $\beta$ )

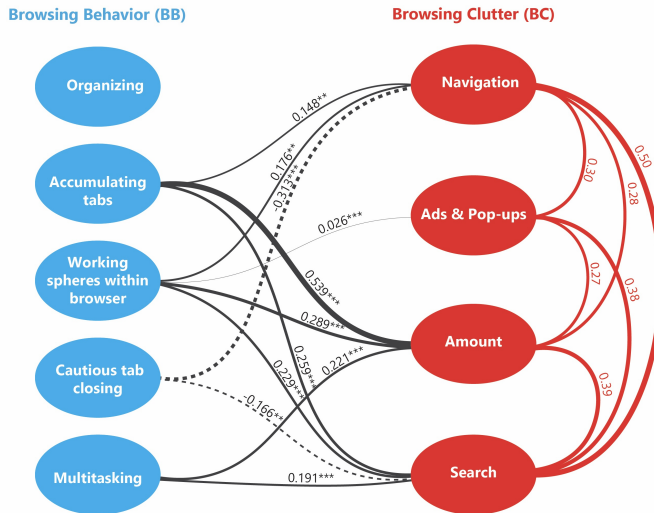
which can in one context aid the user in task performance while distracting them in another context.

**Table 9: Multivariate regression: relationship between browsing clutter forms and perceived seriousness of it ( $N = 400$ ). *Navigation, Ads and Pop-ups, and Amount* have a statistically significant positive relationship to perceived seriousness of the clutter. The three forms of browsing clutter out of four predict how serious problem the user has. Overall, the model explains 15% of the variance of the seriousness score.**

Browsing clutter forms (IVs)	Perceived seriousness score
Navigation	.250*
Ads and Pop-ups	.417***
Amount	.296**
Search	-.044
	$F(4, 395) = 17.93,$
	$p < .001,$
	$adj.R^2 = .15$
$p < .001$ ***, $p < .01$ **, $p < .05$ *, $p < .1$ . Column report regression coefficients ( $\beta$ )	

## 7.2 How browsing clutter emerges – What factors influence cluttered experience?

**Browsing behaviors contribute to browsing clutter.** Our studies show that there are several behaviors and factors that contribute to browsing clutter. The regression model shows the dynamics of how browsing behaviors interact with browsing clutter. Figure 6 illustrates the statistical associations of browsing behavior factors in relation to browsing clutter.



**Figure 6: The relationship between browsing behavior and browsing clutter experience. *Multitasking, Accumulating tabs, Cautious tab closing habits, and Working spheres within browser* behaviors predict browsing clutter. Browsing clutter factors intercorrelate with each other. A negative correlation is indicated with a dotted line, and the regression coefficients are marked with a significance p-value. Factor correlations are indicated with red lines. A thicker line corresponds to a larger coefficient value.**

In the model, *Multitasking* predicts the *Amount* of tabs and *Search* clutter. In the interviews, many users tended to multitask when browsing, due to either the nature of their work or their personal preferences. The high rate of multitasking is supported by previous research on online multitasking [67]. Such multitasking is enabled and motivated by the design of today's browsers, which allow the use of tabs and multiple windows [24, 32]. Moreover, the results reflect prior findings where online multitasking is associated to stress [47].

*Accumulating tabs* has been the focus of much interest in previous research, which have examined the pressures to close and keep tabs [15] and reasons to use tabs [24]. In our model, this factor predicts *Navigation, Search* and *Amount* clutter, which resembles the results by Chang et al. [15] that tabs are experienced as overload. In our model, a closely related aspect is the *Cautious tab closing* habit, which has a negative effect on *Navigation* and *Search*, indicating that closing tabs cautiously decreases the clutter.

In the interviews, we identified two types of habits related to closing tabs: closing tabs when the task is done and reactive closing. Our results indicate that people who accumulate tabs in a reactive pattern and never close them until triggered by an external warning (e.g., browser crash or emotional stress) experience more browsing clutter. Another habit that contributes to the accumulation of tabs is to leave the computer open at the end of the day. As the browser stays open and users simply continue from the web pages they left, they are likely to accumulate more web pages than those who shut down the browser more frequently and started browsing sessions from scratch. We can relate these habits to findings by Vitale et al. [76] who observed that users who tended to hoard digital data encounter costs of data management only when the amount of data became too large, while users who tended to be minimalist had to constantly invest and dedicate their time and effort to managing data.

Importantly, the one factor that predicts all forms of browsing clutter is *Working spheres within browser*. This highlights how web browsers are used to structure work and that web browsers might not reflect users' complex task structures. Chang et al. [15, 16] have investigated how tabs do not match users' mental models of a task. Earlier, González and Mark [27] have argued that modern technology does not support cohesive task structure processing. They noted that people divide their work into thematic working spheres and switch between them constantly during the working day. All of these studies emphasize how important structuring is in browsing tasks and also in the general context of knowledge work.

It is also interesting that *Organizing* behavior had no statistically significant effect on browsing clutter, in contrast to our expectations. Particularly, as the open-ended answers also imply that cluttered interfaces are a common context to browsing clutter, it is counter-intuitive that *Organizing* does not improve the situation.

**Task environment contributes to browsing clutter.** In addition to the behaviors included in the model, we identified from the interview and open-ended answers to the survey that task characteristics (e.g., complexity, importance, and duration) contribute to browsing clutter. This is similar to the model of email overload by Dabbish and Kraut [23] where they found that email work importance influences email overload experience, while task variety

influences email work importance. Further, the open-text-field question in the survey study introduced another task characteristic, that is, the topic. Similarly, the significant influence of topic is shown by Renjith [58], who identified news content as a specific topic that contributes to the experience of information overload. Overall, task characteristics affect the processing that the user engages in, as well as the support that they need from the browser to information management, structuring, and storing. Studies on sensemaking have highlighted the significance of representations that users have and alter ([57, 60]), and how users are likely to prefer passive absorption of information or undirected browsing, as opposed to active and directed search for unknown topics [5].

As browsing tasks become more demanding, this increases the need for information management with the assistance of browser features. The complexity of coordinating co-existing information management methods creates even more challenges to maintaining a clean browsing environment. The diversity on the choice of information management tool was also observed in a study by Jones et al. [35]. Further, as they stated, understanding how users make choices of information management methods can be a key step prior to proposing solutions.

Our results highlight that browsers facilitate overlapping functions, such as information retrieval, communication, structuring information, and storing data. Thus, different forms of clutter and behaviors that contribute to them need to be investigated together to understand the browsing clutter.

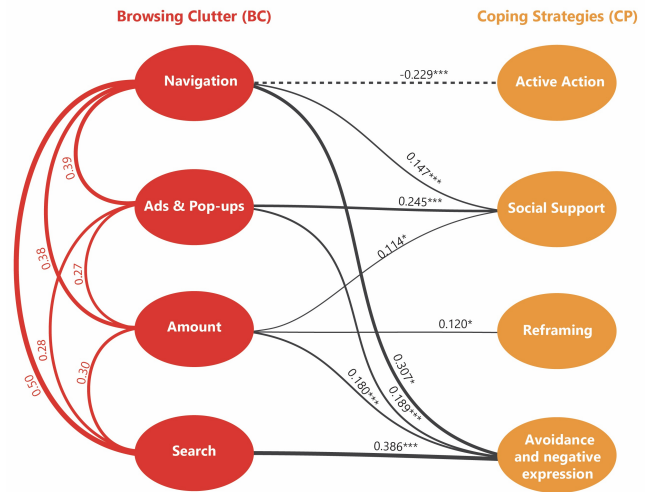
In the future, more investigations are needed into what other behaviors might contribute to increase or decrease of browsing clutter. Other behaviors, individual and social resources, skills, and other factors might affect both the browsing clutter experience and the seriousness of the problem for users. Discovering what other factors contribute to browsing clutter posits exciting opportunities for future research.

### 7.3 Coping with browsing clutter – What users do when they experience clutter?

**Users adapt their attitudes and behavior to cope with browsing clutter.** From our interview, we learned that browsing clutter is an issue that most of our participants experience at least occasionally. However, not all of them considered it as a problem that they aimed to solve. However, we identified certain behaviors that some participants applied to prevent and address the emergence of browsing clutter, which can be compared with coping strategies [6].

The transactional theory of coping describes how the experience of stress is produced in the transaction of individuals and their environment [6]. Folkman and Lazarus define coping as “cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding of the resources of the person” [25, p. 310]. In the context of web browsing, adapting the behavior or attitudes to the browsing clutter are types of coping that users do. Such coping strategies can be categorized into problem-focused and emotion-focused strategies [6].

In the interview results, constraints that were used as coping strategies can be categorized as problem-focused strategies. Managing browsing tasks and the resources needed for completing them, such as the web pages and their contents, drain cognitive



**Figure 7: The relationship between browsing clutter experience and coping strategies. Social support and Avoidance and negative expression predict browsing clutter, while Reframing and Active action predictions are pairwise. Browsing clutter factors intercorrelate with each other. A negative correlation is indicated with a dotted line, and regression coefficients are marked with a significance p-value. Factor correlations are indicated with red lines. A thicker line corresponds to a larger coefficient value.**

and perceptual resources. Examples of problem-focused coping strategies include limiting the number of open tabs intentionally, creating external constraints, and using a browser extension that provides a tool to manage tabs, since they all aim at altering the environment that drains the (psychological) resources [6]. In addition, the concrete actions that users take in the act of browsing to prevent the problem from emerging are all problem-focused strategies. Interestingly, the limiting and constraining behaviors closely resemble email management tactics (e.g., limiting the size of inbox, and restricting checking email) studied by Dabbish and Kraut [23], which affect the experience of email overload. Moreover, information overload has been associated with increased information avoidance [29] and strategies of filtering and withdrawing from information sources [64]. Thus, our findings indicate that these behaviors might reflect general information coping strategies.

Other coping strategies reported by our participants can be categorized as emotion-focused because they are aimed at regulating emotions arising from the stressful encounters with the browser [6]. Our participants mentioned adjusting some of their attitudes towards browsing clutter, including deterministic and adaptive attitudes (see Section 4.3.2). These seem to be emotion-focused coping strategies, as they are intended to reduce individuals’ distress but do not alter the stressor, that is, the clutter.

**Coping strategies increase browsing clutter, while active coping has the opposite effect.** Informed by our findings in the interview study, we included a measurement of coping strategies for browsing clutter with the Brief COPE inventory [13] in our survey

study, which were further modeled to understand how people cope with the clutter they experience. Figure 7 shows the associations of browsing behaviors related to browsing clutter.

The finding that *Avoidance* coping leads to increase in browsing clutter is intuitive, since avoiding the problem does not solve it, but sustains it for a longer time. More interestingly, *Social support* (e.g., turning to other people for emotional support or guidance) has an increasing effect on almost all forms of browsing clutter. It is possible that social support behaves in a similar manner as avoidance, thus sustaining the problem.

Notably, only the *Active action* coping habit has a statistically significant negative relation to *Navigation*. This indicates that the more participants engage in *Active* coping, the less they suffer from cluttered navigation. All other significant coping factors have positive coefficients, suggesting that the more the participants engage in coping, the more they will suffer from browsing clutter. Thus, we might conclude that only *Active* coping in context of navigation is effective coping strategy, while other strategies either increase the cluttered experience or are inconclusively non-significant.

**Browsing clutter is minor problem to majority, but major to some.** In our interviews, participants described clutter they experienced, but their perceptions seemed to differ on whether the browsing clutter would be a serious issue to them. To examine this matter more closely, we included a final question in the survey focusing on how serious problem is the clutter during browsing to the participants.

Most browsing clutter factors predict the seriousness of the problem in our regression model. Thus, the increase in browsing clutter contributes to the user perceiving the clutter as a problem, which also makes sense intuitively: after all, browsing clutter measures the negative experiences that users have while browsing. In total, 24.7% of our survey participants perceived browsing clutter as a serious problem. It indicates that although users might experience clutter while browsing, they are well adapted to it, or do not consider the experience as a problem that they would have means to solve [see also 64, p. 619]. Alternatively, as one of our interview participants (P7) explained: *“Yeah, of course it’s a problem, but it depends on the case. It’s not a very urgent problem, it’s not that serious. I hope there’s no such issue, that would be better. But if the issue is there, I think it’s standable [bearable] for me.”*

The overall model explains about 15% of the variance in the perceived seriousness. This indicates that while browsing clutter factors measure experience of the clutter (that is, negative experiences), it does not solely or exhaustively translate to a clear problem to users. It is likely that other factors also contribute to the users’ considering clutter as a problem. Such factors could include users’ personality characteristics, such as how strongly they react emotionally, or how strongly they react to the loss of control over tasks during clutter. Environmental factors, such as occupation and education, or cultural factors, such as how much productivity and tidiness are expected from individuals, might contribute to this phenomenon. These factors are supported by our open-ended answers, in which the fear of decrease in work productivity was reported, and negative emotions were reported more in the group that perceived clutter as a more serious problem.

Overall, the results from our two studies show that browsing behavior and adaptive coping have an effect on experience of clutter, which in turn sheds light on the adaptive and complex nature of cluttered user experience. However, the intercorrelation of browsing clutter factors highlights that increase in one form of browsing clutter might also cause increase in other forms of browsing clutter.

## 8 CONCLUSIONS

We call *browsing clutter* the group of associated experiences of clutter that users have while browsing online and which cause them stress and overwhelm them. Together our two studies suggest that browsing clutter has several forms: the number of tabs and browser windows, the contents of web pages and interactive elements, and the navigation and search process. Our major contributions are as follows: 1) distinguishing between different forms of browsing clutter, 2) identifying browsing behaviors and coping strategies that contribute to browsing clutter, and 3) modeling the dynamics between browsing behavior, browsing clutter experience and coping strategies.

We conducted an exploratory study to explore what users experience as clutter and what behaviors and factors affect their experiences. Prior research has focused on specific perspectives of browsing-related overload, such as tab overload [15] or web contents [33], or investigated general information overload [29]. We realized that these perspectives explain only a part of the challenge to users. In our findings, we presented that our participants expressed discomfort about the number of tabs, annoying ads, difficulties in navigating web pages, and getting lost in searching specific information. Therefore, we reasoned that a wider perspective is needed to understand the cluttered browsing experience.

Our studies indicate that cluttered experiences are distinct, but at the same time they have significant interactions. By evaluating tabs and windows in relation to their contents and the information search a user is engaged in, we can understand the user experience comprehensively. Significant prior research has been conducted on closely related issues, such as tab overload [15], information overload [29], digital clutter [70, 76], and personal data management [35]. However, our studies provide a framework to understand the interactions of cluttered experiences and user browsing behaviors. Further research is needed to solidify our proposed model.

Based on our two studies, the browsing clutter interacts with user habits and behaviors, and their coping strategies. This indicates that users are adaptive and seek to address the problems they encounter when there are possible actions to take, and to adapt to situations when there are no perceivable actions to take.

Overall, our studies highlight the adaptive nature of users and the browsing clutter phenomenon itself. The browsing clutter is a complex phenomenon that affects user behavior and user experience; moreover, the user behavior and coping affects how browsing clutter emerges and is felt by the user.

In summary, our study emphasizes the diverse nature of the sources of clutter in web browsing experiences. Our two studies contribute to the understanding of browser clutter by conceptualizing and modeling the interactions between different cluttered experiences and behaviors. With better understanding of cluttered

experiences and user habits, we believe it is easier for users and designers to find effective strategies to declutter.

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## A SURVEY SECTION 1: ITEMS ON BROWSING BEHAVIOR

Survey section 1 items: Browsing behavior	
Survey items (Items marked with (*) are reverse coded)	Item mean ( <i>SD</i> )
I work on multiple tasks at the same time.	4.98 (1.55)
I switch between different tasks.	5.35 (1.36)
I focus on one task at a time (*).	3.80 (1.60)
I will keep tabs open until I feel there are too many.	4.26 (2.07)
I close tabs associated to a certain task immediately once I finish it (*).	5.29 (1.59)
I keep open all tabs that I see as potentially relevant.	5.60 (1.44)
I open web pages to look at them later but never revisit them.	3.60 (1.74)
I tend to close unnecessary tabs constantly(*).	4.98 (1.76)
I will check if I still need the tab before closing it.	5.68 (1.48)
I will close the browser window without checking it (*).	2.86 (1.73)
When I'm done with web browsing, I will go through all the tabs that are open.	3.95 (1.95)
I organize my bookmarks.	4.01 (2.18)
I organize my tabs.	4.61 (1.90)
I change the order of open tabs to help me locate them later.	4.82 (2.00)
I use different browser windows within the same browser to distinguish tasks.	4.12 (2.12)
I use different browsers to distinguish my work and personal browsing activities.	3.17 (2.23)
I have browsing tasks that last for days.	4.36 (2.14)
My browsing tasks don't have a simple answer.	4.15 (1.44)
Tasks that I do with the browser are important.	5.09 (1.30)

**Table 10: Survey section 1 items. Participants were asked to rate with 7-point Likert-scale (Never – Always) to the question: When you are using the web browser, how often do you behave in the way described in the following statements?**



## B SURVEY SECTION 2: ITEMS ON BROWSING EXPERIENCE

Survey section 2 items: Browsing experience	
Survey items (Items marked with (*) are reverse coded)	Item mean ( <i>SD</i> )
I get sidetracked from what I was searching for.	3.67 (1.63)
I forget what I was searching for in the first place.	2.65 (1.50)
I get lost.	2.37 (1.48)
I find the answer(s) I want within several search queries (*).	5.08 (1.29)
It's difficult for me to navigate/switch between web pages when I need content from multiple pages.	2.86 (1.52)
It's difficult for me to decide if I have found a satisfying answer to my question from the search results.	3.60 (1.58)
I have too many tabs open.	3.96 (1.86)
I can handle the amount of tabs I have open (*).	5.57 (1.37)
It's easy for me to locate the tab I need from existing opened tabs in the tab bar (*).	5.35 (1.32)
I have too many browser windows open.	3.34 (1.89)
It's difficult for me to locate the window I need from existing opened browser windows.	2.65 (1.48)
I get distracted by ads.	2.86 (1.89)
I get distracted by pop-ups.	3.12 (2.01)
I get distracted by sudden videos or sounds from web pages.	3.63 (1.90)
I feel it's easy to find the section of useful information within a web page (*).	4.98 (1.22)
I feel the information is presented in a complicated way on web page(s).	3.02 (1.46)
Disturbing content on web page distracts me from my main task.	3.33 (1.76)
Exciting content on web page distracts me from my main task.	3.61 (1.73)
Browsing makes me exhausted.	2.80 (1.54)

**Table 11: Survey section 2 items. Participants were asked to rate with 7-point Likert-scale (Never – Always) to the question: When you are using the web browser, how often do you experience the following situations?**

### C SURVEY SECTION 3: ITEMS ON COPING STRATEGIES

Survey section 3 items: Coping strategies	
Survey items	Item mean ( <i>SD</i> )
I concentrate my efforts on doing something about the situation.	4.83 (1.62)
I take action to try to make the situation better.	5.16 (1.51)
I try to come up with a strategy about what to do to the situation.	4.82 (1.59)
I think hard about what steps to take.	4.03 (1.77)
I try to see it in a different light, to make it seem more positive.	3.94 (1.77)
I look for something good in what is happening.	4.03 (1.75)
I accept the reality of the fact that it happens.	4.90 (1.54)
I learn to live with it.	4.47 (1.72)
I make jokes about it.	3.91 (1.93)
I make fun of the situation.	3.90 (1.85)
I seek emotional support from others.	2.29 (1.64)
I seek comfort and understanding from someone.	2.63 (1.74)
I try to get advice or help from other people about what to do.	2.92 (1.87)
I try to get help and advice from other people.	2.96 (1.90)
I turn to work or other activities to take my mind off things.	3.92 (1.75)
I turn to entertainment to get my mind off things.	4.20 (1.82)
I say to myself “this is not a problem”.	3.95 (1.80)
I deny that it happens.	2.25 (1.45)
I say things to let my unpleasant feelings escape.	3.21 (1.81)
I express my negative feelings.	3.28 (1.80)
I give up trying to deal with it.	2.50 (1.50)
I give up the attempt to cope with it.	2.68 (1.61)
I criticize myself for the situation.	2.87 (1.76)
I blame myself for the situation.	2.91 (1.82)

**Table 12: Survey section 3 items. Participants were asked to rate with 7-point Likert-scale (Never – Always) to the question: When you feel your browser is cluttered, how often would you react in the following ways?**

## D STUDY 2: SURVEY SECTION 4-6 GUIDELINE

### D.1 Section 4: Browsing experience perception

In the previous section, you answered questions about the clutter in your web browsing experience. How serious the problem do you see clutter in web browsing being for you?

- (1) How serious is the problem clutter during web browsing to you?  
(7-point Likert-scale: Not a problem - Serious problem)
- (2) How does cluttered browsing affect your daily life?  
\_\_\_\_\_
- (3) What are the situations where you experience clutter in web browsing?  
\_\_\_\_\_

### D.2 Section 5. Demographic and browser usage

In this the last section, we want to ask about your basic demographic information and your general browser usage.

1. **What is your gender? (please select the option that best applies)**
  - a. Male
  - b. Female
  - c. Nonbinary
  - d. Prefer to self-describe
  - e. Prefer not to answer
2. **How old are you?**
  - a. 18–24
  - b. 25–34
  - c. 35–44
  - d. 45–54
  - e. 55–64
  - f. 65–74
  - g. > 74
3. **In which country do you currently reside?**  
\_\_\_\_\_
4. **What is your occupation? (If you are a student, please specify your major?)**
  - a. \_\_\_\_\_
  - b. Prefer not to answer
5. **Your highest level of education (including current education):**
  - a. Less than a high school degree
  - b. High school degree or equivalent
  - c. Bachelor's degree
  - d. Master's degree
  - e. Doctorate or higher
  - f. Other: \_\_\_\_\_
6. **What operating system(s) do you use primarily for web browsing? (Choose all that apply)**
  - a. Mac OS
  - b. Windows
  - c. Linux
  - d. Others \_\_\_\_\_(please specify)
7. **What browser(s) do you use primarily? (Choose all that apply)**
  - a. Google Chrome
  - b. Microsoft Edge
  - c. Mozilla Firefox
  - d. Safari
  - e. Internet Explorer
  - f. Opera
  - g. DuckDuckGo
  - h. Others \_\_\_\_\_(please specify)
8. **On average, how many hours per day do you use the web browser on the computer?**
  - a. Less than 2 hours/day
  - b. 2–4 hours/day
  - c. 4–6 hours/day
  - d. 6–8 hours/day
  - e. 8–10 hours/day
  - f. More than 10 hours/day
9. **What are the tasks you usually use browser for?**  
\_\_\_\_\_
10. **How many tabs do you have open during web browsing on average?**
  - a. Less than 5
  - b. 5–10
  - c. 10–20
  - d. 20–30
  - e. 30–50
  - f. 50–100
  - g. More than 100
11. **How many browser windows do you have open during web browsing on average?**
  - a. 1–3
  - b. 3–5
  - c. 5–10
  - d. >10
12. **When you start a new web browsing session, you usually:**
  - a. Start with a fresh browser
  - b. Continue with a new tab following the web pages where I left
  - c. Start with a new browser window but leave the opened web pages behind
  - d. Other \_\_\_\_\_
13. **I usually use tabs**
  - a. As short-term bookmark
  - b. As task reminder
  - c. To open links in the background
  - d. To mark web pages that I frequently use
  - e. To compare results and go back and forth
  - f. To multitask
  - g. Others \_\_\_\_\_
14. **I usually store information I find online with:**
  - a. Tabs
  - b. Bookmarks
  - c. Download
  - d. Other notebook software
  - e. Physical notebook
  - f. Others \_\_\_\_\_
15. **My tabs usually stay in my browser for:**
  - a. Less than a day

- b. From a day to a week
  - c. From a week to a month
  - d. From a month to about half a year
  - e. More than half a year
16. **What are usually the web pages that stay open the longest?**
- 
17. **What browser native function(s) or extension(s) are you using now that help improve your browsing experience?**
- a. Browser built-in group function
  - b. OneTab
  - c. Toby
  - d. Tree style tab
  - e. Tab Suspender
  - f. Tabs Outliner
  - g. Workona
  - h. Tabby
  - i. Session Buddy
  - j. I am using other(s) \_\_\_\_ (please specify)
  - k. No, I am not using any of these
18. **What browser native feature(s) or extension(s) have you tried to improve the browsing experience but you do not use anymore?**
- a. Browser built-in group function
  - b. OneTab
  - c. Toby
  - d. Tree style tab
  - e. Tab Suspender
  - f. Tabs Outliner
  - g. Workona
  - h. Tabby
  - i. Session Buddy
  - j. I have used other(s) \_\_\_\_ (please specify)
  - k. No, I haven't used any of these
19. **Why did you stop using the tool(s)?**
- 
20. **Do you have any other comments on the surveyed topic?**
- 

## E INTERVIEW GUIDELINE

### NOTE:

- **This is the full interview guideline. This paper reports findings from the subset of the collected interview data.**
- **The second level (i.e., (a), (b), (c) etc.) are follow-up questions that were asked only if needed**

First of all, thanks for accepting the interview invitation. This study is conducted by ... research group, my name is...

The purpose of the study is to explore the factors that affect users' web browsing behavior / browsing experience. You will be asked to answer questions based on some pre-defined topics.

During our conversation, the audio will be recorded for the research purpose. It will take approximately 60 - 90 mins and you are free to interrupt or ask any questions at any time. If you feel any discomfort, please, let me know and we could pause or stop the interview. Please notice that it can sometimes be difficult to hear correctly what one is saying due to the remote situation. So please take this into account and articulate your answer as clearly as possible. Thank you!

We will cover the following topics: Your web browsing behavior, web search strategies, general working style, and personal views of life, emotions, and wellbeing.

Now we will begin the interview. (Start the recording)

### E.1 General browsing behavior

First, we would like to discuss your behavior and habits while browsing the internet. Please answer according to how you see things yourself.

1. **What is, or what are the browsers you usually use?**
  - a. Why did you choose the web browser(s) you are currently using?
  - b. Can you explain/define what a browser tab is (in your own words)? And also browser window? (Clarify the definition for the following discussion)
  - c. How many tabs do you usually have open? Does this number depend on any internal or external conditions? (For example, tasks you are performing, environment, state of mind, etc.)
2. **Do you have any strategies to use tabs or windows? For example, do you use browser windows or tabs to manage tasks or info you are working on?**
  - a. Do you use bookmarks, history functions, and back button? By these functions, we mean... When and How do you use them? For what tasks?
3. **When you are browsing online do you usually work on one thing at a time or several things at the same time?**
  - a. What tasks do you usually multitask? Can you give some examples? On what tasks do you usually focus one at a time?
  - b. How does working on multiple tasks simultaneously make you feel? (What are usually the conditions when you multitask: time pressure ...)
  - c. How does working on one thing at a time make you feel?

4. **When you need to go back to a previously opened browser window or a tab, how do you locate or find it?**
  - a. Have you ever felt lost or confused as you were using [your browser]? When, can you describe...? What did you do to try and overcome this feeling?
  - b. How do you recognize the tabs that you have opened? (How do you memorize where the tabs that you need are?)
  - c. What will you do if you want to search for something that you have opened before?
5. **Could you walk me through the steps you take when you perform a web search?**
  - a. Do you have any specific search strategies?
  - b. How would you start to search if you had to find information about some problem that you know nothing about?
  - c. How do you make queries (keywords, length, punctuation)?
6. **How do you decide if a tab is unnecessary? When do you close those unnecessary ones?**
  - a. How frequently do you clean up (close unnecessary tabs and also organize them in a more clean way) your tabs?
  - b. What do you do with the open tabs at the end of the day? (Close them all, check one by one, leave it ...)
  - c. Are there usually tabs that you open and do not check during the day / Do you usually have unvisited tabs at the end of the day?
7. **How would you rate yourself on web literacy/web skills?**  
As you have seen before in the pre-survey, here we use the web literacy map [3] to help understand your skill set. (Show the map and explain, make sure the map is shown all the time during questions.) You can ask if you are unclear about the definitions. So, according to this map, How would you rate your skills regarding web reading/writing/participating skills from 1-10? Why? Can you give an example?
  - a. Have you studied ways to make your browsing skills better (e.g., using tools)?
  - b. Do you use shortcuts to manage tabs? (For example, close or open a new tab)
  - c. What functions do you use to interact with tabs? For examples, close, open, pin, dragging, mute and so on. Do you know more functions which you don't use? Why?
8. **What challenges have you met during web browsing?**
  - a. Do the challenges related to navigation bother you?
  - b. How do you understand web clutter?
  - c. Is web clutter an issue for you? Why?
  - d. Do you face the same with a mobile device?
9. **What type of tools do you think would help you to manage your tabs?**
  - a. Do you know any assistant tool which helps manage your browser windows or tabs?
  - b. Do you think an automatic assistant to help you manage tabs would be useful?
10. **How do you manage your digital environment?**
  - a. How do you distinguish tabs of working content from your personal ones?
  - b. How do you manage your physical work environment? (e.g., close the door, keep the desk clean?) ?
  - c. Do you prefer individual work or working together?

11. **Do you often experience interruptions during web browsing? What are they?**
  - a. How often do you take a break during web browsing?
  - b. How long does it usually take for you to resume back to your work?

The questions above are all about web browsing behavior, now I would suggest taking a 5 min break . We have some questions left and the following questions will be about your personal views from a more general perspective. In the meanwhile, could you take 1 min to fill in the form I shared in our chat about your personal traits [28]? Thanks a lot! And see you at...

## E.2 Personal traits, motives, and engagement

...

Ok, I hope you've relaxed a bit. Next, for the second part of this study, we would like to discuss with you your view of yourself from a more general perspective. Please answer based on your own perception.

12. **What is your field of expertise?**
  - a. Does your profession influence your browsing tasks?
13. **What type of tasks do you usually do at work?**
  - a. Is there time pressure for your work?
  - b. Can you describe your daily routine at work? How do you plan your work tasks?
  - c. Do you like your job?
14. **How confident are you that you can get tasks done while web browsing?**
  - a. What type of tasks make you feel confident? What unconfident?
15. **What is your aspiration? / What is important to you in your life?**
  - a. How do you see your browsing behavior in relation to that aspiration?
16. **Do your feelings or emotions change during web browsing?**
  - a. How often do you feel excited, stressed, or such strong emotions during browsing? Under what situations?
  - b. How do you feel when you have clutter?
  - c. Have you ever feel overwhelmed because of the amount of open tabs?
17. **How do you understand digital wellbeing?**
  - a. Do you think web browsing is influencing your wellbeing? How?
  - b. Do you think your relationship with digital technology is healthy? Why?

Thanks for answering all the questions we have for today, we will deliver the gift card to your email account. Once the gift card is sent, your email address will be deleted to protect your privacy. Let me know if you have any questions and again thanks a lot for your time and interest!

## F DATA FOR GRAPHS

Number of tabs	Number of responses	Percentage of responses
<5	85	21.2%
5-10	211	52.8%
10-20	65	16.2%
20-30	23	5.7%
30-50	9	2.3%
50-100	7	1.8%
>100	0	0%

**Table 13: Data for Figure 2: Number of open tabs during web browsing.**

Number of windows	Number of responses	Percentage of responses
1-3	318	79.5%
3-5	52	13.0%
5-10	22	5.5%
>10	8	2.0%

**Table 14: Data for Figure 3: Number of open windows during web browsing.**

Seriousness score	Number of responses	Percentage of responses
1	72	18.0%
2	109	27.25%
3	53	13.25%
4	67	16.75%
5	71	17.75%
6	20	5%
7	8	2%

**Table 15: Data for Figure 4: Users' perception on the seriousness of browsing clutter.**

Group	Theme	Code	Frequency of code
People who rate browsing clutter as a mild problem (Likert-scale $\leq 4$ : 90 responses in total)	Challenges during Clutter	Decreasing work efficiency	31
		Distraction	14
	Negative Emotion	Anxious	2
		Annoyed	9
		Overwhelmed	4
		Confused	1
		Frustrated	4
		Stressed	12
People who rate browsing clutter as a serious problem (Likert-scale $> 4$ : 93 responses in total)	Challenges during Clutter	Decreasing work efficiency	23
		Distraction	14
		Computer crash	5
		Hard to navigate information	13
	Negative Emotion	Anxious	3
		Annoyed	9
		Feel chaotic	5
		Overwhelmed	2
		Demotivated	2
		Frustrated	4
		Stressed	9

**Table 16:** Data for Figure 5: The frequencies of codes to question "how browsing clutter affects users' daily life" grouped by themes.