
Special Issue Nr. 35:

Media literacy as intergenerational project: skills, norms, and mediation

Edited by Claudia Riesmeyer, Thorsten Naab,
Anne-Linda Camerini, Ruth Festl, and Christine Dallmann

You do not have to be quick to be information literate!

Comparing Search Strategies between Younger and Older Adults

Mareike Wieland

Abstract

When comparing how younger and older internet users search for information, young people often impress by operating Web applications quickly and effortlessly. However, information literacy is not only a question of speed; it is highly dependent on cognitive abilities such as monitoring and regulating the search process. To avoid a general deficiency perspective on older Web users, this study goes beyond the results of Web searching to focus on individual approaches to information problem solving. We conducted ten guided interviews based on two different search tasks the participants (aged 16-77) worked on while thinking aloud. Applying a qualitative content analysis approach, we find that younger participants (aged 16-26) use more productive strategies to collect information, but observed no age-related differences in completing a complex task. The strong task dependence of our results underlines the necessity of teaching regulative search techniques that are suitable for solving unstructured everyday problems in order to ensure that all users can make the most of today's rich but unstructured information environment.

Informationskompetenz ist keine Frage der Schnelligkeit. Analyse kognitiver Strategien bei der Websuche im Altersvergleich

Zusammenfassung

Jüngere Internetnutzer beeindrucken oft durch ihren schnellen und mühelosen Umgang mit Webanwendungen. Informationskompetenz ist jedoch nicht alleine eine Frage der Geschwindigkeit, sondern von kognitiven Fähigkeiten abhängig, die dem Überwachen des Suchprozesses dienen. Um eine vorschnelle Defizitperspektive auf ältere Webnutzer zu vermeiden, bezieht die vorliegende Studie die individuellen Ansätze zum Lösen von Informationsproblemen mit Hilfe des Webs in die Erfassung der Informationskompetenz mit ein. Die Datenbasis bilden zehn leitfadengestützte Interviews mit Teilnehmerinnen und Teilnehmern zwischen 16 und 77 Jahren, in die jeweils zwei praktische Recherchephasen am Computer integriert waren. Während dieser Recherchen kommentierten die Teilneh-

menden ihr Vorgehen (Methode des Lauten Denkens). Eine inhaltsanalytische Auswertung ergibt, dass die Jüngeren spezifische Strategien der Websuche entwickelt haben, davon aber nur im Kontext eines einfachen Informationsproblems profitieren. Die starke Aufgabenabhängigkeit unserer Ergebnisse unterstreicht die Notwendigkeit, regulative Suchtechniken zu vermitteln, die auch für unstrukturierte Alltagsprobleme geeignet sind. So wird gewährleistet, dass sich die vielfältige, aber unstrukturierte Informationsumgebung des Webs selbstbestimmt zunutze gemacht werden kann.

Information Literacy in the Current Media Environment

Today's media environment is characterized by an overabundance of information. The World Wide Web has a decentralized structure: relevant information has to be localized in an unmanageable amount of resources (van Dijk and van Deursen 2014). The greatest challenges associated with searching for information on the Web are thus (1) evaluating new information in a results-oriented way and (2) integrating these findings into the next search. From a process perspective, information literacy therefore represents a problem-solving ability, in which regulation of the search progress decisively determines whether (and to what end) the searcher can reach his or her objectives (Brand-Gruwel and Stadtler 2011). Therefore, in the current omnipresent, dynamic and dispersed information environment, information literacy should not be considered only a normatively founded, list-like standard (Shenton and Hay-Gibson 2011); it should instead be conceptualized as a regulative competence suitable for everyday use that enables people to benefit from the wealth of available information. This study therefore focuses on how effectively people can shape their search processes in a self-reliant and goal-oriented way.

Media and Information Literacy

Media literacy comprises the dimensions of knowledge, evaluation and action (Schorb 2005); knowledge is a necessary, but not sufficient, condition (Riesmeyer, Pfaff-Rüdiger, and Kümpel 2016). The crucial question of how individuals translate knowledge into action can be addressed in different ways. We assume that media literacy manifests itself in the course of searching. This suggests the need to use a process perspective to reconstruct this translation into knowledge on a micro level (similar to Wirth et al. 2009; Schweiger 2010). Furthermore, it points to the necessity to develop a cognitive media literacy theory (Potter 2004): Conceptualizing media literacy as static knowledge often overlooks the considerable influence that information itself can have on searching. Information here refers to anything one encounters that is perceived as useful – regardless of whether it is complete or factually accurate. The influence of the information itself points to the evolving nature of Web

searching as exemplified in Bates' (1989) «berrypicking model». We hence define information literacy rather broadly as the ability to access, evaluate and use information (ALA 1989). Information-literate users are able to solve an information problem using the Web, which means they can use the unstructured Web environment in a goal-oriented, effective way. For this purpose, they have to develop meta-cognitive, top-down oriented skills like a strong process orientation (Brand-Gruwel et al. 2009), but they should also be able to benefit flexibly from information they encounter inadvertently. Although rather similar at first glance, information literacy differs from common notions of media literacy as it focuses on the act of searching (Bruce 2016). This narrow definition enables us to focus more on interactions with the information system – to analyze information literacy not as solely technical expertise, but as the interplay between cognitions and actions within a given technical infrastructure.

Search Strategies

To analyze information literacy from a process perspective, it is necessary to consider the evolving, dynamic aspects of Web searching. Bates' (1979) definition of «strategies» conceptualizes their overarching function in terms of a superordinate plan while also considering smaller, visible units of action – the «tactics» more aligned with short-term goals. Keeping this differentiation in mind, previous studies often referred to «search strategies» as research objects, but still analyzed them as a function of single actions. Only a small number of studies have investigated the cognitive dimensions of search strategies (Tsai 2009). This approach reduces strategies that involve more than single actions to simple decisions (e.g. using a search engine vs. entering an URL). Thus, little attention is paid to how these single steps integrate into the overall search process. In other words, applying the concept of «tactics» and «strategies» enables us to analyze actions with regard to their overarching function. Doing so can shed light on information literacy as a goal-oriented, processual, and regulative ability.

The Younger, the More Literate in Searching the Web?

Early studies on the Web as an information medium compared the search skills of different age groups and generally found that younger users perform better (for an overview, see Laberge and Scialfa 2005). Laberge and Scialfa (2005) found, for example, that older people take longer to find relevant information, which they attribute to age-related differences in memory performance, processing speed and spatial perception. However, this age effect does not remain significant if topic-specific knowledge and Web experience are included as control variables.

The assumption that older Internet users are less capable (Hargittai 2010) persists despite contradictory findings. Van Deursen, van Dijk, and Peters (2011), for example, demonstrate that although higher age and technical-related skills are negatively associated, they find a positive correlation between age and content-related Internet skills (van Deursen, van Dijk, and Peters 2011). Nevertheless, age has a negative net effect on Internet skills: technical skills outweigh content-related skills. By contrast, open analyses of individual search behavior clearly reveal differences depending on the age group, but these differences do not always manifest as deficits. For example, older people are more structured in their search for information, but this involves spending more time selecting suitable search terms and evaluating search engine results pages (SERP). Younger people are more likely to switch between different sites, are more impulsive in their selection, and make more mistakes (Youmans et al. 2013). For complex tasks, older people may even have an advantage because they can refer to their crystallized knowledge (Karanam and van Oostendorp 2016).

Assessing information literacy by age group should therefore not be restricted to technology-related skills. There is reason to assume that an open, unprejudiced analysis of individual search behavior can generate new insights about factors of successful searching independent of age, as well as deficits in the actions of younger users. This approach to studying search behavior can contribute to intergenerational exchanges on good searching practices. Leaving some restrictions that are indeed caused by physical age aside, such as decreasing vision (Dinet and Vivi 2009), factors other than Internet experience can cause age-based differences in search behavior.

Research Interest

Looking at younger adults operating Web applications effortlessly, it is tempting to view «digital natives» as generally superior to older users (Hargittai 2010). Yet as mentioned above, recent findings call this assumption into question. Van Deursen, van Dijk, and Peters (2011), for example, show that older people are more experienced at selecting, evaluating and strategically using information. People also develop mental representations of the Web, which in turn influence their search strategies (Youmans et al. 2013). For example, older users seem to be less digitally literate when using search engines. But this is not due to general deficiencies; instead, it is because their preferred way of interacting with the Web, and thus their mental model, does not fit the technical design of the Internet (Youmans et al. 2013). Since prior studies have often overlooked the complex cognitive demands necessary to conduct a proper Web search (Brand-Gruwel and Stadler 2011), this paper compares the cognitive strategies that younger and older Internet users employ during active and intentional information seeking (RQ1) by reconstructing their overall approaches to Web searching (RQ2).

Study Design

As information search strategies are highly dependent on personal and situational characteristics, we expect our analysis of the Web search process to reveal a large variety that a standardized design can hardly capture. Therefore, we developed a qualitative, process-oriented approach to reconstructing the individual differences to searching (Strauss and Corbin 2010). The method uses semi-standardized interviews, during which the participants solved two different Internet-based tasks on a desktop computer while thinking aloud (Fig. 1).

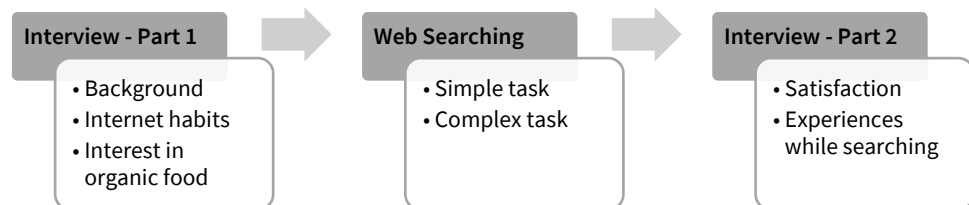


Fig. 1.: Study Design.

Capturing Web Searching

To address the criticism that information literacy is often analyzed on the level of physical interactions only (Litt 2013), we based our study on data triangulation (Flick 2011). Combining screen activity and verbal expressions allows us to analyze the same process from different perspectives (actions and cognitions). We used a screen capturing software Camtasia Studio to save all interactions with the computer. To capture cognitions, we invited the participants to verbalize everything they were thinking, perceiving, and feeling while searching the Web, which were audio recorded.

Since observational data alone do not reveal user intention (Meyen 2011), thinking aloud is a common technique to complement screen data in the context of media usage (Erlhofer 2007). Yet there are two main limitations of this approach. First, it is nearly impossible to speak aloud everything that comes to mind, as an individual may be thinking of more than one thing at a time, and thoughts may be fleeting before they are captured (Weidle and Wagner 1994). Second, it is demanding to search the Web and reflect upon it at the same time. Participants might stop speaking aloud or even worse, their reflection on their search behavior might influence their actions (reactivity). We addressed these potential problems by reminding our participants to speak aloud, but only when they were silent. For example, interviewers asked «um-humm?» or «What are you doing now?» (Olmsted-Hawala et al. 2010). The interviewers thus avoided asking about reasons for taking certain actions during Web searching, and tried to evoke level-1 and level-2 verbalizations only (Ericsson and Simon 1993). However, they took notes to ask for explanations in the subsequent

interviews. We were also able to contextualize the verbal protocols by matching them with the screen data. Additionally, the entrance interviews were used to create an open, non-judgmental environment with the aim of reducing social desirability bias. Despite these concerns, thinking aloud is the only way to reveal at least some aspects of cognition.

Search Tasks as Stimuli

User motivation and the characteristics of a given task have a profound influence on Web searching (Erlhofer 2007). As it is nearly impossible to generate the necessary «real» information in an artificial lab setting (Meyen 2011), the search tasks should at least be generally interesting to the users in order to encourage a minimum level of involvement. We therefore decided to ensure a general interest in the topic, and aligned our sampling strategy to this main criterion. The search tasks (see Table 1) are both related to organic nutrition: a simple «collecting and evaluating» task (Wirth et al. 2016) and a complex task simulating a very specific, abstract information need that cannot be fulfilled by relying on one or two sources (Erlhofer 2007).

Task	
Simple	Read up on the advantages of organic food in terms of environmental issues and save your results.
Complex	The production of food causes CO ₂ emissions depending on the method of production. It makes a difference whether food is produced in conventional or organic farming. Taking Germany as an example, there is a certain per capita consumption of potatoes per year that has to be cultivated. Imagine, we are in the year 2020 : How much CO₂ emissions (in grams) could be saved in Germany if the quantity of potatoes Germans consume per year were cultivated from now on exclusively using organic farming?

Tab. 1.: Wording of Search Tasks.

The simple task is designed to represent a more everyday information need. For everyday purposes, it seems sufficient to get a basic overview of a topic and it is less problematic if this overview builds upon vague or inaccurate information. The complex task involves determining and combining detailed aspects. This requires a high degree of cognitive reflection, either in order to remember sources that provide such detailed information or to sufficiently specify a search query to locate the information. This task is challenging and not typical of everyday searching. However, as it requires a significant amount of cognitive reflection, we designed this task to investigate how pre-planned and structured people approach searching for specific information using the Web.

Sampling

We used a qualitative sampling plan to generate a sample with maximal variance in age and homogeneity in possible influential factors (formal education, gender, former Internet experience, topical interest) (Kelle and Kluge 2010). Subjects were recruited through personal and professional connections, an advertisement in a social health insurance member’s journal and via a special educational facility for elderly people in Dresden. In total, we recruited ten participants between 16 and 77 years. Data collection took place between May and July 2014 in the premises of TU Dresden.

Data Analysis

Data Preparation

The interviews, including the thinking aloud parts, were transcribed using standard spelling, not correcting for filler words or short pauses. The screen interactions, captured as video data, were then put into writing. Using the MAXQDA video coding function, we first structured the video data by defining search phases derived from the literature. Second, we verbalized all visible actions. Based on the search phase structure, we were able to match the thinking aloud protocols with the verbalized actions. The resulting «flow charts» for each search process function as our main source for data analysis (see Table 2 for an example). Our final data base comprises ten transcribed interviews and 18 corresponding flow charts (eight based on the simple, ten based on the complex task due to two faulty data files).

Step	Time (in sec.)	Site	Parameters	Thinking Aloud
Search	33	Google	Query: «per-capita potato consumption»	So, I’m just googling potatoes. That is what I need. Germany.
SERP	07	Google SERP	Selects 1st result: «per-capita consumption of potatoes decreases in Germany»	... decreasing. Aha!
Content	77	wochenblatt.agrarheute.com/	Bavarian Agricultural Weekly Paper - «per-capita consumption of potatoes decreases in Germany»	[...] Now I’d like to have 7 kilos per, 11, let’s say 10, in 2010 there were 57g. Aha. Good quality as the reason. I’m still on this page, it’s named agrar.com. This is where I’ve found per-capita consumption. There is written – yes, I’ll take it.

Tab. 2.: Exemplary «Flow Chart» of Web Searching.

Qualitative Content Analysis

Based on these flow charts, we conducted a qualitative content analysis (Kuckartz 2012). The resulting coding system captures cognitive processes during Web searching as a function of screen activities: The coding system is mainly based on cognitions during Web searching, but also relies on behavioral data when indicated. For example, the evaluative category «level of reflection when entering a search term» is assigned to the level «no reflection» when the participant does not comment on the formulation of a search term that is thus only visible in terms of behavioral data. In a first cycle of coding, we applied eight deductively developed main categories. In a second cycle, we inductively differentiated these categories into subcategories by retrieving the occurrences of codes aligned with the respective main category. Each time a new subcategory was added, we reviewed all the text passages of the corresponding main category again. Seven subcategories revealed an evaluative character, leading to the formulation of nominal and ordinal code specifications (Kuckartz 2012). The final coding system was comprised of nine main categories and 26 subcategories.

Findings

Participants' General Characteristics

According to our sampling strategy, the participants varied in age – ranging from two 16-year-old female high school students to two retired men over 70. All participants had above-average levels of formal education, and the older subjects all had a professional background related to technology. The older participants had less previous Internet usage, but they still worked with computers and used the Web for different purposes (see Appendix for a summary of the main sample characteristics). We refer to participants based on their gender and age: for example, «M57» refers to a male participant who is 57 years old.

Individual Approaches to Active and Intentional Web Searching (RQ1)

As stated in the theoretical introduction, search strategies represent the general approach to searching the Web. These strategies rely on smaller, physical and cognitive steps known as «tactics». We first present some of these tactics, using the structure of Web searching phases, to illustrate how participants approached this task.

Search Engine Use

Every search process entails the use of at least one search engine (e.g. Google or Ecosia) – but without any explicit cognitive reflection. F60 stated: «Most of the time, I'll just enter what comes to mind. For me it is not mandatory [to think about it in advance]» (F60). The majority of search queries consisted of content-bearing terms like «organic food», «CO₂ emissions» or «potatoes». The search inputs differed systematically between the two tasks, as the average number of words per search query was higher for the complex task. The reason is not the use of more keywords but of sentence-like constructions similar to natural language: «saving CO₂ with organic food» (F16-2); «CO₂ emissions in the production of food» (F26); «CO₂ consumption in the cultivation of potatoes» (F65). This approach intends to generate results that precisely match the information problem. F16-1 stated that she always falls back on whole questions if she has «no idea of the topic» (F16-1). F16-2 hoped that her question had already been asked (F16-2) and that the exact answer could be found somewhere on the Web: «I hope then for a concrete result» (F16-2). Instead of reflecting on how to link search terms using Boolean operators, most participants learned that popular search engines also provide answers to questions formulated in natural language. In contrast, M77 used the «advanced Google search» option, searching for pages that «contain all these words»: «organic food, benefits, environment».

In the course of their searches, participants adapt and reformulate their queries. For the simple task, some tried to narrow their initial search query to increase the relevance of the results: «Organic food» > «advantages of organic food» (F26; similar F16-2, M21). M53, F60 («organic food»), and M77 («organic food, benefits, environment») did not change their initial search query during the process; they spent more time re-evaluating the first SERP instead of generating a new list. In the complex task, participants tended to reformulate their search queries (F16-1; F16-2; M21; M53; M57; M77), which is not surprising given the task's different thematic dimensions.

SERP Evaluation

When retrieving the SERP for the first time, participants selected the top result. F16-2 perceived the other links to be «additional information», and F60 stated: «basically, I look at the first one [...] Almost always». However, returning to the SERP in the course of searching, participants started considering the results further down and reflected on them with regard to their potential information: «I leave out the next one, because [...] this only refers [...] to taste. That's why I want to select the link below, with the environmentally friendly and healthy [aspects]» (F16-2). M77 proceeded systematically but slowly, hovering the mouse pointer over each entry, reading the title and meta-description aloud before moving onto the next result.

During the SERP evaluation, the evaluative code «process orientation» covers statements in which a participant verbally relates his or her individual action to the

entire search process, revealing different degrees of reflection. While F60 broadly spoke of «looking further», M53 explicated, «I have to get some information about [CO₂ emissions] first». He also analyzed where the search currently threatened to fail and, like F26, excluded results that did not correspond to the information goal. M77 expressed concerns about «getting distracted» and losing sight of the target. Therefore, he recalled the task («What is my task? Record your results») and carefully evaluated the search result: «it fulfils everything I have written down».

Content Site Reception

After opening a page, the participants had to decide which part of the website they wanted to look at more closely (tactics for task-oriented reception). The evaluative coding scheme differentiates between rationales under explicit task reference vs. those based on more general criteria. A task-oriented reception assesses the fit of the content to the task: «That's pretty good, the page [because] there is a differentiation between conventional and ecological» (M21). Sometimes, the assessment was more implicit: «quantity --- emission --- ahhhh haaa! Over 200 grams CO₂ per kilogram» (M74). On the contrary, selection decisions without a task orientation referred more to presentation features like a Web page that looks «relatively well arranged» (F16-2). Trying to extract relevant content (tactics for information exploitation), some participants summarized the text either verbatim or very closely (M21, M53, F65). M53 demonstrated a problem-solving strategy based on previous knowledge («Good, then I go ahead with [extrapolating from] one person ... say you multiply it by 85 million»). F65 made an assumption about how to interpret the found information in order to be able to make further search steps (F65). While extracting information from a content page, some participants also discovered that they did not understand certain aspects of the task: «What is actually – why should I actually imagine it is the year 2021?» (F26).

What Do Tactics Reveal So Far?

Participants developed very different ways of searching for information on the Web. In summary, we found that the use of a search engine initially involves relatively low cognitive reflection: Called the «strategy of least effort», the participants put little thought into formulating a suitable search query and simply chose the first result link. If the first search was not successful, participants then put in more mental effort to develop their query; here too the evaluation of the results is reflected rather than the initial query adapted («strategy of focused SERP»). These tactics reveal that participants increased their cognitive effort over the course of a search, so some only realized that they did not know what to look for after the initial results were displayed. The next section explains the function of these tactics for the entire search process.

Successful Web Searching and the Role of Age (RQ2)

The identified tactics make it possible to abstract the findings of single actions to general Web search strategies. This section focuses on our main findings: (a) a strategy specific to younger users, (b) the role of own deliberations while searching as part of the complex task and (c) the role of speed.

Using the Hyperlink Structure

All participants (with the exception of M77) started the simple task by directly opening a search engine and immediately entering a search term. They seldom adapted the query during their search. Thus, we first distinguish between search-engine-based strategies and strategies related to interlinked website visits. Participants using the latter approach wandered through the Web by following related, hyperlinked articles, moving between content pages without (re)using a search engine. The information environment guided the search process, a behavior often labeled «browsing» (Kellar, Watters, and Shepherd 2007).

Although browsing does not require any initial cognitive reflection, this strategy is still considered to be the «most difficult variant», as encountering relevant content is perceived to occur «only with a lot of luck» (F26). The interviews reveal that attitudes towards «browsing» differ strongly between those under 30 and those aged 57–77. Younger users consciously allow themselves to be guided from one page to another, especially when they address unspecific information needs. M21 and F26 reported that they prefer to start using «YouTube» or «Wikipedia» in order to «get a broad overview» and «somehow an idea of [the topic]». Both 16 years old reported using multi-thematic websites to begin their searches. Older participants, by contrast, rejected general browsing. They reported avoiding interlinked websites because they are «distracting» and lead to a «fragmented search» (M57, F60, M77). M77 also complained about «too many links» and expressed fear that by following these links, «you would then move in circles».

How does the use of interlinked website visits relate to solving an information task? Although F26 perceived it as difficult, she was still somewhat successful at collecting information in this undirected way – as were the other participants under age 30. By contrast, F60 demonstrated an unsuccessful trial of browsing even though she reported that she usually avoided this approach. Since she justified following a related article with task-unrelated criteria, she lost sight of the actual search goal (that is, collecting information about the advantages of organic food): «Healthy nutrition in the nursing home ... since our mother-in-law was in a nursing home that is also a question» (F60).

Considering the tactics presented above, we conclude that younger users are more successful at browsing because they developed a goal-oriented version of it – the «strategy of heading». We define this as a top-down, goal-driven strategy mainly

based on the tactic of «task-oriented reception». This strategy involves repeatedly reflecting on the task when extracting information, immediately checking the usefulness of the information found, and including the new input into the evolving search. This strategy enables the searcher not only to benefit from the wealth of information on the Web, but also to manage it in a time- and resource-efficient manner. Assuming that interlinked websites provide further relevant information on the advantages of organic food, they did not have to return to a SERP or formulate a new search query, which would require more time and cognitive resources than simply following suggested links. Only young people in our sample displayed the disposition to «just browse» through an unstructured, sometimes overwhelming information environment and to work pragmatically with whatever one encounters – thus to use the Web for «berry picking».

Using One's Own Capacities

While searching for the simple task mostly involved the immediate use of a search engine, a contrary approach to the «strategy of heading» was used to complete the complex task. With the exception of M21 and M57, the participants initially took time to think about the complex search. In these phases of no physical interactions (thinking without acting), M21, M53, and F65 summarized the task in their own words. Others explicitly broke it down into initial and target parameters, and concluded that «for this question [I] have to draw a model first» (M53; similar M21, M77). M53 also anticipated the estimated time required. M77 tried to remember sources and took notes on the necessary search steps on a sheet of paper. Based on these observations, some participants obviously applied a strategy of «initial planning», that is pre-planning and structuring the search by reflecting on the task requirements and anticipating the course of the search required to perform the complex task.

Phases without physically interacting with the computer not only occur at the beginning, but also at various points during the search. We find that these interruptions are associated with the tactics «summarizing», «using previous knowledge» and «formulating intermediate results», which help regulate the search process («strategy of refocusing»). Yet, some participants did not explicitly elaborate on the content at all (F16-2, M57, F60, and M74). Similar to the simple task, F26 again applied a strategy of using interlinked websites (in the undirected browsing version), but here this approach was revealed to be cumbersome: She used excessive mouse movements to search through various sub-pages. When asked by the interviewer what she hopes to find, she replied: «I don't know» (F26). Not elaborating on the content and/or an unguided search process are obviously related to being unsuccessful, whereas initial planning or refocusing – and thus using one's own cognitive capacities – are the most important ingredients of success for the complex task.

Slow(er), but self-reliant

In line with previous findings, this study reveals a difference in processing speed depending on age: The simple task requires discovering information in distributed structures; finding more than one environmental advantage is essential. Thus, time constraints influenced the simple more than the complex task. By setting the processing time for each participant in relation to his or her total number of search phases, we are able to include a time-related measure in our analysis. On average, younger users (< 30 years) spent 55 seconds per search phase for the simple task (compared to 1:14 minutes for older users). For the complex task, younger participants spent an average of 36 seconds within a single search phase, while older participants spent 59 seconds. Younger users made more frequent and faster changes between search phases. This gives them an advantage in processing a task that requires collecting information from different sources simply due to their higher processing speed (a result similar to that found by Karanam and van Oostendorp 2016). The three elders (> 60) were aware of their slower progress, but did not see this as a problem: «I was [...] a bit slow (...), that doesn't bother me» (F60: 143) or: «Thank God it's not time that matters here» (M74). However, M77 felt «a certain pressure of time, stress that caused me to collect first». In contrast, M53 and M57 did not regard time as a critical factor.

Thus, we cannot conclude that faster surfing automatically translates into greater literacy in Web searching. We found that immediately «diving into» the wealth of information is associated with basing the progress of the search on the guidance of the external resource – the «Web». In combination with meta-regulatory skills, the aforementioned «heading strategy» can emerge out of this approach. Without regulation, however, it can also cause the user to lose sight of the search goal or to be satisfied with the «first-best» solution. Even more important, there are questions that are too specific to find a whole and concrete answer in the Web. Cautiously interpreting our data in terms of age, older participants might tend to approach the Web more as an external knowledge repository that does not provide solutions, but helps them find the right information to solve the problem (M53, F60, M77). Some of the younger users, however, expect the Web to answer the question (F16-1, F16-2, F26). This tendency might become more prevalent as more and more platforms arise that pre-select, filter and recommend content to users.

Discussion and Conclusions

The Role of Age

Although searching the Web varies greatly between individuals, we used the analytical concept of tactics and strategies to identify similarities in information problem-solving using the Web. For a simple information collection task, using interlinked websites by applying a «strategy of heading» – a goal-oriented version of «just browsing» – is useful. This strategy was only used by younger participants (< 30); older subjects (53–77 years) tended to have concerns about what they regarded as random surfing (although some of them did «browse» as well). The simple task benefited from performing more search steps in a short amount of time, which gave younger participants an advantage. For the complex task, which involved locating specific information, there were no major differences in performance based on age. This task benefits most from pre-planning and interrupting the search to rely on previous knowledge or to elaborate on the information found – a strategy that some of the older participants (F65, M77) tended to use, while some younger users (F16-1, F16-2, F26) relied more on the results offered by the search engine. In our view, this indicates different perceptions of the value of technical systems like «the Web» as an external knowledge repository among people of different ages; they differ in their willingness to delegate information problems to the guidance of a technical authority. By this, we do not mean to imply that age is a direct influencing factor of searching behavior. However, age might still function as an indicator for these dispositions, leading to the development and application of different strategies, which might in turn affect search success. We therefore consider the individual's willingness to delegate the task of «cognitive» reflection to the Web to be the underlying determinant. People's attitude to using the Web might be as important as their cognitive or technical abilities in determining their level of information literacy.

Methodological Reflections

As observing media usage in a naturalistic environment is costly and nearly impossible for pragmatic reasons (Meyen 2011), we initiated the usage artificially by assigning tasks to participants. In addition to the limited external validity of this approach, it might also be associated with a fear of failure for the participants (Meyen 2011). However, most of the participants reported that the study setting inspired their ambitions. Furthermore, the interviews revealed that they took searching for the information seriously, although they perceived the tasks to be artificial. Internal validity is hence probably sufficiently fulfilled, but transferring the findings to other tasks is subject to reservation.

Another limitation that is not easy to resolve is how to investigate potential age effects without generating them by design. We addressed this concern by first deriving the tactics on an individual level, independent of age. We then investigated similarities between persons, resulting in indications of differences between those under 30 and those aged 53–77.

By focusing on other facets of Web searching than the three arguments presented above, different groups of comparison might have emerged. For example, there were similarities in the way M21, M53 and M77 structured their thinking that we could not elaborate on here due to limited space. In order to compare approaches to Web searching between different people, future studies should systematically collect media biographies instead of using just their age, and plan the analysis accordingly.

Implications for Information Literacy Research and Teaching

The definition of information literacy applied in this study originates from information behavior research; it has thus far received little attention within media pedagogy. However, this study demonstrated that it is worthwhile to consider a navigation and process perspective on information literacy, and to focus more on the interplay of cognitions and the information system's characteristics. Since search success is highly dependent on cognitive reflection, information literacy manifests itself in the process of searching. Although we do not question the value of formulating media literacy principles in the sense of an aspiring standard in general, two main aspects should be considered in the future: (1) How can a transfer of these ideals to the dynamic and fast Web environment succeed? (2) How can we break down the aspiring information literacy standards to a level appropriate for everyday problems?

The identified «strategy of heading» could be such a starting point for teaching how to move through (and profit from) an unstructured but potentially rich information environment. This strategy could also stimulate an explicit reflection on the value of self-reliance in Web searching, and in turn address the risks that can arise from delegating informational tasks to recommender systems without conscious reflection. Either way, the aim will be to make some (presumably younger) people more aware of the act of using the Web, while others (presumably older) should be encouraged to dare to «just browse». An intergenerational exchange on how different people approach Web searching (e.g. using the concept of mental models) might increase awareness of each other's skills as well as one's own shortcomings. Based on our findings, information literacy should above all teach meta-regulative skills that make it possible to assess the requirements of an information problem and to use one's own reflections as well as the Web's wealth of unstructured information.

Further Research

Further research should try to reconstruct the mental models of Web searching in the sense of active vs. passive guidance through an information environment using a broader sample. By including media biographies, possible reasons for this behavior might emerge as well as more sophisticated grouping variables than «age». Thus, future studies should define «age» as an indicator for mediating concepts like mental models, so that age-related characteristics of Web searching are taken into account but do not obscure characteristics that are independent of age.

References

- American Library Association. 1989. *Presidential Committee on Information Literacy: Final Report*. Accessed December 07, 2018. <http://www.ala.org/acrl/publications/whitepapers/presidential>.
- Bates, Marcia J. 1979. «Information Search Tactics.» *Journal of the American Society for Information Science* 30 (4): 205–14.
- Bates, Marcia J. 1989. «The Design of Browsing and Berrypicking Techniques for the Online Search Interface.» *Online Review* 13 (5): 407–24. <https://doi.org/10.1108/eb024320>.
- Brand-Gruwel, Saskia, Iwan Wopereis, and Amber Walraven. 2009. «A Descriptive Model of Information Problem Solving While Using Internet.» *Computers & Education* 53 (4): 1207–17. <https://doi.org/10.1016/j.compedu.2009.06.004>.
- Brand-Gruwel, Saskia, and Marc Stadtler. 2011. «Solving Information-Based Problems: Evaluating Sources and Information.» *Learning and Instruction* 21 (2): 175–79. <https://doi.org/10.1016/j.learninstruc.2010.02.008>.
- Bruce, Christine. 2016. «Information Literacy Research: Dimensions of the Emerging Collective Consciousness.» *Australian Academic & Research Libraries* 47 (4): 220–38. <https://doi.org/10.1080/00048623.2016.1253423>.
- Dinet, Jerome, and Robin Vivi. 2009. «Elderly People as Web Seekers: Needs, Strategies and Difficulties.» In *Human-Computer Interaction*, edited by Inaki Maurtua: InTech.
- Ericsson, Anders, and Herbert A. Simon. 1993. *Protocol Analysis: Verbal Reports as Data*. Rev. ed. Cambridge, MA: MIT Press.
- Erlhofer, Sebastian. 2007. *Informationssuche im World Wide Web: Taktiken und Strategien bei der Nutzung von Suchmaschinen*. Berlin: Wvb, Wiss. Verl.
- Flick, Uwe. 2011. *Triangulation*. Wiesbaden: VS Verlag für Sozialwissenschaften.
- Hargittai, Eszter. 2010. «Digital Na(t)ives? Variation in Internet Skills and Uses among Members of the 'Net Generation'.» *Sociological Inquiry* 80 (1): 92–113. <https://doi.org/10.1111/j.1475-682X.2009.00317.x>.

- Karanam, Saraschandra, and Herre van Oostendorp. 2016. «Age-related Differences in the Content of Search Queries when Reformulating.» In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16*, edited by Jofish Kaye, Allison Druin, Cliff Lampe, Dan Morris, and Juan P. Hourcade, 5720–30. New York: ACM Press.
- Kellar, Melanie, Carolyn Watters, and Michael Shepherd. 2007. «A Field Study Characterizing Web-based Information Seeking Tasks.» *Journal of the American Society for Information Science and Technology* 58 (7): 999–1018.
- Kelle, Udo, and Susann Kluge. 2010. *Vom Einzelfall zum Typus: Fallvergleich und Fallkontrastierung in der qualitativen Sozialforschung*. 2., überarbeitete Aufl. Qualitative Sozialforschung Bd. 15. Wiesbaden: VS Verlag für Sozialwissenschaften.
- Kuckartz, Udo. 2012. *Qualitative Inhaltsanalyse: Methoden, Praxis, Computerunterstützung*. Weinheim [u.a.]: Beltz Juventa.
- Laberge, Jason C., and Charles T. Scialfa. 2005. «Predictors of Web Navigation Performance in a Life Span Sample of Adults.» *Human Factors* 47 (2): 289–302. <https://doi.org/10.1518/0018720054679470>.
- Litt, Eden. 2013. «Measuring Users' Internet Skills: A Review of Past Assessments and a Look Toward the Future.» *New Media & Society* 15 (4): 612–30. <https://doi.org/10.1177/1461444813475424>.
- Meyen, Michael. 2011. *Qualitative Forschung in der Kommunikationswissenschaft: Eine praxisorientierte Einführung: [Lehrbuch]*. Studienbücher zur Kommunikations- und Medienwissenschaft. Wiesbaden: VS Verlag für Sozialwissenschaften.
- Olmsted-Hawala, Erica L., Elisabeth D. Murphy, Sam Hawala, and Kathleen T. Ashenfelder. 2010. Think-Aloud Protocols: A Comparison of Three Think-Aloud Protocols for use in Testing Data-Dissemination Web Sites for Usability. *Proceedings of the 28th international conference on Human factors in computing systems*, 2381–2390. New York: ACM Press.
- Potter, W. James. 2004. «Argument for the Need for a Cognitive Theory of Media Literacy.» *American Behavioral Scientist* 48 (2): 266–72. <https://doi.org/10.1177/0002764204267274>.
- Riesmeyer, Claudia, Senta Pfaff-Rüdiger, and Anna Kümpel. 2016. «Wenn Wissen zu Handeln Wird: Medienkompetenz aus Motivationaler Perspektive.» *M&K* 64 (1): 36–55. <https://doi.org/10.5771/1615-634X-2016-1-36>.
- Schorb, Bernd. 2005. «Medienkompetenz.» In *Grundbegriffe Medienpädagogik*, edited by Jürgen Hüther and Bernd Schorb, 257–62. München: Kopaed.
- Schweiger, Wolfgang. 2010. «Informationsnutzung online: Informationssuche, Selektion, Rezeption und Usability von Online-Medien.» In *Handbuch Onlinekommunikation*, edited by Klaus Beck and Wolfgang Schweiger. 1st edition, 184–210. Wiesbaden: VS Verlag für Sozialwissenschaften.
- Shenton, Andrew K., and Naomi V. Hay-Gibson. 2011. «Information Behaviour and Information Literacy: The Ultimate in Transdisciplinary Phenomena?» *Journal of Librarianship and Information Science* 43 (3): 166–75. <https://doi.org/10.1177/0961000611410767>.
- Strauss, Anselm, and Juliet Corbin. 2010. *Grounded Theory: Grundlagen Qualitativer Sozialforschung*. Unveränd. Nachdr. der letzten Aufl. Weinheim: Beltz.

- Tsai, Meng-Jung. 2009. «Online Information Searching Strategy Inventory (OISSI): A Quick Version and a Complete Version.» *Computers & Education* 53 (2): 473–83. <https://doi.org/10.1016/j.compedu.2009.03.006>.
- van Deursen, Alexander J.A.M., Jan A.G.M. van Dijk, and Oscar Peters. 2011. «Rethinking Internet Skills: The Contribution of Gender, Age, Education, Internet Experience, and Hours Online to Medium- and Content-Related Internet Skills.» *Poetics* 39 (2): 125–44. <https://doi.org/10.1016/j.poetic.2011.02.001>.
- van Dijk, Jan A. G. M., and Alexander J. A. M. van Deursen. 2014. *Digital Skills: Unlocking the Information Society*. New York: Palgrave Macmillan US.
- Weidle, R., and A. Wagner. 1994. «Die Methode des Lauten Denkens.» In *Verbale Daten. Eine Einführung in die Grundlagen und Methoden der Erhebung und Auswertung.*, edited by G. Huber and H. Mandl, 81–103. Weinheim: Beltz.
- Wirth, Werner, Tabea Böcking, Veronika Karnowski, and Thilo von Pape. 2009. «The WEB-NAS Analysis Method: A Holistic Approach to the Analysis of Web Navigating and Searching Behavior.» *Communication Methods and Measures* 3 (3): 115–46. <https://doi.org/10.1080/19312450903155604>.
- Wirth, Werner, Katharina Sommer, Thilo von Pape, and Veronika Karnowski. 2016. «Success in Online Searches: Differences between Evaluation and Finding Tasks.» *Journal of the Association for Information Science and Technology* 67 (12): 2897–2908. <https://doi.org/10.1002/asi.23389>.
- Youmans, Robert J., Brooke Bellows, Christian A. Gonzalez, Brittany Sarbone, and Ivonne J. Figueroa. 2013. «Designing for the Wisdom of Elders: Age Related Differences in Online Search Strategies.» In *Universal Access in Human-Computer Interaction. User and Context Diversity*. Vol. 8010, edited by David Hutchison, Takeo Kanade, Josef Kittler, Jon M. Kleinberg, Friedemann Mattern, John C. Mitchell, Moni Naor et al., 240–49. Lecture Notes in Computer Science. Berlin, Heidelberg: Springer.

Acknowledgments

The author would like to thank the reviewers for their valuable comments and suggestions. I especially like to thank Rebecca Renatus for designing and implementing the study as well as for sharing the data with me.

Appendix

Description of Participants

Participant	Age	Education	Professional Background	Internet Usage	Topical Interest
F16-1	16	High School	Student, grade 10	daily, «actually always»	+
F16-2	16	High School	Student, grade 11	daily, using smart-phone and netbook	+
M21	21	High School Graduation	Student Communication Science	daily, internet as main information source	++
F26	26	High School Graduation	Student Sociology	daily, Internet for almost all purposes	+
M53	53	University Degree	Land Surveyor	regularly, but not daily; «not that excessive»	+
M57	57	University Degree	Construction Supervisor	quite regularly	+
F60	60	University Degree	Researcher in Natural Sciences	regularly in work related settings	+
F65	65	University Degree	Retired, former in the field of precision engineering	almost daily	++
M74	74	University Degree	Retired, former an engineer	almost every second day; «I'm still learning»	?
M77	77	University Degree	Retired, former in the field of protection and control technology	daily using a PC, but not the Internet; «first, bank transactions, second stock market data»	+
,+ +' «strong interest»; ,+' «some interest»; ,?' «not discussed in interview»					