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How to present online information to older cancer patients

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Voor mijn ouders

Chapter 1

Introduction and dissertation outline

Providing information to cancer patients is crucial within cancer care. Patients need information to prepare for their treatment, to cope with their illness, and to manage their disease in daily life (De Haes & Bensing, 2009). As cancer is often a disease of older adults (American Cancer Society, 2015), and aging populations are predicted to grow in the upcoming decades, it is expected that cancer incidences will increase simultaneously (Dutch Cancer Society, 2011). However, age-related communication barriers often complicate the ways cancer information is provided, which makes older patients an especially vulnerable group for receiving poor information (Sparks & Nussbaum, 2008).

In the current technology age, the Internet has become a powerful source of cancer-related information (Medlock et al., 2015). At the same time, older adults are the fastest growing group online (File & Ryan, 2014), especially in Western countries, such as the Netherlands. In 2005, only 43% of people aged between 65 and 75 years used the Internet on a daily basis, while in 2013, more than 73% of this older age group used the Internet (Statistics Netherlands, 2014). Older patients might particularly benefit from online sources as they are at risk of poor information provision. The Internet could thus function as an important source of cancer information in addition to other sources, such as healthcare providers (Fiksdal et al., 2014).

Despite the potential opportunities of using the Internet for older patients, effective online communication is not guaranteed. Due to, among other reasons, low health literacy levels and low computer usage, which are more prevalent among aging populations, older people see themselves as less able and are often less motivated to utilize the Internet for health information (Bodie & Dutta, 2008). Moreover, web designs may pose barriers as well by not accounting for visual acuity, cognitive abilities, and motor skills of older adults (Becker, 2004). In acknowledging older patients' skills and experience with the Internet, it is crucial to investigate how to present online information to older cancer patients in order to enhance their *ability* and *motivation* to process online information. This dissertation therefore aims to explore how online cancer information can be optimally presented to older patients. This ultimately contributes to better online cancer information provision for older cancer patient populations.

Online cancer information for aging populations

It is widely recognized that mere information provision does not mean that every individual is able to use information. On the one hand, one can be limited in cognitive resources required to process a certain message. On the other hand, one can deliberately choose not to use all cognitive resources available to process information. Message processing can thus be considered a result of an individual's *ability* and *motivation* to process information (Lang, 2000; Petty & Cacioppo, 1986). Considering the increasing availability of online cancer sources and the growing number of older patients using such sources, it is important to understand how well these aging patients are *able* to use online cancer sources and to what extent they are *motivated* to use such sources. In doing so, ways to present online cancer information can be identified that address older patients' *ability* as well as *motivation* to process information from online cancer sources.

Older patients' ability to process online cancer information

The ability to process information generally declines as one ages (Brown & Park, 2003). A vast amount of research confirms that older adults remember substantially smaller amounts of information as compared to younger adults (Maylor, 2005). At the same time, older adults experience more illnesses concurrently than any other age group (World Health Organization, 2014), and thus need to memorize more complex medical information about treatment and disease. This suggests that adequate recall of information, that is the ability to remember and reproduce information (Van der Meulen, Jansen, Van Dulmen, Bensing, & Van Weert, 2008), is essential for older adults' health. Inadequate recall of information has been associated with poor disease management (Kravitz et al., 1993), inaccurate medication intake (Linn, Van Dijk, Smit, Jansen, & Van Weert, 2013), and less active participation in medical decision making (Gaston & Mitchell, 2005). Recall of information is thus a prerequisite for crucial health outcomes. In older age, one's ability to process information might be hampered due to decline in basic cognitive abilities, such as decreased working memory and processing speed (Becker, 2004). On the other hand, older adults gain substantial knowledge and experience during their life, which may compensate for the age-related decline in cognition (Hess, 2005). Nonetheless, theoretical models of cognitive aging posit that older adults have more difficulties memorizing medical information than younger adults (Brown & Park, 2003). Considering the trend of presenting crucial cancer information online – sometimes even exclusively online (Lippincott, 2004) – older patients are expected to use online cancer sources in addition to other relevant sources to learn about their treatment and disease. More than among younger patients, the ability to use online information in particular is also influenced by e-health literacy, which refers to the ability to seek, find, understand, and act on health information from electronic sources to solve a health problem (Norman & Skinner, 2006b). Older adults might therefore struggle even more when processing cancer information from online sources.

Older patients' motivation to process online cancer information

Apart from the ability to process information, effective online information processing also depends on one's motivation. As satisfaction with information may motivate the uptake of information (Park & Lim, 2007), website satisfaction might enhance one's motivation to process online cancer information. Website satisfaction can be defined as Web users' "predispositions to respond favorably or unfavorably to Web content (Chen & Wells, 1999, p. 28)." Older patients might have a less overall positive experience using online cancer sources because of lower e-health literacy skills and visual, cognitive, and physical impairments that occur during the normal aging process (Becker, 2004; Bodie & Dutta, 2008). On the other hand, older patients might be more motivated to process information when information meets their emotionally relevant goals (Carstensen, Isaacowitz, & Charles, 1999). The socioemotional selectivity theory suggests that the awareness of time left in life plays an essential role in motivation (Carstensen, Fung, & Charles, 2003). As older people perceive less time left in life than younger people, older patients shift toward prioritization of emotionally meaningful goals (Carstensen et al., 1999). Research has illustrated this by older adults' superior cognitive performance for emotional information versus

non-emotional information (Carstensen & Mikels, 2005), indicating that while general cognitive processing capacities decline in older age, emotional functioning is relatively spared. When online cancer information addresses older patients' emotional goals, they might be more motivated to process information, which consequently results in better recall of information as well. Satisfaction with online information might directly reflect such motivation, while recall of information might indirectly reflect motivation through enhanced satisfaction to process online information. It is therefore important to consider *ability* as well as *motivation* when designing online cancer information for older cancer patients.

Presenting online cancer information to older patients

The Internet provides the opportunity to present information in a variety of ways. With the availability of computer graphics and visualization technologies, Web designers have the ability to present written information with visuals, such as illustrations and videos (Mayer, 2014). There is ample evidence that such visuals positively contribute to the effectiveness of cancer materials. It has been repeatedly found that illustrations are able to attract attention, increase satisfaction, improve understanding and learning, and improve adherence (see for a review Houts, Doak, Doak, & Loscalzo, 2006). Similar to illustrations, videos have the ability to engage viewers, increase positive thoughts, and improve recall (Kreuter et al., 2008). Nevertheless, it is unclear how such visuals benefit older patients in particular to being more satisfied with information and better recall information.

The role of visuals in online cancer information

Combining verbal (e.g., written information) with visual (e.g., illustrations, videos) modes of communication positively influences how information is processed (Mayer, 2002). The dual coding theory explains that combining verbal with visual modes of communication allows individuals to take advantage of the full capacity of both verbal and visual information processing systems (Paivio, 1971). Yet, according to the cognitive load theory, both verbal and visual systems are limited in their cognitive capacity and can therefore only process a certain amount of material simultaneously (Baddeley, 1992). Moreover, individuals actively select, organize, and integrate information that can be connected to relevant prior knowledge (Mayer, 1999). These assumptions of dual coding theory, cognitive load theory, and active processing are integrated in the cognitive theory of multimedia learning (CTML), which proposes a rationale for how information is processed in multimedia environments (Mayer, 2002). Multimedia refers to the way of presenting information, which entails both verbal (i.e., spoken or written text) and visual (i.e., static or moving visuals) communication (Mayer, 2014). It therefore concerns a multiple mode format (e.g., combining verbal and visual representations, such as text and illustrations) rather than a multiple media format (i.e., combining multiple media devices, such as a computer screen and a doctor's voice) (Mayer & Sims, 1994; Mayer, 2014).

The CTML aims to reduce cognitive load in online information processing, which makes the solutions offered by this theory especially relevant for older adults. Older adults have in general a smaller total cognitive capacity than younger adults (Van

Gerven, Paas, Van Merriënboer, & Schmidt, 2000), suggesting that offering online cancer information in a multiple mode format might expand older patients' cognitive capacity, thereby enhancing one's *ability* to process information thus increasing recall of online cancer information. At the same time, providing information in a multiple mode format might *motivate* older patients to process information through increased satisfaction with the information (e.g., Levie & Lentz, 1982; Park & Lim, 2007). Because of their vivid nature, illustrations and videos might target older adults' emotional goals by making text-only information more emotionally appealing and gratifying, which might consequently motivate older adults to process online cancer information more deeply.

Within the CTML, basic principles for designing multiple mode messages are put forth that might enhance website satisfaction and recall of information among older patients in particular. These include the multimedia principle, the modality principle, and the personalization principle. These three principles theoretically explain why adding illustrations and videos to online information could be particularly effective to enhance older patients' website satisfaction and recall of cancer information.

The multimedia principle

The multimedia principle, as proposed by the CTML, posits that combining written text with illustrations is more effective than information presented in a single format (e.g., text only) (Mayer, 1999). The dual coding theory claims that individuals have two separate verbal and visual information processing systems (Paivio, 1971), which explains how one's cognitive capacity can be expanded when written text (verbal information) is combined with illustrations (visual information). By building referential connections between verbal and visual mental representations of the same information, dual coding theory predicts that information is more deeply processed (Mayer, 2002). A vast amount of research confirms this notion by showing empirical evidence for the value of adding illustrations to health-related text information on satisfaction and recall of information (see for a review Houts et al., 2006).

As theory posits that illustrations are effective, the question is what types of illustrations are especially effective. A recent content analysis revealed that two types of illustrations are commonly used in cancer materials: cognitive and affective illustrations (King, 2015). Cognitive illustrations complement and explain written information by aiming to facilitate comprehension and learning of information, whereas affective illustrations are irrelevant to better understanding information, but rather aim at enhancing enjoyment and positive feelings about the information (Levie & Lentz, 1982). Examples of cognitive illustrations are those depicting medical procedures or medical conditions, or icons that explain how and when to take medication as prescribed (Morrow, Hier, Menard, & Leirer, 1998). Affective illustrations mainly show people (e.g., emphatic caregivers and patients) or other objects (e.g., fruits and vegetables) (King, 2015).

Cognitive illustrations facilitate processing of information by improving comprehension and recall of information (Levie & Lentz, 1982). In line with the dual coding theory and CTML, cognitive illustrations present text information in visual form so that individuals can actively select, organize, and integrate text and illustrations (Mayer, 1999). Moreover, cognitive illustrations have been found to enhance

satisfaction with health-related information as well (Park & Lim, 2007). Nonetheless, empirical evidence for the effect of using cognitive illustrations on older patients' information processing in particular has been scarce, and the studies that have been done among healthy older adults show inconsistent findings (e.g., Liu, Kemper, & McDowd, 2009; Morrow et al., 1998). Moreover, as the CTML expects that adding illustrations might result in better recall of information, it assumes that people actively attend to illustrations to select, organize and integrate text and illustrations. Although literature has recognized the strong association between attention and recall (Lang, 2000), studies have not yet focused on how older adults attend to text and illustrations about cancer and how this attention is related to recall of information.

Besides cognitive illustrations, affective illustrations can function to enhance enjoyment and affect emotions and attitudes (Levie & Lentz, 1982). Affective illustrations are found to increase satisfaction (Park & Lim, 2007), and might motivate to actively process information. Other than cognitive illustrations, affective illustrations might serve a different role in older adults' processing of information. The socioemotional selectivity theory predicts an age-related emphasis on emotionally relevant material and a reallocation of processing resources toward the positive aspects of information (Löckenhoff & Carstensen, 2004). This so-called positivity bias in older adults' information processing has been shown in a vast number of studies, which reveal that older adults have a general preference for positive information over negative information (see Reed, Chan, & Mikels, 2014). For instance, the positivity bias has been found for positively versus negatively framed health messages, where older adults relative to younger adults rated the positively framed health messages as more informative and recalled a higher proportion of the positive to negative messages (Shamaskin, Mikels, & Reed, 2010). Adding affective illustrations to online cancer information might elicit positive feelings about the information and, consequently, improve recall of information, especially among older patients. This, however, has not yet been investigated.

The modality principle

In addition to using illustrations in online cancer information, videos are also considered effective in online cancer communication (Kreuter et al., 2008). The CTML describes the modality principle to explain the effectiveness of using videos, which states that information is more deeply processed when information is presented audiovisually than when presented in visual format only (e.g., written text and static illustrations) (Sweller, Ayres, & Kalyuga, 2011). Although combining text with illustrations addresses both verbal (written text) and visual (static illustrations) information processing systems (Paivio, 1971), text and illustrations are both processed in the visual channel, whereas videos are processed in both auditory and visual channels. Therefore, text with illustrations formats are more likely to cause overload in the visual channel because both text and illustrations compete for the limited resources in the visual working memory (Mayer, 2002). Using video instead of text (with illustrations) has been found to reduce cognitive load when processing information (Tabbers, Martens, & Merriënboer, 2004). Moreover, research has shown that videos enhance satisfaction with health-related materials (Dunn, Steginga, Rose, Scott, & Allison, 2004) and improve recall of information (Kreuter et al., 2008).

As older adults have a smaller total cognitive capacity relative to younger adults, the potential gain from videos is expected to be proportionally greater in older adults (Paas, Van Gerven, & Tabbers, 2005). The cognitive aging principle in multimedia learning explains that older adults' reduced working memory can be effectively expanded by addressing more than one sensory modality when presenting information, such as eyes (i.e., by presenting information visually) and ears (i.e., by presenting information auditory) (Paas et al., 2005). Videos are therefore expected to compensate for older adults' reduced working memory capacity. Previous research has provided evidence for this notion by revealing decreased levels of cognitive load in older adults when information was presented in multimodal format (i.e., video) versus unimodal format (i.e., illustrations only) (Van Gerven, Paas, Van Merriënboer, Hendriks, & Schmidt, 2003). Whether these promising effects also hold for improved satisfaction with and recall of cancer information among older patients has not yet been tested.

The personalization principle

Besides the effects of using illustrations and videos in online cancer information, the style in which the verbal written or spoken information is conveyed plays a crucial role as well. The CTML proposes the personalization principle, which explains that information is better processed when presented in conversational narration style than when presented in formal narration style (Moreno & Mayer, 2000). Unlike a nonpersonalized formal narration style, conversational narration style refers to a more personalized communication style by presenting information in the first and second person as if the narrator were directly talking to the receiver of the message (Mayer, 2002). Conversational style is often used in narrative communication, which is referred to as "any cohesive and coherent story with an identifiable beginning, middle, and end that provides information about scene, characters, and conflict; raises unanswered questions or unresolved conflict; and provides resolution (Hinyard & Kreuter, 2007, p. 778)." The fact that conversational-styled messages are more deeply processed than formal-styled messages can be explained by theories of conversation, which suggest that people engage in conversations based on conversational rules, such as the commitment to try to understand what another person is telling (Grice, 1975). Alternatively, the narrative communication literature explains the effectiveness of conversational style through enhanced narrative engagement, meaning that one is cognitively and affectively involved with actively processing the information from a narrative (Slater & Rouner, 2002). Message recipients can be involved with the narrative, that is the storyline, but also with the characters who play a role in the narrative. The effectiveness of conversational style has been acknowledged, especially concerning improved recall of information (Ginns, Martin, & Marsh, 2013). We can also expect conversational style to enhance satisfaction, especially when used in video messages, as narrative (i.e., conversational) versus informational (i.e., formal) videos have been found to increase liking and decrease negative evaluation of the video (McQueen & Kreuter, 2010). Moreover, being cognitively and affectively involved with the storyline and its characters has been considered important for enhancing satisfaction and recall in health-related contexts (e.g., Murphy, Frank, Moran, & Patnoe-Woodley, 2011).

Despite the lack of empirical evidence regarding the effects of conversational style on older patients' satisfaction and recall, there is reason to assume that older patients might especially benefit from cancer information that is presented in conversational style. Older adults have a better narrative memory, which means that they tend to memorize stories better than younger adults (Sparks & Nussbaum, 2008). Conversational-styled messages might therefore be more appreciated by older adults and help them to better memorize information. This, however, has not yet been investigated in the context of presenting online cancer information to older patients.

The role of visuals for older adults in this dissertation

To summarize, the CTML proposes the multimedia, modality, and personalization principle to explain how information can be effectively enhanced for older adults. In this dissertation, we will apply these principles to online cancer information materials aiming at increasing older patients' website satisfaction and recall of information. The central question to this dissertation will be: "How can online cancer information be optimally presented to older patients?"

Objectives and outline of the dissertation

Objectives

This dissertation aims to gain insight into how online cancer information can be optimally presented to older patients to enhance their *ability* and *motivation* to process online cancer information. In addressing this aim, we examine the value of adding illustrations and videos to cancer-related websites to improve website satisfaction and recall of information. We thereby focus on how these visuals benefit older adults in particular, and examine the role of chronological age and age-related factors in the effectiveness of online visual cancer materials. To reach our ultimate goal, which is answering the question on how online cancer information can be optimally presented to older patients, we formulated three research questions:

(1) How can illustrations be used to enhance older adults' website satisfaction and recall of online cancer information?
(2) How can videos be used to enhance older adults' website satisfaction and recall of online cancer information?
(3) Does age matter when presenting online cancer information to enhance older adults' website satisfaction and recall of information?

Outline

This dissertation consists of six studies outlined in seven chapters (see Figure 1.1). Each chapter describes one study and represents independent empirical studies that contain abstracts, theoretical foundations, methods, results, and discussions. The relationships between the seven chapters are visualized and described below.

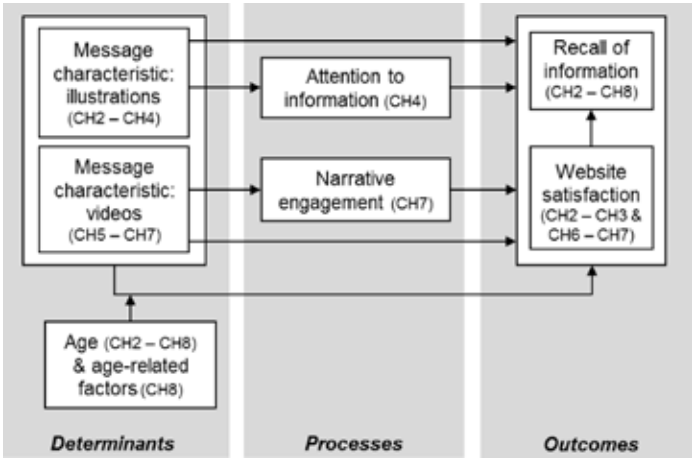

Figure 1.1. Visualization of the dissertation outline.

Chapter 2 and 3 examine the effects of using illustrations on recall of information and website satisfaction, and Chapter 4 explores the underlying mechanisms of those relationships. The main aim of **Chapter 2** is to examine whether using cognitive and affective illustrations increases website satisfaction and recall of information. This aim was investigated in an online experiment among younger and older healthy participants, who were exposed to a webpage with or without cognitive and/or affective illustrations. The effects of illustrations and age differences are being discussed. To test the generalizability of these results to a patient population, **Chapter 3** describes a replication study among younger and older colorectal cancer patients. Again, the influence of adding illustrations on website satisfaction and recall of information is reported, and age differences are elaborated upon. To find possible explanations for the effects of using illustrations in online cancer information, **Chapter 4** aims to provide insight into *how* individuals attend to online webpages that include illustrations, and *under what conditions* attention leads to improved recall of information. In an eye-tracking experiment, attention to a webpage was assessed and connected to adequate recall of information. This chapter provides more insight into the mechanisms behind information recall from online sources among younger and older adults. Chapter 5 and 6 investigate the effects of videos on recall of information and website satisfaction, with Chapter 7 exploring the underlying mechanisms of those relationships. **Chapter 5** explores the use of formal and conversational videos in online cancer information. The aim of this chapter is to examine how video versus text might improve recall of information. This aim was addressed in an online experiment among healthy younger and older adults, and was replicated among lung cancer patients in **Chapter 6**. The formal and conversational video were integrated in a webpage to test the effects on older patients' website satisfaction and recall of information. To this end, age differences were discussed as well. **Chapter 7** attempts to explain the mechanisms behind the effectiveness of conversational videos by exploring the mediating role of narrative engagement. More

insight is provided into active ingredients of effective health videos for older adults. The contribution of age in the effectiveness of online cancer materials is investigated in **Chapter 8** by investigating the role of chronological age and age-related ability and motivation factors in recall of information. Chronological age may simply function as a catch-all term that consists of many different factors that together help to understand older adults' recall of information. Using cross-sectional data of older patients with various forms of cancer, a multiple regression analysis critically appraises the role of chronological age and age-related ability and motivation in predicting information recall. In the final chapter, **Chapter 9**, the key findings and implications of the results of this dissertation are discussed. Furthermore, this final chapter highlights future directions for research and practice, and provides an answer to the question how online information can be optimally presented to older cancer patients.

Chapter 2

Using cognitive and affective illustrations to enhance older adults' website satisfaction and recall of online cancer-related information

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Abstract

This study examined the effect of adding cognitive and affective illustrations to online health information (vs. text only) on older adults' website satisfaction and recall of cancer-related information. Results of an online experiment among younger and older adults showed that illustrations increased satisfaction with attractiveness of the website. Younger adults were significantly more satisfied with the comprehensibility of the website than older adults, whereas older adults were more satisfied with perceived emotional support from the website than younger adults. Being more emotionally satisfied with the website led to greater recall of information for older adults, but not for younger adults. Illustrations can be used to enhance older adults' website satisfaction and consequently recall of online cancer-related information.

Introduction

In 2011, 650 million people worldwide were aged 60 years or older, and it is expected that this group of older adults will expand up to 2 billion by 2050 (World Health Organization, 2011). Many Western countries, such as the Netherlands, experienced an even bigger relative increase in aging populations. This is mainly due to the "baby boomers" or "sixties generation" turning 65 from 2011 onward (Garssen, 2011). Along with this trend, an increase in disease ratings, such as increased cancer incidences, is shown as well. Cancer is mainly a disease of older adults and it is expected that the cancer incidence among older adults aged 65 years or older will increase by 40% between 2007 and 2020 (Dutch Cancer Society, 2011).

At the same time, more cancer-related information is presented through the Internet and is sometimes even exclusively presented online (Lippincott, 2004; Morrell, 2002). This poses both possibilities and limitations for older adults. On the one hand, the Internet fulfills a wide range of information and support needs (Iredale, Mundy, & Hilgart, 2011) and increasingly more older adults use the Internet to fulfill those needs (Statistics Netherlands, 2011b). On the other hand, older adults may misunderstand these computer technologies because of their inexperience with such technologies and decline in basic abilities, such as cognitive (e.g., decreased working memory) and sensory (e.g., decreased visual acuity) impairments (Becker, 2004).

In an attempt to make online health information more user-friendly, scholars have presented guidelines to improve the usability of websites for older adults (Money, Lines, Fernando, & Elliman, 2011). However, most website designers do not adhere to these guidelines. In using a small font size, drop-down menus, and hypertext links, websites are found to be used less accurately and efficiently by older adults than by younger adults (Romano Bergstrom, Olmsted-Hawala, & Jans, 2013). Moreover, health literacy (i.e., the motivation and ability to obtain, process, and understand health information to make appropriate health decisions) has been found markedly lower in older adults than in younger adults (Baker, Gazmararian, Sudano, & Patterson, 2000; McCray, 2005). These hindering age-related factors make older adults a vulnerable group for poor online health communication.

As a result, the inability to use websites and its content correctly is related to greater dissatisfaction (Parrott, Raup Krieger, Silk, & Egbert, 2008) and might lead to lower levels of information recall. Website satisfaction can be defined as web users' "predispositions to respond favorably or unfavorably to web content" (Chen & Wells, 1999, p. 28). One can distinguish between different types of website satisfaction. It is often found that people are dissatisfied with the comprehensibility of online medical information, due to low readability of such materials (McInnes & Haglund, 2011). Comprehension refers to "the process of interpreting the meaning of words or pictures to understand their collective meaning" (Houts, Doak, Doak, & Loscalzo, 2006, p. 178). *Satisfaction with the comprehensibility of the website* can be defined as the extent to which Web users are content with the readability level and understandability of the information on the website. On the other hand, Web users might be satisfied with the comprehensibility of the website but still evaluate the website as not satisfying. This might be due to low *satisfaction with the attractiveness of the website*. This refers to the extent to which users find the website well-developed and enjoyable. Furthermore, website users might shape their attitude according to

their *satisfaction with the perceived emotional support from the website*. Satisfaction with perceived emotional support from the website is defined as the extent to which users feel that the website helps to deal with emotions and stress. Previous research has acknowledged the emotional benefits of online information. For instance, using the Internet for cancer-related information led to greater feelings of social support and increased feelings of hope in breast cancer patients, indicating that online information can enhance feelings of emotional support (Fogel, Albert, Schnabel, Ditkoff, & Neugut, 2002; Vilhauer, 2009).

Satisfaction is an important factor in motivating people to process and learn information and is expected to be positively related to recall of information (Ley, 1988; Park & Lim, 2007). Monahan (1995) found that information that evokes positive feelings, such as satisfaction, is better recalled. Similarly, Park and Lim (2007) suggested that positive emotions, such as satisfaction, lead to better recall of information as well. Recall of information refers to the ability to remember and reproduce information (Van der Meulen, Jansen, Van Dulmen, Bensing, & Van Weert, 2008) and is important for patients' health and well-being (McGuire, 1996) and adherence to medical regimes (Ley, 1988). To increase website satisfaction and recall of health-related information, medical texts are often supported with illustrations (Houts et al., 2006). Previous research found that using illustrations was positively related to satisfaction with information and recall of information (Katz, Kripalani, & Weiss, 2006). However, to our knowledge, no studies have looked into what types of illustrations on a website will be beneficial for enhancing website satisfaction and recall of information among older adults. Therefore, this article aims to examine the effect of cognitive and affective illustrations on website satisfaction and recall of cancer-related information among older adults as compared to younger adults.

Cognitive and affective illustrations

Illustrations are widely used to improve learning from textual information (Levie & Lentz, 1982). Many studies have focused on the effect of adding illustrations to a text (versus text only) on website satisfaction (Van Weert et al., 2011), comprehension (Houts et al., 2006), and recall of information (Katz et al., 2006). Fewer studies have looked into what types of illustrations might be used to optimize these outcomes. Levie and Lentz (1982) described a functional approach to the effects of illustrations and suggested that illustrations could perform multiple functions, such as feeling and thinking. They distinguish between cognitive (thinking) and affective (feeling) functions of illustrations. Cognitive illustrations are explanatory illustrations, supporting a text and aiming to facilitate learning of information by improving comprehension and information recall. For instance, medication instructions can be improved by adding icons that explain how and when to take the medication as prescribed (for examples, see Morrow, Hier, Menard, & Leirer, 1998). Affective illustrations are illustrations that are irrelevant for understanding the text (Park & Lim, 2004) and aim to enhance enjoyment and affect emotions and attitudes. Text-irrelevant illustrations, such as pictures of flowers and empathic caregivers, can increase arousal and attention (e.g., see Park & Lim, 2007). In the next sections, we discuss how cognitive and affective illustrations might influence website satisfaction and recall of cancer-related information.

The effects of illustrations on website satisfaction

Cognitive illustrations are found to positively affect satisfaction with information. Previous studies have shown that adding cognitive illustrations increased comprehension with the information (e.g., Morrow et al., 1998). This was also true when cognitive illustrations were added to online information (Van Weert et al., 2011). These findings are in line with the functional approach to cognitive illustrations, assuming that cognitive illustrations aim to facilitate learning (Levie & Lentz, 1982). In contrast to cognitive illustrations, affective illustrations aim to enhance enjoyment and arouse positive emotions, such as attraction and liking (Monahan, 1995). Affective illustrations play an important role in drawing attention to information and increasing satisfaction with information (Park & Lim, 2004). Following Levie and Lentz's (1982) functional approach to illustrations, we assume that affective illustrations influence different dimensions of satisfaction than cognitive illustrations. Affective illustrations are expected to increase both satisfaction with attractiveness and emotional support, as affective illustrations aim to enhance enjoyment and affect emotions and attitudes (Levie & Lentz, 1982). Affective illustrations have been found to increase emotional interest in the information presented as well (Harp & Mayer, 1997). In addition, a previous study showed that adding a cognitive illustration to online information increased satisfaction with the attractiveness of the website (Van Weert et al., 2011). Based on the functional approach and previous studies, we expect: *Adding a cognitive illustration to a text (vs. text only or text with affective illustration) increases satisfaction with comprehensibility of the website (H1a)*. Furthermore, we propose: *Adding a cognitive and/or affective illustration to a text (vs. text only) increases satisfaction with attractiveness of the website (H1b)*. Ultimately, we hypothesize: *Adding an affective illustration to a text (vs. text only or text with cognitive illustration) increases satisfaction with emotional support from the website (H1c)*.

The effects of illustrations on recall of cancer-related information

Also in line with the functional approach of Levie and Lentz (1982) is the role of cognitive illustrations in learning information. Cognitive illustrations explain (parts of the) information and aim to increase understanding and thereby recall of this information. The cognitive theory of multimedia learning[1] (Mayer, 1999) states that people understand instructional material (i.e., explanation of cancer treatment) better when presented in multiple forms, including verbal (i.e., text) and visual representations (i.e., illustrations). This idea is derived from the dual coding approach, suggesting that people have separate verbal and visual processing systems (Paivio, 1971). According to this approach, combining text and visual results in better memory for information, because these are coded separately in memory and are therefore better retrieved from memory (Paivio, 1971). Thus, messages are expected to be more effective when information is presented with corresponding illustrations, rather than text alone. This is called the multimedia effect (Mayer, 1999). Empirical research has indeed found that adding illustrations to textual information is an effective way of enhancing adults' understanding and recall of medical information (Morrow et al., 1998).

[1] The definition of multimedia learning applies to the term "multimodal" (which refers to the idea that people use two or more sense modalities) rather than "multimedia" (which refers to the idea that people use two or more medium representations).

Although much research has shown evidence for the multimedia effect in learning from written materials among younger adults (Cherry, Dokey, Reese, & Brigman, 2003; Houts et al., 2006), research on the multimedia effect among older adults is often limited or inconsistent (Brotherstone, Miles, Robb, Atkin, & Wardle, 2006; Liu, Kemper, & McDowd, 2009). Although Brotherstone et al. (2006) found that illustrations enhanced older adults' understanding of the preventive aim of cancer screening, Liu et al. (2009) found that although older adults spent more time looking at illustrations than younger adults, they had poorer comprehension of the illustrations compared to younger adults. The latter study concluded that older adults had more difficulties integrating illustrations with the illustration-related text. This might be due to a decline in cognitive functions, such as working memory, which allows people to process and retrieve information simultaneously during such complex activities (Morrell & Park, 1993). Cognitive illustrations might therefore not always be beneficial for older adults. We therefore propose: *Adding a cognitive illustration to a text (vs. text only or text with affective illustration) increases recall of cancer-related information on a website in younger but not in older adults (H2a)*.

Limited evidence is also found for the effect of affective illustrations on recall of information. Particularly older adults showed increased levels of recall when affective illustrations were presented (Mather & Knight, 2005). This greater focus on positive information in older adults' memory is called the positivity bias (Mather & Carstensen, 2005). Mather and Knight (2005) explain this by the socioemotional selectivity theory (Carstensen, Isaacowitz, & Charles, 1999), which asserts that older adults have more emotion-related goals and use these goals to encode and memorize information. The socioemotional selectivity theory is a life-span theory predicting that the perception of time influences motivational goals in life (Carstensen, Fung, & Charles, 2003). When one perceives much time left in life, goals related to knowledge acquisition are activated, whereas when time is perceived as limited, a shift toward goals related to emotion regulation is observed (Carstensen et al., 1999). For instance, social interactions, such as contact with family members, that optimize emotional experiences become of greater importance and are more valued by older adults (Carstensen et al., 2003).

According to the socioemotional selectivity theory (Carstensen et al., 1999) there are two ways in which emotional goals influence older adults' information recall. First, information that is relevant to emotional goals is made more salient in older adults' attention and memory. As older adults use their emotional goals to memorize information (Mather & Knight, 2005), affective illustrations might make their emotional goals more salient, resulting in more effective information processing and, consequently, in better recall. Cognitive illustration might not make these goals salient, and might therefore not be processed well. Second, because older adults hold more emotionally meaningful goals, they allocate more cognitive resources toward emotion regulation (Carstensen et al., 1999). This focus on emotion regulation positively influences memory for information that gratifies emotional well-being (Mather & Carstensen, 2005). Hence, information that is perceived as emotionally satisfying might be remembered better by older adults than less emotionally satisfying information. We might therefore expect that not only affective illustrations will influence older adults' recall of information, but also the satisfaction with emotional support that is perceived from a website. Thus, regardless of adding illustrations, satisfaction with

emotional support may lead to increased recall of information for older adults, but not for younger adults. Following the socioemotional selectivity theory, we expect: *Adding an affective illustration to a text (vs. text only or text with cognitive illustration) will increase recall of cancer-related information for older adults, but not for younger adults (H2b)*. In addition, we propose: *Higher levels of satisfaction with emotional support from the website will increase recall of cancer-related information for older adults, but not for younger adults (H3)*.

This article examines the effect of cognitive and affective illustrations on satisfaction with attractiveness, comprehensibility, emotional support from a website, and recall of cancer-related information in older adults as compared to younger adults. In assessing age differences, we chose age younger than 65 years for the younger age group and age 65 and older as the older age group. These two age groups have been found as worthy of separate analysis in several studies on adulthood development (Staudinger & Bluck, 2001) and disease in adulthood (Silliman, Troyan, Guadagnoli, Kaplan, & Greenfield, 1997).

Methods

Design

A 4 (condition: text only vs. additional cognitive illustration vs. additional affective illustration vs. both illustrations) by 2 (age group: younger [$<$ 65 years] vs. older [$\geq$ 65 years]) between-subjects factorial design was used to examine the effect of cognitive and affective illustrations on website satisfaction and recall of information. For this experiment, a webpage of the Netherlands Cancer Institute (NKI) was used on which information about radiofrequency ablation (RFA) treatment was explained. This treatment for lung cancer patients uses radiofrequency waves to destroy the tumor. Because of the unknown character of RFA treatment, little prior knowledge was expected, which enhances the validity of the recall measurement. Four different versions of the webpage were created, containing either text-only information, information supported by two cognitive illustrations, information supported by an affective illustration, or information supported by both the cognitive and affective illustrations, respectively.

Pretest illustrations

To select the most appropriate cognitive and affective illustrations for the NKI webpage, a pretest was conducted among 46 students. Seven cognitive colored drawings illustrating a part of the content of the text were tested: Four depicted the RFA treatment involving a needle, and three represented a pneumothorax, which is a complication that can occur during RFA treatment. The illustrations were evaluated with three items on a 7-point semantic scale ($\alpha = .85$). Items included, for instance, "the illustration does not fit the text/does fit the text." Results showed for the RFA treatment that one illustration scored significantly higher than the other three, $F(3,180) = 34.75$, $p < .001$, $\eta_p^2 = .37$. For the pneumothorax, results yielded no significant effects, but based on the mean scores, one of the illustrations scored better than the other two ($M = 5.27$, $SD = 1.40$ vs. $M = 4.77$, $SD = 1.51$ and $M = 4.80$, $SD = 1.52$).

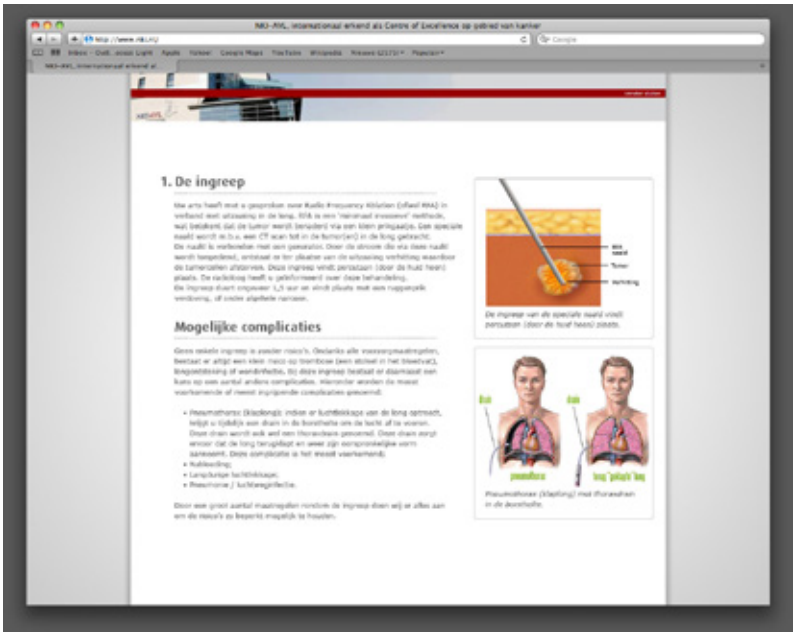

Figure 2.1. Snapshot of the NKI webpage containing the cognitive illustrations.

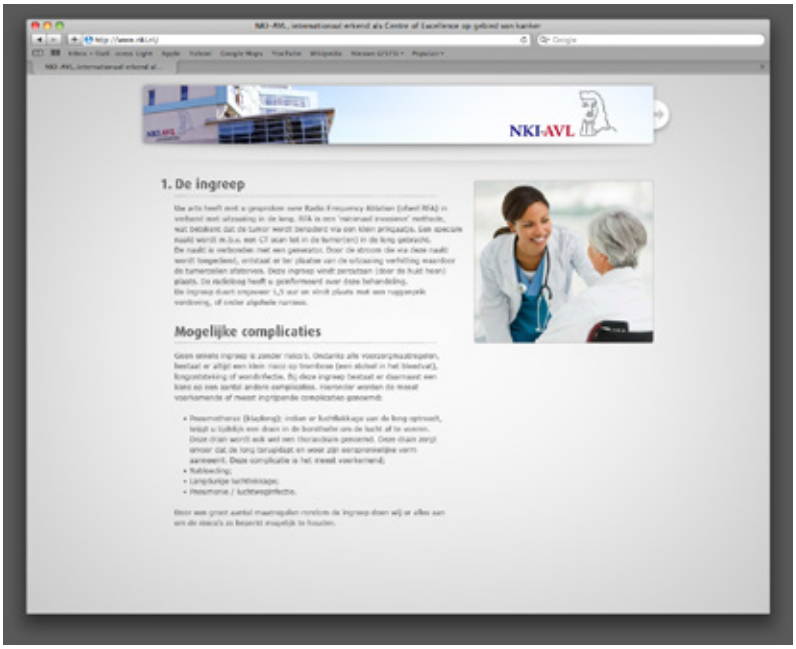

Figure 2.2. Snapshot of the NKI webpage containing the affective illustrations.

Seven affective illustrations were tested, again using three items with a 7-point semantic scale (α = .81). The affective illustrations were colored photos that represented, for instance, a doctor smiling to a patient. Items involved "the illustration does not give a good feeling/does give a good feeling." Results showed that one affective illustration scored significantly higher than others, $F(6, 315) = 8.25$, $p < .001$, $\eta_p^2 = .14$. On the basis of this pretest, the cognitive and affective illustrations were chosen as stimulus materials (see Figures 2.1 and 2.2, respectively, for the cognitive and affective illustrations embedded in the NKI webpage).

Procedure

Participants ($n = 436$) were recruited via online panels (i.e., proefpersonen.nl and the "Booming experience" panel) and snowballing technique to obtain a heterogeneous sample. Participants were eligible to participate when they (1) were 18 years or older, (2) had no prior knowledge on RFA treatment, and (3) were able to read and write Dutch. Participants who indicated having prior knowledge on RFA were excluded from further analysis (i.e., scoring higher than 4 on a 7-point scale; $n = 6$). When participants entered the online survey, an introductory text was shown, followed by questions on background characteristics. Next, participants were randomly assigned to one of the four webpages stratified by age group. They were instructed to read the information on the webpage carefully and they were told that they were not able to return to the webpage after turning to the next page. On average, participants spent 90.86 seconds ($SD = 76.90$) on the website. Older participants did not take significantly more time viewing the webpage than younger participants ($M_{younger} = 85.96$, $SD = 64.97$, vs. $M_{older} = 98.92$, $SD = 92.89$), $F(1, 434) = 2.93$, $p = .088$, $\eta_p^2 = .01$. Immediately after viewing the webpage, recall of information was assessed. This was followed by the webpage again, but this time participants were instructed to focus on the feelings and thoughts that were elicited when looking at the website. Again, immediately after exposure, website satisfaction was administered.

Measures

Website satisfaction

Website satisfaction was measured by the Website Satisfaction Scale (WSS) based on items of the website attitude scale (Chen & Wells, 1999) and items of the Leisure Satisfaction Scale (LSS: Beard & Ragheb, 1980). Part of this scale was also used in a previous study (Van Weert et al., 2011). Satisfaction with comprehensibility included three items, such as "the website is understandable" (α = .89), satisfaction with attractiveness included five items, such as "the website is well developed" (α = .81), and satisfaction with emotional support included four items, such as "the website helps dealing with stress" (4 items, α = .93), all to be scored on a 7-point Likert scale, ranging from 1 (totally disagree) to 7 (totally agree).

Recall of information

The assessment of information recall was based on the Netherlands Patient Information Recall Questionnaire (NPIRQ: Jansen, Van Weert, et al., 2008). Questions were generated from the RFA information and were pretested among 12 students. This resulted into 11 open-ended recall questions, such as "can you name the most

common complication during an RFA treatment?" All questions were provided with the answer options "not discussed," "discussed, but I can't remember the details," and "discussed, namely . . .." Based on the RFA text, a codebook was developed for allocating scores to each of the recall questions. Recall scores could range from 0 (not recalled), to 1 (recalled partially), to 2 (recalled correctly). Two independent coders double coded the recall scores of 81 (18.6%) respondents. Interrater reliability appeared to be good (mean $\kappa = .87$, range .66 – 1.00). The 11 items were computed into a total recall score, ranging from 0 to 22. Additionally, percentages of recall scores were calculated.

Background characteristics

Background measures included age, gender, level of education, Internet use, prior medical knowledge, information preferences, and monitoring coping style. Educational level was divided into low, middle, and high level of education. Internet use was assessed asking for the number of hours spent on average per week on the Internet. Prior medical knowledge about lung cancer and RFA knowledge was measured by two items asking about the amount of knowledge the participants had on lung cancer and RFA measured on a 7-point Likert scale.

Statistical analysis

Descriptive statistics were used to describe the sample characteristics. To determine whether experimental conditions and age groups differed on gender, age, educational level, Internet use, and (RFA) medical knowledge, F-statistics and chi-statistics were conducted where appropriate. For testing the effects of illustrations on website satisfaction and recall, four separate analyses of variance (ANOVAs) were conducted with satisfaction with comprehensibility (H1a), satisfaction with attractiveness (H1b), satisfaction with emotional support (H1c), and recall of information (H2a/b) as dependent variables, and condition and age groups as factors. Additional Tukey's HSD test and independent-sample t-tests were conducted to check for age differences within conditions. For testing the relationship between satisfaction with emotional support and recall for the two age groups (H3), a simple moderation analysis was performed using the conditional process modeling program PROCESS, Model 1 (Hayes, 2012). All effects were subjected to bootstrap analyses with 5,000 bootstrap samples and a 95% confidence interval (CI). Recall of information was used as the dependent variable, with satisfaction with emotional support as the independent variable, and age groups as a moderator.

Results

Sample characteristics

Four-hundred and thirty-six participants filled out the online questionnaire ($n = 436$). Of these participants, 271 were younger adults (< 65 years; $M = 47.47$, $SD = 15.61$) and 165 were older adults (≥ 65 years; $M = 70.34$, $SD = 4.33$). The eight experimental conditions stratified by age group differed significantly on gender, $\chi^2 = 19.68$, $p = .006$. Besides age, $F(1, 434) = 338.15$, $p = .001$, $\eta_p^2 = .44$, the two age groups significantly differed on gender, $\chi^2 = 16.02$, $p < .001$, and educational level,

$\chi^2 = 10.40$, $p = .006$. Controlling for gender and educational level did not alter the main and interaction effects of condition and age group. Therefore, we did not control for gender and educational level in the following analyses. Sample characteristics are presented in Table 2.1.

Table 2.1. Sample characteristics ($n = 436$)

	Younger adults (< 65 yrs.) $n = 271$		Older adults (≥ 65 yrs.) $n = 165$		p
Variable	*n*	*(%)*	*n*	*(%)*	
Gender					< .001
Male	98	36.2	92	55.8	
Female	173	63.8	73	44.2	
Age					.001
Mean (*SD*)	47.47 (15.61)		70.34 (4.33)		
Range	18 – 64		65 – 85		
Education					.006
Low	54	19.9	54	32.7	
Middle	78	28.8	47	28.5	
High	138	50.9	63	38.2	
Internet use (hours per week)					.603
Mean (*SD*)	13.17 (9.76)		12.66 (9.13)		
Range	1 – 70		0 – 50		
Medical knowledge lung cancer (scale 1 – 7)a					.142
Mean (*SD*)	2.34 (1.46)		2.15 (1.18)		
Range	1 – 7		1 – 6		
Medical knowledge RFA (scale 1 – 7)a					.494
Mean (*SD*)	1.28 (0.67)		1.24 (0.62)		
Range	1 – 4		1 – 4		
Time spent on the website (in seconds)					.088
Mean (*SD*)	85.96 (64.97)		98.92 (92.89)		
Range	2.96 – 580.08		6.33 – 808.28		

Note. Not all figures add up to 100%, due to missing data. Conditions stratified by age group did only significantly differ on gender. *SD*, standard deviation. [a]A higher score indicates more knowledge.

Website satisfaction

Adding cognitive illustrations did not significantly increase satisfaction with comprehensibility compared to text only, $p = .861$, adding an affective illustration, $p = .892$, or adding both illustrations, $p = .911$, in both younger and older adults. We did find a main effect for age on satisfaction with comprehensibility, $F(1, 423) = 8.99$, $p = .003$, $\eta_p^2 = .02$, indicating that younger adults scored significantly higher on satisfaction with comprehensibility than older adults ($M_{younger} = 5.95$, $SD = 0.98$ versus $M_{older} = 5.62$, $SD = 1.29$). When compared within conditions, this difference only reached significance in the text-only condition, $t(99) = 2.09$, $p = .039$. Thus, Hypothesis 1a was rejected.

A significant main effect was found for condition on satisfaction with attractiveness, $F(3, 423) = 9.26$, $p < .001$, $\eta_p^2 = .06$. Satisfaction with attractiveness was increased by adding cognitive illustrations, $p < .001$, an affective illustration, $p = .016$, or both illustrations, $p < .001$, compared to text only. Hence, Hypothesis 1b was supported. Furthermore, no main effects were found for condition on satisfaction with emotional support, $F(3, 422) = 0.53$, $p = .662$, $\eta_p^2 = .00$. This indicated that adding an affective illustration did not increase satisfaction with emotional support, rejecting Hypothesis 1c. A significant main effect was found for age, $F(1, 422) = 4.95$, $p = .027$, $\eta_p^2 = .01$, indicating that older adults reported in general being more satisfied with the perceived emotional support from the website than younger adults ($M_{younger} = 3.98$, $SD = 1.44$ versus $M_{older} = 4.29$, $SD = 1.31$). All main and interaction effects are reported in Table 2.2.

These findings showed that both cognitive and affective illustrations increase satisfaction with attractiveness compared to text only, but do not increase satisfaction with comprehensibility and emotional support. Furthermore, younger adults were more satisfied with the comprehensibility of the website than older adults and older adults were more satisfied with the perceived emotional support from the website than younger adults.

Table 2.2. Website satisfaction with comprehensibility, attractiveness, and emotional support stratified by condition and younger (< 65 yrs.) and older (≥ 65 yrs.) adults (n = 430)

		Satisfaction with comprehensibility		Satisfaction with attractiveness		Satisfaction with emotional support	
	n	*M*	*SD*	*M*	*SD*	*M*	*SD*
Text only	101	5.73	1.22	4.45	1.10	3.98	1.54
Younger adults	61	5.93	0.91	4.45	1.04	3.84	1.53
Older adults	40	5.43[b]*	1.54	4.46	1.20	4.19	1.55
Cognitive illustration	113	5.85	1.07	5. 07[a]***	0.90	4.03	1.43
Younger adults	73	5.93	1.07	5.10	0.91	3.84	1.51
Older adults	40	5.71	1.05	5.00	0.87	4.37	1.23
Affective illustration	103	5.74	1.16	4.86[a]*	0.87	4.16	1.28
Younger adults	64	5.84	1.09	4.88	0.86	4.06	1.26
Older adults	39	5.58	1.27	4.82	0.89	4.33	1.30
Both illustrations	113	5.95	1.04	5.10[a]***	0.98	4.23	1.36
Younger adults	67	6.08	0.82	5.13	0.97	4.20	1.46
Older adults	46	5.75	1.30	5.06	0.99	4.29	1.21
Total	430	5.82	1.12	4.88	0.99	4.10	1.40
Younger adults	265	5.95	0.98	4.91	0.98	3.98	1.44
Older adults	165	5.62[c]**	1.29	4.84	1.02	4.29[c]*	1.31

Note. Website satisfaction subscales range from 1 to 7. A higher mean indicates more satisfaction with the website. *M*, mean; *SD*, standard deviation. Figure does not add up to $n = 436$ due to missing data. [a]Mean differs significantly compared to the text-only condition (main effect of condition). [b]Mean differs significantly compared to younger adults within the text-only condition (interaction effect). [c]Mean differs significantly compared to younger adults within the total group (main effect of age). * $p < .05$. ** $p < .01$. *** $p < .001$.

Recall of cancer-related information

Younger adults recalled on average 38.5% of the information correctly and older adults 36.1%, $F(1, 428) = 1.08$, $p = .300$, $\eta_p^2 = .00$. Results also yielded no significant main effects for condition, $F(3, 428) = 0.18$, $p = .910$, $\eta_p^2 = .00$, nor an interaction effect between condition and age group, $F(3, 428) = 0.59$, $p = .619$, $\eta_p^2 = .00$. No significant differences were found between younger and older adults' recall of information when cognitive illustrations were added to the website ($M_{younger} = 8.41$, $SD = 4.58$ vs. $M_{older} = 7.93$, $SD = 4.63$; $t(114) = 0.54$, $p = .592$) or when an affective illustration was added to the website ($M_{younger} = 8.20$, $SD = 5.07$ vs. $M_{older} = 8.74$, $SD = 5.05$; $t(103) = 0.54$, $p = .594$). Therefore, Hypotheses 2a and 2b were not supported, indicating that cognitive illustrations do not increase information recall in younger (and older) adults and affective illustrations do not increase information recall in older (and younger) adults. Total recall scores for each condition and recall scores stratified by age group are shown in Table 2.3.

For testing the relationship between satisfaction with emotional support and recall of information for younger and older adults (H3), PROCESS showed no significant interaction effect between satisfaction with emotional support and age group on recall of information, $b = 0.51$, $SE = 0.35$, $t = 1.46$, $p = .145$. However, a conditional effect of satisfaction with emotional support on recall of information for the older adults was revealed, $b = 0.56$, $SE = 0.28$, $t = 1.97$, $p = .050$, indicating that when older adults perceived higher emotional support from the website, they recalled significantly more information. This effect was not significant for the younger adults, $b = 0.05$, $SE = 0.20$, $t = 0.24$, $p = .811$, confirming Hypothesis 3. This conditional effect is depicted in Figure 2.3.

Table 2.3. Percentages of information recalled correctly stratified by condition and younger (< 65 years) and older (≥ 65 years) adults ($n = 436$)

		Recall of cancer-related information		
	n	*% recall*	*M*	*SD*
Text only	101	38.1	8.38	4.54
Younger adults	61	40.2	8.84	3.83
Older adults	40	34.9	7.68	5.44
Cognitive illustration	116	37.5	8.24	4.58
Younger adults	76	38.2	8.41	4.58
Older adults	40	36.0	7.93	4.63
Affective illustration	105	38.2	8.40	5.04
Younger adults	66	37.3	8.15	5.07
Older adults	39	49.7	8.74	5.05
Both illustrations	114	36.7	8.07	5.06
Younger adults	68	38.3	8.43	5.42
Older adults	46	34.3	7.54	4.48
Total	436	37.6	8.27	4.80
Younger adults	271	38.5	8.46	4.75
Older adults	165	36.1	7.95	4.87

Note. Recall of information ranges from 0 to 22 ($M = 8.27$, $SD = 4.80$). The higher the score the more information was recalled correctly. *M*, mean; *SD*, standard deviation.

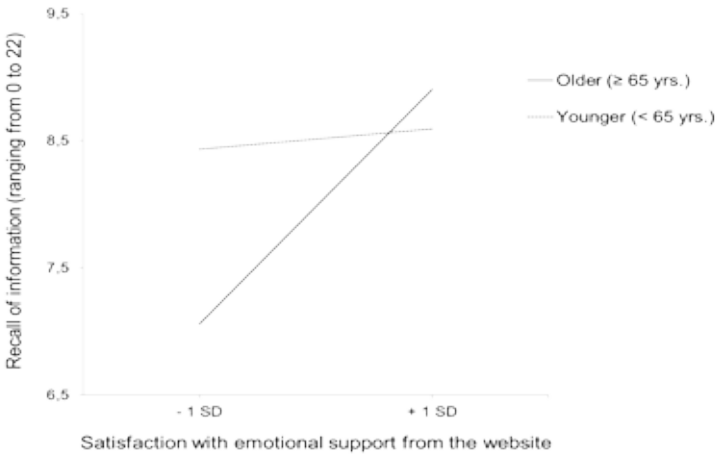

Figure 2.3. Interaction effect between satisfaction with emotional support and age on recall of information.

Discussion

This study examined the effect of adding cognitive and affective illustrations to online health information on older adults' website satisfaction and recall of cancer-related information. Results showed that both younger and older adults were more satisfied with the attractiveness of the website when any type of illustration was provided. Furthermore, older adults were more emotionally satisfied with the website than younger adults. Being more emotionally satisfied with the website led to greater recall for older adults, but not for younger adults, which is the major finding of this study. In this section, the theoretical contribution of the study is highlighted, followed by limitations and future research directions. Furthermore, the practical implications are discussed.

Our data revealed some interesting findings that can contribute to the theoretical framework of using illustrations in online health communication. The results revealed that emotion regulation plays an important role in older adults' memory for cancer-related information. When older adults perceived information as emotionally gratifying (i.e., high levels of satisfaction with emotional support from the website), recall of information was significantly higher than when older adults perceived information as not emotionally gratifying (i.e., low levels of satisfaction with emotional support from the website). This effect was not found for younger adults, which is in agreement with the socioemotional selectivity theory (Carstensen et al., 1999) that asserts that older adults hold more emotionally meaningful goals than younger adults and put more effort into memorizing information that is relevant to their goals (i.e., emotional well-being).

The data partially supported Levie and Lentz's (1982) functional approach to illustrations. An affective illustration led to increased satisfaction with the attractiveness of the website, which is consistent with the affective function of illustrations. However,

it did not increase satisfaction with emotional support from the website. The data showed no support for the cognitive function of illustrations: Adding cognitive illustrations was not associated with greater satisfaction with the comprehensibility of the website. However, consistent with the findings of Park and Lim (2004), we found that cognitive illustrations can have affective functions as well, and enhanced satisfaction with the attractiveness of the website. In explaining website satisfaction, age was found to explain some of the variance in website satisfaction. Younger adults were more satisfied with the comprehensibility of the website than older adults, especially when no illustrations were used, and older adults were more satisfied with the perceived emotional support from the website than younger adults.

We could not find evidence for the positivity bias in older adults' memory. Adding an affective illustration did not increase older adults' recall of information. This might be explained by our pretest sample, which consisted of students. As aging leads to differences in perceptions of stimuli (Mather & Carstensen, 2005), older adults may not have perceived the affective illustrations as intended. Similarly, our "healthy" sample might have accounted for not finding the positivity bias as well. It might be possible that our sample did not perceive the affective illustration as emotionally relevant, because of their low personal relevance for the topic. Future research should examine whether older adults perceive different illustrations as affective than do younger ones, as well as whether cancer patients have different perceptions of what illustrations are affective compared to healthy adults. It is therefore desirable to replicate this study among older cancer patients to test the positivity bias in older adults' memory.

We did also not find support for the multimedia effect, stating that adding cognitive illustrations should result in superior results compared to text-only information (Mayer, 1999). Adding cognitive illustrations did not lead to an increase in recall of information for either younger or older adults. This might be explained by literature suggesting that other content-related and person-related factors, such as readability of the text and health literacy level of the learner, play a more important role than illustrations (McInnes & Haglund, 2011). Older adults are usually found to have lower health literacy, which might influence the extent to which they learn information (McCray, 2005; Mårtensson & Hensing, 2012). As we did not measure health literacy, we do not know whether our sample of older adults indeed had lower health literacy than the younger age group and whether differences in health literacy levels would have influenced the effects of cognitive illustrations. Future research should further examine whether health literacy influences processing of cancer-related information.

Although our results give insight into how illustrations influence older adults' website satisfaction and recall of cancer-related information, some other factors might explain our results as well. "Age alone is a meaningless demographic" (Lippincott, 2004, p. 106) and chronological age is of course not the only factor our two age groups differ on. Both age groups are very heterogeneous entities, varying on multiple levels (both within and between groups). Especially the older age group is a very heterogeneous group; individual differences increase as people get older (Dannefer, 1988). Future research should unravel the complex underlying structure of age and other factors, such as gender, education level, and Internet experience (Loos, 2012). For instance, we did not find differences in Internet experience between the older and

younger age group in our sample, which might have biased the results. Although older adults increasingly use the Internet, they use the Internet less frequently than younger adults at the moment (Statistics Netherlands, 2011b). However, it is expected that Internet use among older populations will grow due to the process of generational change and the use of information and communication technology (ICT) facilities. Today's younger adults will be the future's older adults. The current lower Internet experience in the older generation will thus be resolved in time (Duimel, 2007).

As illustrations are used by website designers to enhance website satisfaction and recall of information, these results can contribute to a better understanding of how and when illustrations are effective for older adults. Our results showed that cognitive and affective illustrations can increase satisfaction with attractiveness, but do not contribute to enhanced satisfaction with the comprehensibility and emotional support from the website. The results also showed that perceiving emotional support from a website is related to older adults' ability to correctly recall cancer-related information. It is therefore important to consider what kind of online information provision leads to enhanced emotional support in older adults. Website designers could take these results into account when creating information for older adults on the Web to optimize website satisfaction and recall of information.

Chapter 3

Illustrations enhance older colorectal cancer patients' website satisfaction and recall of online cancer Information

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Abstract

This study aims to investigate the effects of illustrations in online cancer information on older cancer patients' website satisfaction (i.e., satisfaction with the attractiveness, comprehensibility and emotional support from the website) and recall of information. In an online experiment, 174 younger (< 65 years) and older (≥ 65 years) colorectal cancer patients were randomly exposed to a webpage about transanal endoscopic microsurgery consisting of either text-only information, text with two cognitive illustrations or text with two affective illustrations. In general, adding cognitive illustrations compared to text-only information improved the satisfaction with the attractiveness of the website in both younger and older patients. For older patients in particular, cognitive illustrations facilitated recall of cancer information: whereas older patients recalled less information overall compared to younger patients (39% vs. 50%), no statistically significant differences in age on recall were observed when cognitive illustrations were added to text. Furthermore, older patients were more satisfied with the emotional support from the website than younger patients, especially when affective illustrations were present. Our results suggest that effective online cancer communication for ageing populations involves considering both cognitive and affective illustrations to enhance website satisfaction and recall of cancer information.

Introduction

As the Internet is becoming an increasingly valuable source of cancer information, it is important to acknowledge the consequences for aging populations. Older adults are the fastest growing group online (Hart, Chaparro, & Halcomb, 2008; US Census Bureau, 2010). Recent figures in the Netherlands show that 80% of people aged between 65 and 75, and 39% of people aged 75 and older, currently use the Internet (Statistics Netherlands, 2013b). Similar figures exist for other Western countries (Cresci, Jarosz, & Templin, 2012). Yet older adults are known for having more problems seeking, finding and understanding online cancer information than their younger counterparts (Xie, 2008). This might result in lower satisfaction with cancer-related websites (Rideout, Neuman, Kitchman, & Brodie, 2005). Website satisfaction is an important motivational factor for processing and learning information (Park & Lim, 2007). Website satisfaction may, therefore, also influence recall of information, that is the ability to reproduce information. Recall of information is crucial for optimal health outcomes, such as adequate medication intake (Linn, Van Dijk, Smit, Jansen, & Van Weert, 2013), reduced anxiety (Stark & House, 2000) and active participation in decision making (Gaston & Mitchell, 2005). However, more than half of online medical information is immediately forgotten (Van Weert et al., 2011; Bol, Van Weert, et al., 2014), especially by older adults due to gradual decline in cognitive resources that are necessary for understanding and processing new medical information (Salthouse & Babcock, 1991; Brown & Park, 2003). It is, therefore, crucial to identify effective ways of presenting online information to older adults to increase website satisfaction and recall of information.

Cognitive and affective illustrations in online cancer information

Illustrations are commonly used in health information materials about cancer (King, 2015), and have been found to enhance website satisfaction (Bol, Van Weert, et al., 2014) and recall of information (Houts, Doak, Doak, & Loscalzo, 2006). The functional approach to the effects of text illustrations distinguishes between two types of illustrations: cognitive and affective illustrations (Levie & Lentz, 1982). Cognitive illustrations, such as icons and graphs that visually represent text, are explanatory by facilitating comprehension and learning of information (King, 2015; Levie & Lentz, 1982). Affective illustrations, such as photos of persons, do not aim to explain text information but rather aim to enhance enjoyment and elicit positive emotions (Levie & Lentz, 1982).

Earlier research gives reason to assume that cognitive and affective illustrations can influence three types of website satisfaction. First, studies have shown that both cognitive and affective illustrations increase *satisfaction with the attractiveness of a website* (Van Weert et al., 2011; Bol, Van Weert, et al., 2014). This type of satisfaction refers to the extent to which web users find the website nicely looking and enjoyable. Second, research has also shown that cognitive illustrations are especially effective in improving *satisfaction with the comprehensibility of a website* (Van Weert et al., 2011). This can be defined as the extent to which users are content with the readability level and clarity of the information on the website. Third, affective illustrations contribute to higher *satisfaction with the emotional support from a website* (Harp & Mayer, 1997).

Online information is found to provide its users with emotional benefits by enhancing feelings of, for instance, hope and empowerment (Fogel, Albert, Schnabel, Ditkoff, & Neugut, 2002; Høybye, Johansen, & Tjørnhøj-Thomsen, 2005), and can therefore be referred to as the extent to which users feel that a website helps deal with emotions and stress.

Furthermore, the cognitive theory of multimedia learning suggests that individuals learn better from words and pictures than from words alone (Mayer, 2014). As cognitive illustrations facilitate building mental images by creating connections between words and pictures, these illustrations are expected to reduce working memory demands, which in turn increases recall of information (Paivio, 1990). Cognitive illustrations might especially benefit
older people, as their working memory capacity gradually declines as they age (Salthouse & Babcock, 1991). Moreover, affective illustrations can also aid older adults in recalling information. The socioemotional selectivity theory argues that emotionally relevant information is better remembered by older adults, since emotional goals are prioritized when life is perceived as more limited (Carstensen, Fung, & Charles, 2003). Affective illustrations could generate positive feelings, which may transfer to the online text as well, resulting in better recall of information.

While a number of studies have examined the effects of illustrations on website satisfaction (e.g., Park & Lim, 2007) and recall of information (e.g., Mayer, 2014), research on how older cancer patients could benefit from cognitive and affective illustrations has been scarce, and findings have been inconsistent. For instance, while some research has reported that cognitive illustrations improve website satisfaction in older healthy adults (Van Weert et al., 2011), other research did not find evidence for enhanced website satisfaction in older healthy adults when cognitive or affective illustrations were present (Bol, Van Weert, et al., 2014). Likewise, with respect to recall of information, some research has claimed that older adults recall information better when cognitive illustrations are added to text (Cherry, Dokey, Reese, & Brigman, 2003) or when affective illustrations are present (Carstensen et al., 2003), while other research has failed to find such evidence (Liu, Kemper, & McDowd, 2009).

There are several possible explanations for these inconsistent findings. First, definitions of young and old age differ across studies. Second, research among patient populations is limited. Considering that previous age definitions might not be representative for the average age of younger and older cancer patients, this study specifically aims to investigate the effects of cognitive and affective illustrations on website satisfaction and recall of online cancer information among colorectal cancer patients. We thereby particularly focus on how older cancer patients benefit from such illustrations. However, to test whether adding illustrations would not disadvantage younger cancer patients, we compare the effects of both younger and older cancer patients. In assessing age differences, we chose age younger than 65 for the younger age group and age 65 and older as the older age group. These two age groups are generally considered suitable for separate analysis in oncology settings (Jorgensen, Young, Harrison, & Solomon, 2012). The central research question to this study is: What are the effects of adding cognitive and affective illustrations to online information on younger and older colorectal cancer patients' website satisfaction and recall of information?

Method

Colorectal cancer patients were randomly assigned to one of three experimental conditions (webpage with text-only information vs. webpage with text and cognitive illustrations vs. webpage with text and affective illustrations) stratified by age (younger [$<$ 65 years old] vs. older [$\geq$ 65 years old]). Power calculation was based on a between-subjects design using an analysis of variance (ANOVA) to analyze differences between the experimental conditions and age groups. To acquire statistical power of 80% to detect medium effect sizes ($f = 0.25$) with an alpha of 0.05, a total sample size of at least 158 patients was needed (Cohen, 1988).

Stimulus materials

We used the Deventer Hospital website to develop a webpage containing information about transanal endoscopic microsurgery (TEM), a minimally invasive solution for the excision of certain rectal polyps or early-stage rectal tumors. It was important that our participants had no prior knowledge about TEM to ensure that information recall was a result of exposure to the webpage presented during this experiment. Since TEM is a relatively uncommon treatment in the colorectal cancer patients of our study sample, we expected our participants to have little prior knowledge. We created three versions of this webpage: text-only information, text with cognitive illustrations and text with affective illustrations. The text information about TEM was the same across conditions.

Based on two pretests (see Appendix A for more detailed description), two cognitive and two affective illustrations were selected. First, eight cognitive and eight affective illustrations were pretested among colorectal cancer patients ($n = 48$). The cognitive illustrations contained four illustrations depicting TEM treatment using a special tube to excise rectal polyps or early-stage rectal tumors, and four illustrations depicting a stoma, which is an artificial opening of an internal organ on the surface of the body created surgically as a result of a complication that can occur during TEM treatment. The eight affective illustrations were colored photos depicting health professionals with or without patients.

Based on three cognitive items, we selected two cognitive illustrations depicting (1) the TEM treatment and (2) a stoma. Three affective items revealed the most favorable affective illustration, which was selected as the upper illustration on the affective illustrations webpage. However, the pretest did not reveal a second particularly well-evaluated affective illustration, resulting in conducting a second pretest among a new sample of colorectal cancer patients ($n = 16$). Based on this second pretest, we selected the webpage with two affective illustrations that showed (1) a male doctor presenting an anatomical model of a colon and (2) a female doctor visiting a male patient who is lying in bed. The illustrations were added on the right side of the webpage (see Figures 3.1 and 3.2).

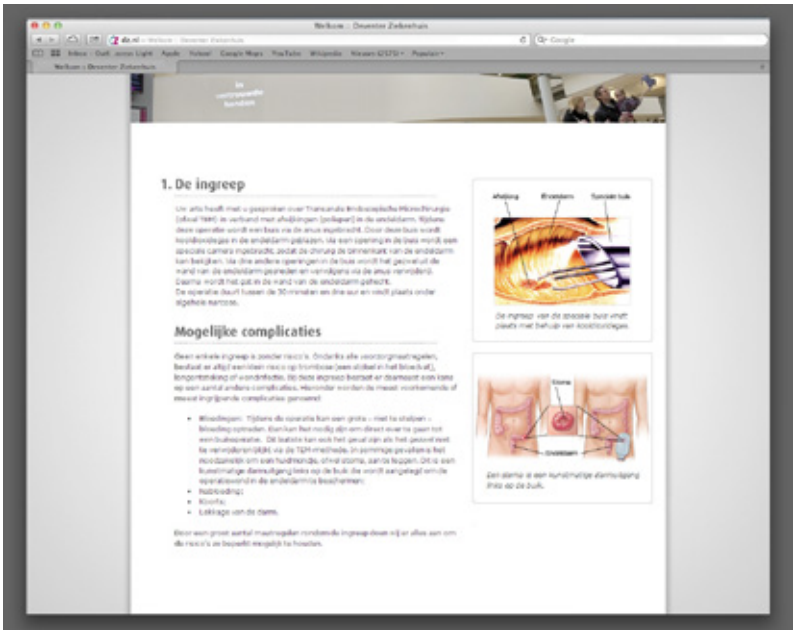

Figure 3.1. Webpage of the Deventer Hospital containing information on transanal endoscopic microsurgery and two cognitive illustrations.

Figure 3.2. Webpage of the Deventer Hospital containing information on transanal endoscopic microsurgery and two affective illustrations.

Sample

Patients with a colon, rectum or rectosigmoid carcinoma who had visited the Deventer Hospital in the Netherlands for a follow-up consultation between March 2011 and May 2014 were identified. Eligibility criteria required patients to (1) be aged 18 years or older, (2) have no cognitive declines according to the medical file, (3) have access to the Internet to complete the online questionnaire and (4) have provided digital informed consent. Only follow-up patients were approached, since we considered it unethical to provide newly diagnosed patients with information about a treatment option (TEM) that would not be among the available treatment options that were being discussed with their oncologists.

Procedure

A physician assistant at the Deventer Hospital selected colorectal cancer patients who met the first two eligibility criteria of the study. Patients were approached by telephone and asked whether they had access to the Internet and were willing to complete an online questionnaire. Patients were then informed about the study, and interested patients received a link to an online questionnaire. Patients could only start the questionnaire after consenting with the proposed study via a statement in the questionnaire. After questions on socio-demographic and medical characteristics, patients were randomly exposed to one of three webpages. Patients were informed to carefully attend to the webpage and that they could not return to the webpage. After exposure, patients' recall of the information on the webpage was assessed. Next, patients were able to view the webpage again, followed by questions on their satisfaction with the webpage. Finally, patients were asked whether they completed the questionnaire themselves, with someone else or whether someone else completed the questionnaire for them. Ethical approval for this study was granted by the local feasibility advisory committee of the Deventer Hospital (reference number ME 13-26) and the institutional review board of the Amsterdam School of Communication Research (reference number 2014-CW-100).

Measures

Website satisfaction

Website satisfaction was measured with the Website Satisfaction Scale (Bol, Van Weert, et al., 2014), which consists of three subscales, that is satisfaction with the attractiveness of the website, satisfaction with the comprehensibility of the website and satisfaction with the emotional support from the website. A selection of items reflecting these scales were, respectively, "the website contains clear language," "the website looks nice" and "the website gives ease of mind." All items were rated on a 7-point Likert scale (1 = "totally disagree," 7 = "totally agree"). A confirmatory factor analysis (CFA), using the three original subscales as put forth by Bol, Van Weert, et al. (2014), resulted in very poor fit. An exploratory factor analysis suggested a better three-factor solution by omitting two items that loaded on two factors (factor loadings > 0.40). After omission, CFA resulted in a good fit with χ^2 (31) = 55.73, p = .004, root mean squared error of approximation (RMSEA) = .068, Standardized Root Mean Square Residual (SRMR) = .062, Tucker-Lewis Index (TLI) = .974, comparative fit index (CFI) = .982 Reliability analysis confirmed three reliable subscales, that is

satisfaction with the attractiveness of the website (three items, α = .86), satisfaction with the comprehensibility of the website (three items, α = .88) and satisfaction with the emotional support from the website (four items, α = .95).

Recall of information

Recall was assessed based on the Netherlands Patient Information Recall Questionnaire (Jansen, Van Weert, et al., 2008). Eleven free-recall questions reflected the TEM information on the webpage, for example "During TEM treatment, a special tube is used. How is this tube inserted?" All questions were provided with a textbox in which patients could answer each specific question. Scores were allocated using an a priori developed codebook, consisting of the following scores: 0 (not recalled), 1 (partially recalled) and (fully recalled). A second coder independently scored 45 (25.9%) of the cases to assess interrater reliability, which appeared to be good (mean κ = 0.94, range = 0.85 – 1.00). Scores for the 11 questions were summed and ranged from 0 to 22. These scores were converted to percentages of correctly recalled information.

Patient characteristics

Patients' socio-demographic background was addressed by items that enquired about age, gender and education. Next, patients' medical background was assessed by items about diagnosis (i.e., type and time since diagnosis in months) and treatment (i.e., type and treatment goal). Additional relevant background characteristics included Internet use (hours per week), prior medical knowledge (i.e., in general, about colorectal cancer, and about TEM, measured on a 7-point Likert scale, range: 1 = "no knowledge," 7 = "much knowledge") and patients' frailty. Frailty was measured using the Groningen Frailty Indicator (Schuurmans, Steverink, Lindenberg, Frieswijk, & Slaets, 2004), a 15-item scale to screen the loss of functions and resources in physical (mobility functions, multiple health problems, physical fatigue, vision, hearing), cognitive (cognitive functioning), social (emotional isolation) and psychological functioning (depressed mood, feelings of anxiety). Each item was rated with 0 or 1 point, resulting in a sum scale ranging from 0 (not frail at all) to 15 (very frail).

Statistical analysis

F-statistics and chi-square statistics were used to test whether randomization had succeeded for age, gender, educational level, diagnosis, treatment, Internet use, prior medical knowledge and frailty. To establish whether adding illustrations to text enhances website satisfaction and recall of cancer information, four ANOVAs were conducted, with condition and age group as independent variables, and the three satisfaction subscales and recall of cancer information as the dependent variables. Additional Tukey's HSD (honest significant difference) tests (to compare means within the three experimental groups) and simple effects analysis (to compare means of one independent variable within the other) were conducted where appropriate.

Results

Sample randomization and characteristics

The patient recruitment flow is depicted in Figure 3.3. A total of 371 patients were assessed for eligibility, of which 73.3% ($n = 272$) were eligible to participate in the study. Eligible participants were more likely to be younger than non-eligible participants, $F(1, 369) = 33.63$, $p < .001$, $\eta_p^2 = 0.08$, and were more often men, $\chi^2 = 7.03$, $p = .008$. The main reason for not being eligible to participate in the study was not having access to a computer or the Internet (89.9%, $n = 89$). Before randomization, another 20.6% ($n = 56$) dropped out, resulting in randomizing 83 younger and 133 older patients to the experimental conditions. Of those who were randomized to the allocated condition (i.e., text-only information, $n = 70$; text with cognitive illustrations, $n = 73$; text with affective illustrations, $n = 73$), 7.4% ($n = 16$) did not finish the questionnaire for unknown reasons. Of those patients who completed the questionnaire ($n = 200$), 13.0% ($n = 26$) were excluded from analysis, due to having prior TEM knowledge (i.e., scored higher than 4 on a 7-point Likert scale) (42.3%, $n = 11$), reporting to have another diagnosis than colorectal cancer (15.4%, $n = 4$), not understanding the questionnaire (15.4%, $n = 4$), not having completed the questionnaire independently (11.5%, $n = 3$), reporting to have undergone TEM (11.5%, $n = 3$) and filling out the questionnaire twice (3.9%, $n = 1$). The total sample of 174 patients was sufficient to detect meaningful differences according to the power analysis.

The final sample of 174 patients was on average 67.75 years old ($SD = 9.02$, range = 37 – 90) and 61.5% were men. Of these patients, 62 were younger ($M_{age} = 58.03$, $SD = 5.17$, 56.5% men) and 112 were older adults ($M_{age} = 73.13$, $SD = 5.50$, 64.3% men). Besides older patients being significantly older than younger patients, $F(1, 172) = 313.34$, $p < .001$, $\eta_p^2 = 0.65$, older patients were also less likely to receive chemotherapy compared to younger patients, $\chi^2 = 4.84$, $p = .028$, and had less prior colorectal cancer knowledge, $F(1, 172) = 4.28$, $p = .040$, $\eta_p^2 = .02$, and TEM, $F(1, 172) = 4.37$, $p = .038$, $\eta_p^2 = .03$. Nevertheless, the experimental conditions stratified by age group did not differ on any of these variables, which suggested successful randomization. We, therefore, did not include any covariates in our analyses. Patient characteristics stratified by age are shown in Table 3.1.

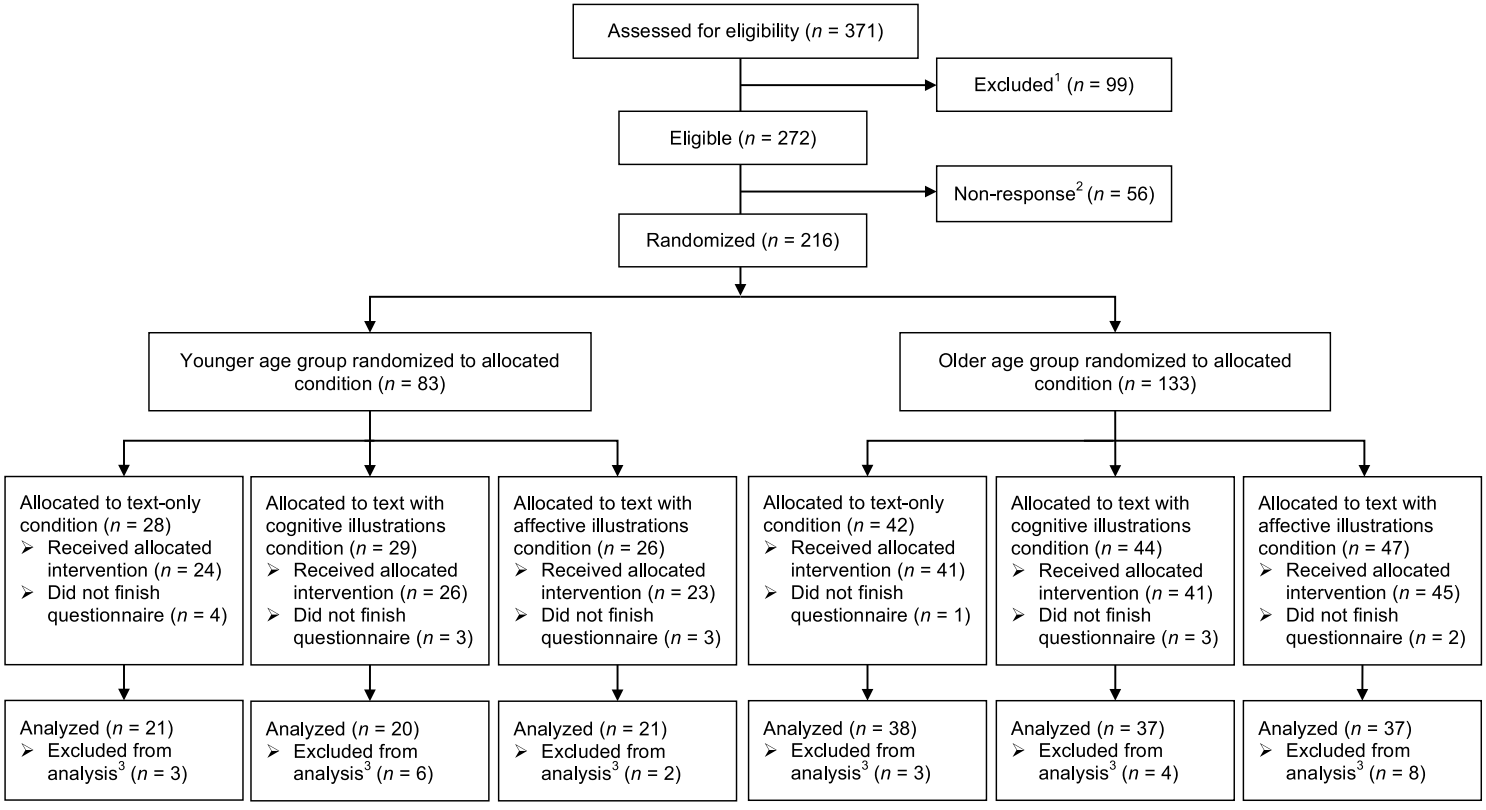

Figure 3.3. Patient recruitment flow chart.

Notes. [1]Did not have access to Internet/computer ($n = 89$), suffered from cognitive declines ($n = 4$), unknown ($n = 6$); [2]Did not feel like participating ($n = 26$), felt too sick or too tired ($n = 8$), struggled with online questionnaire ($n = 6$), felt too old to participate ($n = 3$), deceased ($n = 1$), other ($n = 3$), unknown ($n = 9$); [3]Too much prior TEM knowledge ($n = 11$), patient-reported other diagnosis than colorectal cancer ($n = 4$), did not understand the questionnaire ($n = 4$), questionnaire filled out by someone else ($n = 3$), underwent TEM ($n = 3$), duplicate ($n = 1$).

Table 3.1. Patient characteristics

Variable	All, *n* = 174	Younger patients, *n* = 62	Older patients, *n* = 112	*p*-value
Sociodemographic characteristics				
Age, mean ± *SD*	67.75 ± 9.02	58.03 ± 5.17	73.13 ± 5.50	< .001
Gender				.393
Male, *n* (%)	107 (61.5)	35 (56.5)	72 (64.3)	
Female, *n* (%)	67 (38.5)	27 (43.5)	40 (35.7)	
Education level				.336
Low education level, *n* (%)	78 (45.9)	24 (39.3)	54 (49.5)	
Middle education level, *n* (%)	48 (28.2)	21 (34.4)	27 (24.8)	
High education level, *n* (%)	44 (25.9)	16 (26.2)	28 (25.7)	
Medical characteristics				
Type of diagnosis				
Colorectal cancer, *n* (%)	174 (100.0)	62 (100.0)	112 (100.0)	NA[a]
Breast cancer, *n* (%)	3 (1.7)	1 (1.6)	2 (1.8)	1.000
Lung cancer, *n* (%)	2 (1.1)	0 (0.0)	2 (1.8)	.752
Haematological cancer, *n* (%)	1 (0.6)	0 (0.0)	1 (0.9)	1.000
Urological cancer, *n* (%)	4 (2.3)	0 (0.0)	4 (3.6)	.328
Skin cancer, *n* (%)	4 (2.3)	0 (0.0)	4 (3.6)	.328
Time since diagnosis (months), mean ± *SD*	39.71 ± 43.82	33.98 ± 18.33	42.88 ± 52.72	.200
Type of treatment				
Surgery, *n* (%)	139 (79.9)	49 (79.0)	90 (80.4)	.991
Chemotherapy, *n* (%)	72 (41.4)	33 (53.2)	39 (34.8)	.028
Radiation therapy, *n* (%)	50 (28.7)	20 (32.3)	30 (26.8)	.556
Hormone therapy, *n* (%)	3 (1.7)	0 (0.0)	3 (2.7)	.489
Immunotherapy, *n* (%)	2 (1.1)	1 (1.6)	1 (0.9)	1.000
None, *n* (%)	32 (18.4)	9 (14.5)	23 (20.5)	.437
Other, *n* (%)	20 (11.5)	10 (16.1)	10 (8.9)	.239
Treatment goal				.070
Curative, *n* (%)	156 (89.7)	59 (95.2)	97 (86.6)	
Palliative, *n* (%)	9 (5.2)	3 (4.8)	6 (5.4)	
Unknown, *n* (%)	9 (5.2)	0 (0.0)	9 (8.0)	
Other background characteristics				
Internet use, mean ± *SD*	7.45 ± 7.26	7.73 ± 7.73	7.29 ± 7.01	.707

Prior medical knowledge				
General medical knowledge[b], mean ± *SD*	2.46 ± 1.48	2.73 ± 1.65	2.31 ± 1.36	.078
Medical knowledge about colorectal cancer[b], mean ± *SD*	2.07 ± 1.42	2.37 ± 1.65	1.91 ± 1.25	.040
Medical knowledge about TEM[b], mean ± *SD*	1.52 ± 0.89	1.71 ± 0.98	1.42 ± 0.81	.038
Frailty[c], mean ± *SD*	2.15 ± 1.80	1.98 ± 1.90	2.23 ± 1.74	.383

Note. Not all figures add up to 100% due to missing data. *P*-values show (in)significant differences between the younger and older age group. *SD*, standard deviation. [a]Not applicable due to no variation in variable, that is, all patients were diagnosed with colorectal cancer. [b]A higher score indicates more knowledge, measured on a 7-point Likert scale. [c]A higher score indicates higher frailty, measured on a scale ranging from 0 to 15.

Effects of illustrations and age on website satisfaction

Adding illustrations to text information significantly increased satisfaction with the attractiveness of the website in both younger and older patients, $F(2, 168) = 6.74$, $p = .002$,$\eta_p^2 = .07$. Satisfaction with the attractiveness of the website was especially enhanced when cognitive illustrations were present ($M = 5.00$, $SD = 1.15$) as compared to affective illustrations ($M = 4.65$, $SD = 1.19$) and text-only information ($M = 4.16$, $SD = 1.44$). Yet adding illustrations did not increase satisfaction with the comprehensibility of the website compared to text-only information, $F(2, 168) = 0.50$, $p = .606$, $\eta_p^2 = .01$. Even though older patients were in general more satisfied with the emotional support from the website than younger patients, $F(1, 168) = 5.25$, $p = .023$, $\eta_p^2 = .03$, simple effects showed that this age difference only reached significance when affective illustrations were added to text, $F(1, 170) = 4.57$, $p = .034$. To summarize, cognitive illustrations increased younger and older patients' satisfaction with the attractiveness of the website, but did not increase satisfaction with the comprehensibility and emotional support. When affective illustrations were added to text information, older patients were more satisfied with the emotional support from the website than younger patients. Descriptives of the website satisfaction measures appear in Table 3.2.

Table 3.2. Effects of cognitive and affective illustrations on website satisfaction stratified by younger and older cancer patients

		Satisfaction with the attractiveness		Satisfaction with the comprehensibility		Satisfaction with the emotional support	
	n	*M*	*SD*	*M*	*SD*	*M*	*SD*
Text-only information	59	4.16	1.44	5.55	1.25	3.83	1.81
Younger patients	21	3.86	1.43	5.79	0.97	3.35	1.42
Older patients	38	4.33	1.44	5.42	1.37	4.10	1.96
Text with cognitive illustrations	57	5.00[a]***	1.15	5.86	0.98	4.15	1.28
Younger patients	20	4.98	1.09	5.77	0.99	4.09	1.31
Older patients	37	5.01	1.19	5.91	0.99	4.19	1.27
Text with affective illustrations	58	4.65	1.19	5.66	1.32	4.25	1.41
Younger patients	21	4.41	0.87	5.84	1.12	3.75	1.46
Older patients	37	4.78	1.33	5.55	1.43	4.53[b]*	1.31
Total	174	4.60	1.31	5.69	1.19	4.07	1.52
Younger patients	62	4.41	1.23	5.80	1.01	3.72	1.41
Older patients	112	4.71	1.34	5.63	1.28	4.27[c]*	1.55

Note. Website satisfaction subscales range from 1 to 7, with higher scores indicating more satisfaction with the website. *M*, mean; *SD*, standard deviation. [a]Mean differs significantly compared to the text-only information condition (main effect of condition). [b]Mean differs significantly compared to the younger patients in the text with affective illustrations condition (interaction effect). [c]Mean differs significantly compared to the younger patients in general (main effect of age). * $p < .05$. *** $p < .001$.

Effects of illustrations and age on recall of information

On average, older patients recalled less information than younger patients, $F(1, 168) = 9.19$, $p = .003$, $\eta_p^2 = .05$: whereas younger patients recalled almost half of the information correctly (49.7%), older patients recalled on average 38.6% correctly ($M_{older} = 8.49$, $SD = 5.03$ vs. $M_{younger} = 10.94$, $SD = 5.11$). Adding illustrations did not increase younger and older patients' recall of information, $F(2, 168) = 0.10$, $p = .905$, $\eta_p^2 = .00$. Nevertheless, results yielded a marginally significant interaction effect between condition and age, $F(2, 168) = 2.93$, $p = .056$, $\eta_p^2 = .03$. Simple effects analysis revealed that older patients recalled significantly less information than younger patients when information was presented as text-only information ($p = .001$) or as text with affective illustrations ($p = .036$). However, this difference disappeared when information was presented as text with cognitive illustrations ($p = .938$), indicating that cognitive illustrations improve older patients' recall of information. To summarize, older patients recall less information in general than younger patients. Nevertheless, older patients recall similar amounts of information as younger patients when cognitive illustrations are added to online text information. Recall scores appear in Table 3.3.

Table 3.3. Effects of cognitive and affective illustrations on recall of information stratified by younger and older cancer patients

			Recall of information	
	n	*Percent recall*	*M*	*SD*
Text-only information	59	40.59	8.93	5.50
Younger patients	21	53.68	11.81	5.38
Older patients	38	33.36	7.34[a]***	4.94
Text with cognitive illustrations	57	43.68	9.61	5.40
Younger patients	20	43.18	9.50	5.71
Older patients	37	44.00	9.68	5.31
Text with affective illustrations	58	43.41	9.55	4.66
Younger patients	21	51.95	11.43	4.07
Older patients	37	38.59	8.49[b]*	4.68
Total	174	42.55	9.36	5.18
Younger patients	62	49.73	10.94	5.11
Older patients	112	38.59	8.49[c]**	5.03

Note. Recall of information ranges from 0 to 22, with higher scores indicating the more information was recalled. *M*, mean; *SD*, standard deviation. [a]Mean differs significantly compared to the younger patients in the text-only condition (interaction effect). [b]Mean differs significantly compared to the younger patients in the text with affective illustrations condition (interaction effect). [c]Mean differs significantly compared to the younger patients in general (main effect of age). * $p < .05$. ** $p < .01$.*** $p < .001$.

Discussion

Considering the trend of making crucial cancer information available on the Internet, online cancer information should be presented in such a way that ageing populations are satisfied with and able to recall the presented information. Previous research on the effectiveness of illustrations has not demonstrated consistent findings on how older cancer patients in particular may benefit from illustrations when using cancer information online (Liu et al., 2009; Bol, Van Weert, et al., 2014). To the best of our knowledge, this is the first study to examine how cognitive and affective illustrations enhance website satisfaction and recall of online cancer information among colorectal cancer patients.

Our results suggest that adding illustrations benefits both younger and older patients: cognitive illustrations increased both younger and older patients' satisfaction with the attractiveness of the website as compared to text-only information. Furthermore, whereas adding cognitive or affective illustrations did not disadvantage younger patients' website satisfaction and recall of cancer information in general, older patients in particular seem to benefit from having such illustrations on a cancer-related website. The most important clinically relevant finding was that older patients' recall of information improved when cognitive illustrations were added to text information. While older patients performed substantially worse on recall of information compared

to younger patients overall (39% vs. 50%), adding cognitive illustrations to text led to improved recall of information in such a way that no statistically significant age differences in recall were observed.

Another important finding was that older patients were more satisfied with the emotional support from the website, especially when affective illustrations were added to text information. This finding further supports the ideas presented by the socioemotional selectivity theory (Reed, Chan, & Mikels, 2014). Perceiving emotional support from a website is considered an important predictor of adequate recall of information in older adults (Bol, Van Weert, et al., 2014), suggesting that affective illustrations that contribute to perceived emotional support in older patients may, in turn, motivate them to process information. This indicates that illustrations that do not serve as cues for building mental images might nevertheless be able to improve recall of information.

Previous studies have shown inconsistent findings with regard to the effectiveness of illustrations in online cancer communication with older adults. For instance, Liu et al. (2009) found that, even though older adults spent more time looking at illustrations than younger adults, they had poorer comprehension of the health-related information, and Bol, Van Weert, et al. (2014) found no benefit of adding illustrations for older adults' satisfaction and recall. The effects found in the present study might be explained by the sample under investigation. The two abovementioned studies included healthy adults, while the current study included cancer patients. The latter sample might have been more motivated to attend to cancer materials. A recent study revealed that older adults recall more information when taking the time they need to process information (Bol, Van Weert, Loos, et al., 2015). The cognitive and affective illustrations may have increased attention to the webpage, which in turn might have increased website satisfaction and recall of online cancer information among older cancer patients in particular.

Our findings have some important implications for clinical care. Online information can be offered to older cancer patients in addition to clinical encounters. Older individuals process medical information better when such information is provided through multiple sources, for instance by combining interpersonal communication (e.g., communication during clinical encounters) with media sources (e.g., the Internet) (Sparks & Turner, 2008). Websites as used in this study can be provided to cancer patients before, during or after their consultation to prepare for clinical encounters (e.g., by preparing questions to ask the doctors), seek information (e.g., about treatment options) and reduce anxiety (e.g., to seek reassurance that the doctor is doing the right thing) (Ziebland et al., 2004). Furthermore, oncologists could use cognitive illustrations as a tool to help older patients process medical information adequately during consultations.

This study has some limitations. First, we exposed patients to online cancer information about TEM in an experimental setting. Although patients were able to look at the information at their home computer, simply providing a single webpage via an online survey does not reflect how patients seek, find, appraise and act upon information they would naturally find online. Moreover, information about a relatively unknown treatment, such as TEM, might not have been perceived as relevant to our study sample. Personal relevance of information is an important motivational factor for

individuals' willingness to process information (Petty & Cacioppo, 1986). We might have, therefore, underestimated the overall effects on website satisfaction and recall of information. Nevertheless, as the information was the same across all webpages, we were still able to reveal the added value of cognitive and affective illustration in online cancer information.

Second, our sample might have underrepresented older and female patients. Older patients might have been excluded more often because of our inclusion criteria (e.g., needing to have Internet access). Even though the numbers of older adults online rapidly increase, they still use the Internet significantly less than younger adults (Statistics Netherlands, 2013a; Van Weert et al., 2014). Nevertheless, our data reveal positive effects of illustrations in online cancer information for older patients in particular, and these effects might have been even stronger when older inexperienced Internet users were also included in our study sample. The underrepresentation of women in our study might be due to the prevalence of colorectal cancer across sex: men are more likely than women to develop colorectal cancer (International Agency for Research on Cancer, 2012). Thus, even though women are underrepresented in this study, these numbers of men and women are representative for colorectal cancer populations.

Future research could focus on other beneficial communication strategies to improve older patients' satisfaction and recall of online cancer information. A growing body of research emphasizes the value of tailoring information to patients' information needs and preferences (Noar, Benac, & Harris, 2007). Research has shown that older adults yield more variety in their preference of how information is presented (e.g., in text-only format, video format) (Soroka et al., 2006), and should be considered when developing online cancer materials for older adults.

In conclusion, the results reveal an effective communication strategy to improve older cancer patients' website satisfaction and recall of online cancer information. In the current climate of making crucial cancer information increasingly available online, illustrations might be beneficial for most patients, especially older patients, although investigating individuals' specific information needs and preferences should never be neglected.

Chapter 4

How are online health messages processed? Using eye tracking to predict recall of information in younger and older adults

This chapter is currently in press as: Bol, N., Van Weert, J. C. M., Loos, E. F., Romano Bergstrom, J. C., Bolle, S., & Smets, E. M. A. (in press). How are online health messages processed? Using eye tracking to predict recall of information in younger and older adults. *Journal of Health Communication*.

Abstract

Little research has focused on what precedes processing of health messages to predict recall of information, and whether age matters in this regard. To address this gap, this study investigates the relationship between attention and recall among younger (< 65 yrs.) and older (≥ 65 yrs.) adults. Using eye tracking, participants were exposed to a webpage consisting of text-only information, text with cognitive illustrations, or text with affective illustrations. When attention to text increased, older adults recalled more information, whereas younger adults did not. On the other hand, younger adults paid more attention to cognitive illustrations than older adults, and recalled more information. These results reveal conditions under which health messages are effectively recalled by younger and older adults.

Introduction

Attention to information is a critical first step in information processing and eventual recall of information (Wedel & Pieters, 2000). Recall of information is the ability to remember and reproduce information correctly and plays an important role in predicting many health-related behaviors, such as successful disease management (Kravitz et al., 1993) and adherence to medical regimes (Ley, 1988; Linn, Van Dijk, Smit, Jansen, & Van Weert, 2013). Unfortunately, approximately 40 to 80 percent of medical information is immediately forgotten after exposure (Kessels, 2003), especially by older adults (Jansen, Butow, et al., 2008). Older adults have more problems seeking, finding, and understanding health information than younger ones, particularly when presented online (Xie, 2008). Even though increasingly more older adults are using the Internet (Hart, Chaparro, & Halcomb, 2008; US Census Bureau, 2010), this does not necessarily mean that they are able to understand and recall online health information. To optimize recall of information among older adults, information should be provided in such a way that their cognitive abilities are taken into account (Van Gerven, Paas, Van Merriënboer, & Schmidt, 2000). One way to accomplish this is by using illustrations that complement online health texts. Illustrations can serve as cues that enable one to make connections between words and pictures in building mental images, and, thereby, reducing working memory demands (Paivio, 1990). Numerous studies have revealed positive effects on recall of information when adding illustrations to information (e.g., Houts, Doak, Doak, & Loscalzo, 2006; Levie & Lentz, 1982).

Although much research has focused on the effects of using illustrations in health messages (e.g., on recall of information), none to date has considered the process that precedes these effects. Even though three major subprocesses (encoding, storage, and retrieval) have been acknowledged (Lang, 2000), little is known about the association between encoding information (i.e., attention to text and illustrations) and retrieval (i.e., recall of such text and illustrations), whether the encoding process can predict retrieval, and whether age matters in this regard. This study evaluates the relationship between attention to and recall of online health information among younger and older adults. We use eye tracking to gain novel insights into *how* individuals attend to online health texts and illustrations and *under what conditions* this attention leads to accurate recall of information.

Attention to online health information

Attention is not only important for processing information and eventual recall of it (Wedel & Pieters, 2000), but also for a message to register. In their functional approach to the effects of illustrations, Levie and Lentz (1982) propose that illustrations serve an attentional function, that is, attracting and directing attention. In addition, illustrations purportedly serve cognitive and affective functions as well. Cognitive illustrations are those that mainly complement textual information and help people to understand text, whereas affective illustrations are irrelevant to the text but aim to evoke positive feelings and elicit positive emotions (Park & Lim, 2004). Research has shown that attention to information increases when messages include cognitive illustrations (Delp & Jones, 1996) or affective illustrations (Park & Lim, 2007).

Even though a large number of studies have focused on the effects of adding

illustrations, especially cognitive ones, to improve recall (e.g., Levie & Lentz, 1982; Mayer, 2003), research has not yet focused on which parts of information are attended to when illustrations are added to texts. Whether cognitive and affective illustrations arouse interest in the full text or only in the illustrations is unclear (Levie & Lentz, 1982). Traditional measures of attention, such as simply asking whether people had read the instructions (Delp & Jones, 1996) or assessing perceived attention to the information (Park & Lim, 2007), do not provide detailed insights into which parts of information (i.e., text and/or illustrations) are focused on. Such measures may fail to capture attention at all accurately, as it is difficult to remember if one paid attention and, if so, to what extent. Eye tracking could offer greater insight into which specific parts of a health webpage attract attention. This raised the following research question: *How is attention to text and cognitive and affective illustrations divided on a health webpage? (RQ1a)*

Some research has focused on how younger and older adults attend to online information; however, findings have not been consistent. Several studies have indicated that older adults spend in general more time looking at information since their pace of processing information is lower than that of younger adults (John & Cole, 1986; Liu, Kemper, & McDowd, 2009). On the other hand, other studies have found evidence for the contrary (Bol, Romano Bergstrom, et al., 2014) or found no age differences in attention to information when, for instance, videos were added to online information (Bol et al., 2013). Moreover, it is unknown which parts of online information (i.e., text and/or illustrations) are focused on specifically by younger and older adults. It might be that some parts of online information need more processing time than others, and this might differ across age. We therefore explore the following research question: *How do younger and older adults attend to text and illustrations on a health webpage? (RQ1b)*

Does attention to online health information predict recall?

Illustrations also influence how information is recalled. From the perspective of cognitive theory of multimedia learning, information is more deeply embedded in memory when text is combined with illustrations than when text is the exclusive format (Mayer, 1999). The theory is based on the idea that people have two separate processing systems for verbal (i.e., text) and visual (i.e., illustrations) information. As these systems are individually limited, combining text with illustrations will expand cognitive capacity, which results in better recall of information (Paivio, 1971). This multimedia effect is expected to occur when complementary illustrations (i.e., cognitive illustrations) are added to text (Mayer, 1999).

As this theory assumes that people actively use both text and illustrations (during the encoding process) to create mental images that they store in working memory for retrieval in recalling information (Mayer, 1999), it is vital to know to what extent text and illustrations are attended to. Since previous studies have mainly focused on the retrieval process (i.e., recall of information), the individual effects of attention to text and illustrations on recall of information is presently unknown. We therefore pose the following research question: *Is higher attention to text and/or illustrations on a health webpage related to better recall of health information? (RQ2a)*

Whereas previous research has provided evidence for the multimedia effect among younger learners (see Mayer, 2003), studies regarding the multimedia effect in older adults have been scarce and have provided mixed results. Some studies have shown that older adults recall more information when cognitive illustrations are added to text (e.g., Cherry, Dokey, Reese, & Brigman, 2003), while other research has failed to find evidence for the multimedia effect in older adults (e.g., Bol, Van Weert, et al., 2014). Moreover, an eye-tracking study indicated that although older adults spend more time looking at text and illustrations, they have more difficulties integrating illustrations with text (Liu et al., 2009). Exploring whether attention is predictive of recall of information is therefore especially of interest for those of older age. As attention to and recall of information are expected to be related (Wedel & Pieters, 2000), an explanation for age-related differences in the retrieval process (i.e., recall of information) could be that older adults enact a different encoding process (i.e., attention to information) from younger adults. Eye tracking enables us to discern how older adults attend to information (i.e., text and/or illustrations), as well as to examine how predictive this is of their recall of information. We therefore address the following research question: *Is the relationship between attention to text and/or illustrations on a health webpage and recall of health information different for older and younger adults? (RQ2b)*

Methods

Design

We investigated the effect of attention to cognitive and affective illustrations and text on recall of information by exposing participants to one of three conditions (condition: text-only information vs. text and two cognitive illustrations vs. text and two affective illustrations) stratified by age (age: younger [$<$ 65 yrs.] vs. older [$\geq$ 65 yrs.]). These two age groups are generally considered worthy for separate analysis when studying aging effects in health (Jorgensen, Young, Harrison, & Solomon, 2012; Silliman, Troyan, Guadagnoli, Kaplan, & Greenfield, 1997). To reach a statistical power level of 0.80 for detecting large effect sizes (effect size f = .40) with an alpha level of .05, a total sample size of at least 86 participants was required (Cohen, 1988). Permission for this study was granted by the institutional review board of the research institute.

Participants

Participants (n = 129) were recruited via mailings and flyers, the senior panel database of the Dutch Senior Citizens' Association (ANBO), and a snowballing technique. We combined these several recruitment techniques to create a heterogeneous sample. Adults were eligible to take part if they (a) were 18 years or older, (b) had no prior knowledge concerning Radio Frequency Ablation (RFA), (c) had normal to corrected-normal vision, and (d) had no severe cognitive decline according to the Mini Mental State Examination (MMSE: Kok & Verhey, 2002). No prior knowledge on RFA was required since participants were exposed to information about RFA treatment. Although we chose RFA because it is a relatively unknown treatment and we expected our participants to have little prior knowledge of it, we measured participants' prior knowledge and excluded those who reported to have knowledge about RFA (i.e.,

scoring > 4 on a 7-point Likert scale). Table 4.1 presents background characteristics of the sample stratified by younger (< 65 yrs.) and older (≥ 65 yrs.) adults.

Table 4.1. Background characteristics ($n = 97$)

	Younger adults (< 65 yrs.) $n = 55$		Older adults (≥ 65 yrs.) $n = 42$		p
Variable	*n*	*(%)*	*n*	*(%)*	
Gender					.351
Male	21	38.2	20	47.6	
Female	34	61.8	22	52.4	
Age					< .001
Mean (*SD*)	44.02 (12.03)		73.48 (5.90)		
Range	21 – 64		65 – 88		
Education					.019
Low	7	12.7	14	33.3	
Middle	16	29.1	14	33.3	
High	32	58.2	14	33.3	
Internet experience (hours per week)					.085
Mean (*SD*)	15.81 (9.90)		12.27 (9.95)		
Range	0 – 40		1 – 50		
Medical knowledge about lung (scale 1 – 7)[a]					.135
Mean (*SD*)	2.09 (0.97)		1.81 (0.83)		
Range	1 – 5		1 – 4		
Medical knowledge about RFA (scale 1 – 7)[a]					.462
Mean (*SD*)	1.15 (0.36)		1.10 (0.30)		
Range	1 – 2		1 – 2		
Cognitive status (MMSE)[b]					.397
Mean (*SD*)	28.84 (1.17)		28.62 (1.34)		
Range	25 – 30		24 – 30		

Note. Conditions stratified by age did only significantly differ on age and education. *SD*, standard deviation. [a]A higher score indicates more knowledge. [b]A score of 24 or higher indicates no cognitive impairments according to the Mini Mental State Examination (MMSE)

Stimulus material

All participants were exposed to one of three versions of a webpage of the Netherlands Cancer Institute (NKI) on which information concerning RFA appeared: (1) text-only information, (2) text and two cognitive illustrations, and (3) text and two affective illustrations. The text information was constant across conditions. Stimulus material of a previous study was used in which cognitive and affective illustrations were extensively pretested (for detailed description, see Bol, Van Weert, et al., 2014). One cognitive illustration reflected the RFA treatment using a needle to destruct the tumor and the other visualized a pneumothorax, which was one of the complication described in the text. To make the illustrated webpages comparable for eye-tracking purposes, the webpage with affective illustrations required a second illustration. In a pretest, we combined the affective illustration that was already on the webpage in the previous study with three others that were ranked highly in the study's pretest. Students ($n = 49$) indicated on a seven-point Likert scale to what extent they felt these illustrations would be compatible on a webpage. One combination scored highest ($M = 4.02$, $SD = 1.64$) compared to the other two combinations ($M = 3.92$, $SD = 1.54$ and $M = 2.51$, $SD = 1.47$) and was therefore chosen for the affective illustrations webpage. The affective illustrations entailed a photo of a female doctor bending over a female patient and a photo of a male doctor with an anatomical model of the lungs and a patient (see Figure 4.1 and 4.2 for the webpages with cognitive and affective illustrations).

Procedure

The participants were invited and informed about the experiment via email, and were asked to complete an online screening questionnaire concerning age, gender, education, Internet experience, vision, and prior RFA knowledge. Using this information, we stratified our sample on age (< 65, ≥ 65), gender, level of education, and Internet experience. This stratified sample was equally distributed across the three experimental conditions. When the participants arrived for the study, a researcher explained the study procedure, answered questions they had, and asked them to sign an informed consent form. They were to sit behind a 22-inch monitor at a distance between 60 and 80 cm. The SMI RED 120 (2012) eye tracker was attached to the bottom of the monitor. The angular average distance from the actual gaze point to the one measured by the eye tracker was 0.4^0. Eye-tracking data were collected with a gaze sample rate of 120Hz per second, and gaze samples were recorded for eye fixations of 80ms or more. Participants were to follow a moving black dot with their eyes for calibration purposes. After calibration, they read instructions that explained that they could look at the webpage as long as they wanted, and when they were finished, they were to press the space button to record the data. Upon completion (after participants pressed the space bar), participants completed an online questionnaire to assess recall of the information they had just been exposed to. Finally, a researcher assessed participants' cognitive status. At the very end, participants were thanked and were compensated 20 euros for their participation.

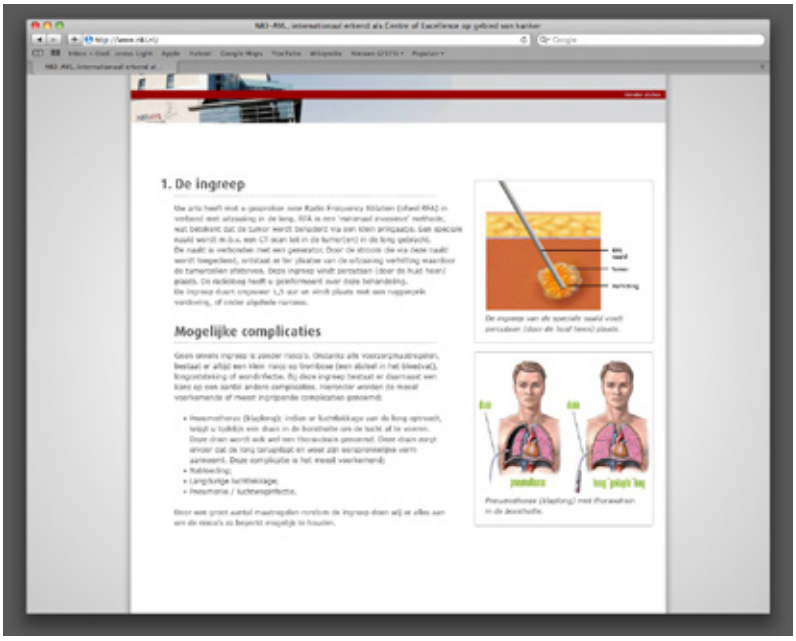

Figure 4.1. Webpage containing RFA text information and cognitive illustrations.

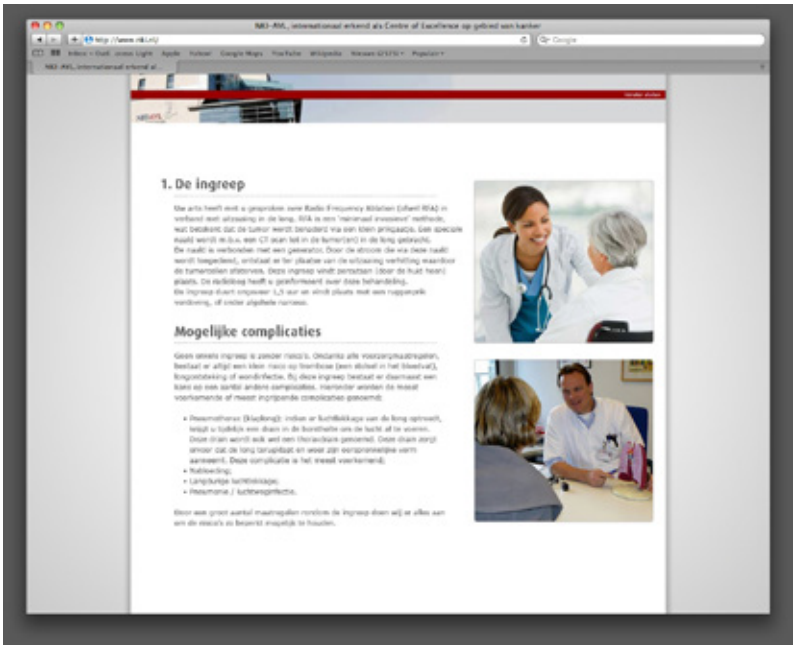

Figure 4.2. Webpage containing RFA text information and affective illustrations.

Measures

Recall of health information

Recall was assessed based on the Netherlands Patient Information Recall Questionnaire (NPIRQ: Jansen, Van Weert, et al., 2008). Questions were produced from the RFA information text, which resulted in 11 free-recall questions, such as "What is the most common complication that can occur during RFA treatment?" (Bol et al., 2013; Bol, Van Weert, et al., 2014). Corresponding answer options were "not discussed," "discussed, but I can't remember the details," and "discussed, namely…." Scoring entailed use of a codebook and ranged from 0 (not recalled), to 1 (recalled partially), to 2 (recalled correctly). Recall scores in 21 cases (21.6%) were double coded by two independent coders to establish interrater reliability (mean $\kappa = .91$, range .67 – 1.00). Scores for the 11 questions were summed and yielded scores within a maximum range from 0 to 22 ($M = 7.09$, $SD = 3.63$). The raw scores were converted to percentages of correctly recalled information. Recall scores and percentages stratified by condition and age group are presented in Table 4.2.

Table 4.2. Percentages of information recalled correctly stratified by condition and younger (< 65 yrs.) and older (≥ 65 yrs.) adults ($n = 97$)

		Recall of health information		
	n	*% recall*	*M*	*SD*
Text only	32	34.1	7.50	3.54
Younger adults	18	35.9	7.89	3.66
Older adults	14	31.8	7.00	3.44
Cognitive illustrations	35	32.6	7.17	3.72
Younger adults	20	38.6	8.50	3.53
Older adults	15	24.5	5.40[a]*	3.29
Affective illustrations	30	29.9	6.57	3.69
Younger adults	17	31.0	6.82	3.54
Older adults	13	28.3	6.23	4.00
Total	97	32.2	7.09	3.63
Younger adults	55	35.4	7.78	3.58
Older adults	42	28.1	6.19[b]*	3.55

Note. Recall of information ranges from 0 to 22. The higher the score the more information was recalled correctly. *M*, mean; *SD*, standard deviation. [a]Mean differs significantly compared to younger adults in the cognitive illustrations condition. [b]Mean differs significantly compared to younger adults.
* $p < .05$.

Attention to the webpage

Participants' attention to the webpage was recorded via the eye tracker in terms of total fixation duration on the webpage (in seconds) ($M = 83.10$, $SD = 41.06$) (Djamasbi, Siegel, & Tullis, 2010). In addition, two Areas of Interest (AOIs) were created for independent determination of the time the participants spent fixating on the text versus the illustrations. Attention was measured in terms of total fixation duration inside the AOIs (in seconds). Heat maps and gaze opacities were created using the cumulative fixation duration data for all participants. In a fixation duration heat map, red indicates a longer time fixating in the area, whereas yellow and green indicate a lesser time fixating in the area, with green indicating the least duration of fixation. In a gaze opacity map, areas receiving attention are visible, and areas that do not are blacked out.

Background variables

Background measures included age, gender, level of education, Internet experience, prior medical knowledge (of lung cancer and RFA treatment), and cognitive status. The age variable (which is continuous) was dichotomized: younger than 65 for the younger age group and 65 and older for the older age group (Jorgensen et al., 2012; Silliman et al., 1997). Level of education was divided into low (primary education, lower vocational education, preparatory secondary vocational education, and intermediate secondary vocational education), middle (senior secondary vocational education and university preparatory vocational education), and high (higher vocational education and university). Internet experience was assessed by the average number of hours the participants reportedly spent per week using the Internet. Prior medical knowledge of lung cancer and RFA was measured via two items using seven-point Likert scales relating to the participants' amount of knowledge of lung cancer and RFA. Cognitive status was assessed using the MMSE, which is a widely used scale to assess the severity of cognitive decline (Kok & Verhey, 2002). None of the participants in our sample were excluded based on the MMSE, as they all scored below the threshold of 24, indicating no severe cognitive decline, such as dementia (Folstein, Folstein, McHugh, & Fanjiang, 2001).

Statistical analyses

The eye-tracking data were prepared and exported to SPSS using the SMI BeGaze software. To test the effects of condition and age on attention (H1a, H1b, RQ1a, RQ1b), three 3 (condition) by 2 (age) ANOVAs were conducted with attention (fixation duration) to the entire webpage, to the text, and to the illustrations as the dependent variables. Examining whether attention predicts recall of information (RQ2a) and how this relationship is moderated by age (RQ2b) was investigated by employing moderation analyses using Hayes' PROCESS macro (Hayes, 2012). All effects were subjected to bootstrap analyses with 5,000 bootstrap samples and a 95% Confidence Interval (CI). Recall of information was the dependent variable, attention to the information on the webpage was the independent variable, and age was a moderator. The independent and moderating variable were centered to the mean.

Results

Eye-tracking data and participants

Prior to analysis, eye-tracking scan paths of all 129 participants were examined. Participants with poor eye-tracking data were removed from the dataset. Poor data included abnormal scan paths due to technical issues (e.g., eye tracker misidentified participant's eyes) and bad tracking ratios (i.e., when less than 75% of the eye movements were recorded by the eye tracker: Romano Bergstrom, Olmsted-Hawala, & Bergstrom, 2014). This was the case for data from 32 participants (mean tracking ratio = 68.6%). Thus, data of 97 participants were included (mean tracking ratio = 94.4%), which exceeded the minimum number of participants ($n = 86$) that was needed according to the power analysis. Even though excluded participants were more likely to be older than included participants (see discussion), $\chi^2 = 4.80$, $p = .028$ ($n = 21$, 65.6%), the excluded older participants did not differ in recall of information compared to the included older participants, $F(1, 126) = 2,33$, $p = .130$. The remaining 97 participants did not differ across the three experimental conditions stratified by age on gender, $\chi^2 = 2.02$, $p = .847$, education level, $\chi^2 = 9.93$, $p = .447$, Internet experience, $F(5, 91) = 1.79$, $p = .123$, $\eta_p^2 = .09$, prior medical knowledge, $F(5, 91) = 1.28$, $p = .278$, $\eta_p^2 = .07$, and prior RFA knowledge, $F(5, 91) = 0.45$, $p = .811$, $\eta_p^2 = .02$. Of the 97 participants, 57.7% were female, and had a mean age of 56.77 years old ($SD = 17.65$).

Age and attention to health information

In answering the question on how attention to text and illustrations is divided on a health webpage (RQ1a), we found that the most time spent on the webpage was dedicated to reading the text information. In the text-only condition, the younger and older adults spent on average 98.1% of their time fixating on the text information on the webpage ($M = 77.60$ seconds, $SD = 35.46$). In the cognitive and affective illustration conditions, respectively 82.8% and 95.9% of the total fixation duration was related to text information (resp. $M = 71.90$, $SD = 42.87$ and $M = 79.61$, $SD = 39.53$) and another 14.9% and 2.3% on the illustrations (resp., $M = 12.90$, $SD = 9.78$ and $M = 1.94$, $SD = 2.20$). Attention to the entire webpage did not differ across conditions, $F(2, 91) = 0.24$, $p = .786$, $\eta_p^2 = .01$. This indicates that despite adding visual elements (i.e., cognitive or affective illustrations), participants spent similar time fixating on the webpage. Cognitive illustrations received significantly more attention than the affective illustrations by both younger and older adults, $F(1, 61) = 35.19$, $p < .001$, $\eta_p^2 = .37$. Heat maps and gaze opacities for the three experimental conditions are presented in Figure 4.3, and the descriptives of the attention measures stratified by condition and age group appear in Table 4.3. When exploring age differences in how online health information is attended to (RQ1b), we found that younger adults ($M = 15.39$, $SD = 11.01$) spent about 60.8% more time fixating on the cognitive illustrations than older adults ($M = 9.59$, $SD = 6.85$), $F(1, 61) = 5.69$, $p = .020$, $\eta_p^2 = .09$ (see Figure 4.4).

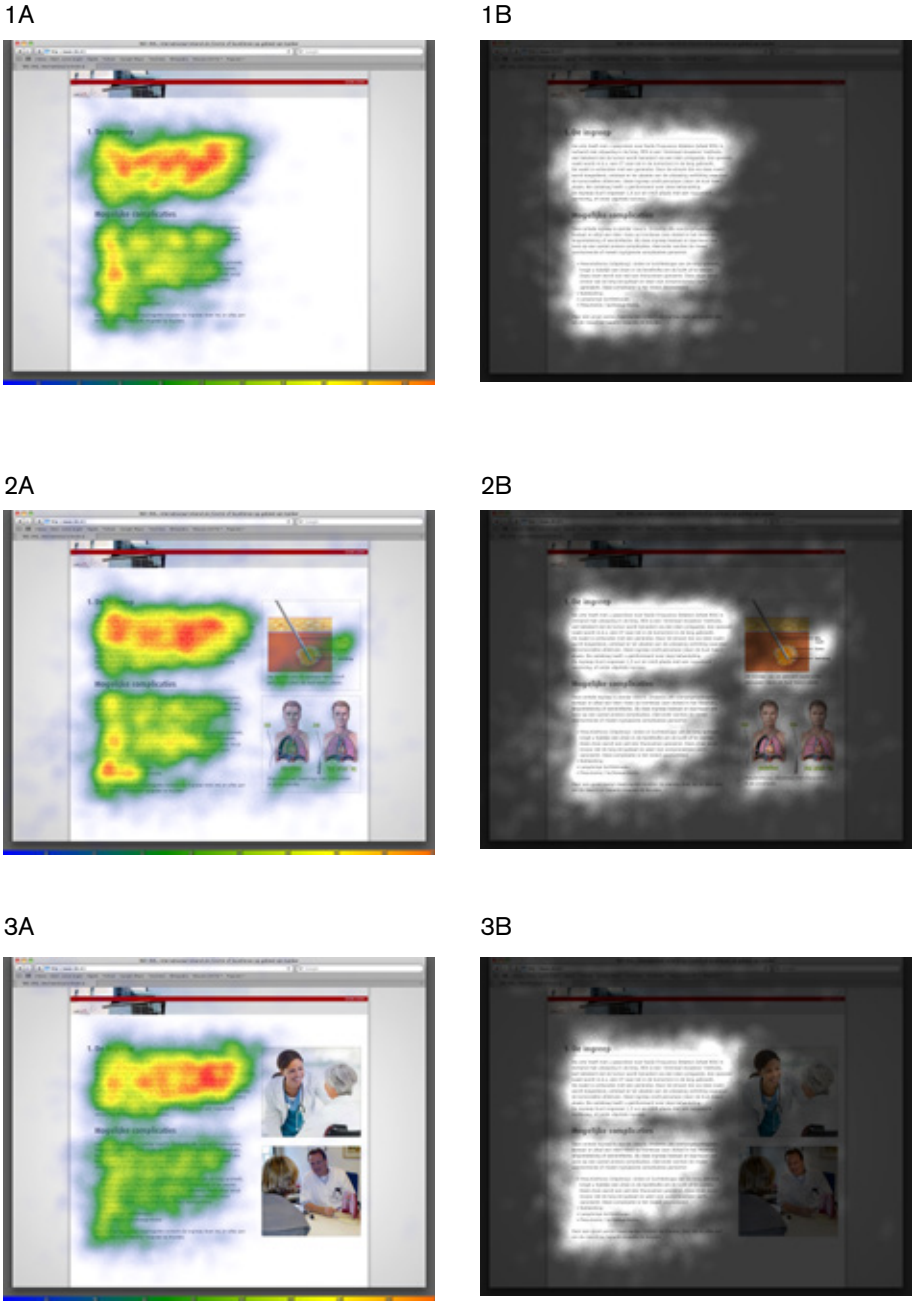

Figure 4.3. Heat maps (A's) and gaze opacities (B's) of the average fixation time of all participants in the text-only condition (1's), text with cognitive illustrations condition (2's), and text with affective illustrations condition (3's).

Table 4.3. Attention to the information on the webpage (in seconds) stratified by condition and younger (< 65 yrs.) and older (≥ 65 yrs.) adults ($n = 97$)

		Attention to the webpage		Attention to the text		Attention to the illustrations	
	n	*M*	*SD*	*M*	*SD*	*M*	*SD*
Text only	32	79.13	36.04	77.60	35.46	-	-
Younger adults	18	83.39	34.49	82.08	34.42	-	-
Older adults	14	73.66	38.53	71.84	37.22	-	-
Cognitive illustrations	35	86.81	46.44	71.90	42.87	12.90	9.78
Younger adults	20	94.23	56.41	76.92	52.22	15.39	11.01
Older adults	15	76.91	27.11	65.20	26.04	9.59[a]*	6.85
Affective illustrations	30	83.00	40.36	79.61	39.53	1.94[b]***	2.20
Younger adults	17	91.65	47.95	87.26	47.20	2.38	2.58
Older adults	13	71.70	25.05	69.60	24.79	1.36	1.50
Total	97	83.10	41.06	76.16	39.24	7.84	9.13
Younger adults	55	89.88	46.88	81.81	44.84	9.41	10.49
Older adults	42	74.22	30.17	68.77	29.30	5.77	6.54

Note. Attention to the webpage ranges from 27.42 to 264.17 seconds, attention to the text ranges from 9.59 to 242.31 seconds, and attention to the illustrations ranges from 0 – 42.05. The higher the score, the higher fixation time on (elements of) the webpage. The sum of attention to the text and attention to the illustrations does not equal the attention to the webpage, as participants also spent time outside the AOIs. *M*, mean; *SD*, standard deviation. [a]Mean differs significantly compared to younger adults in the cognitive illustrations condition. [b]Mean differs significantly compared to the cognitive illustrations condition. * $p < .05$. *** $p < .001$.

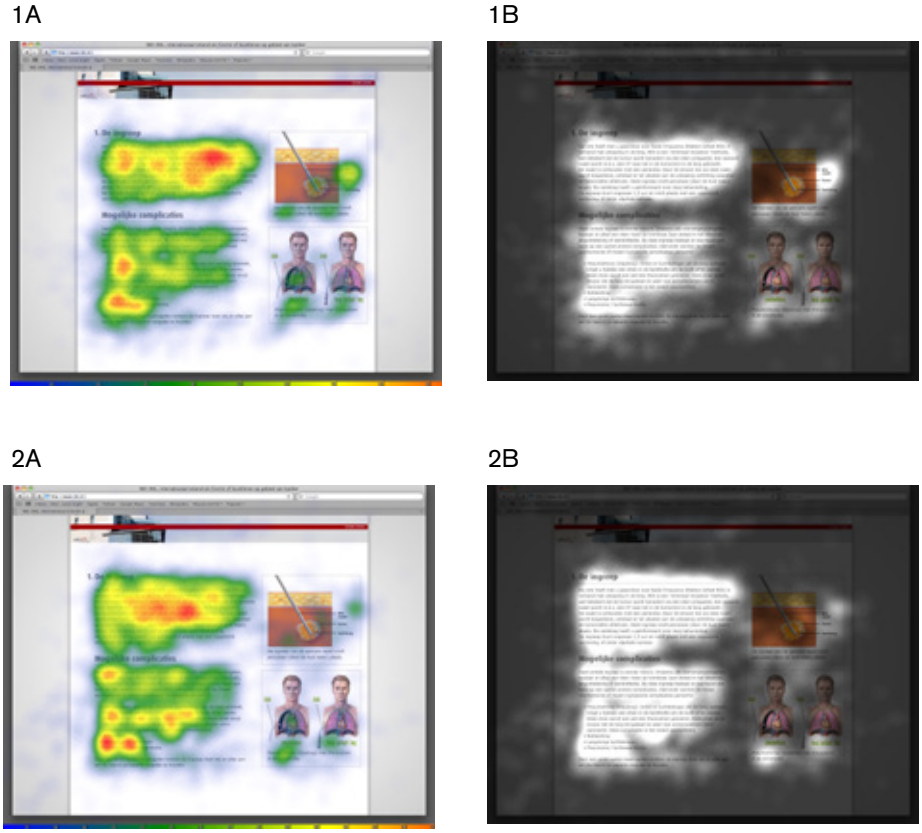

Figure 4.4. Heat maps (A's) and gaze opacities (B's) of the average fixation time on the text with cognitive illustrations website of younger (1's) and older (2's) participants.

Relationships of age, attention, and recall

When examining whether attention to text and/or attention to illustrations was related to recall of information (RQ2a), attention to text information (in seconds) was predictive of recall of information ($b = .02$, $SE = .01$, $p = .022$), whereas attention to cognitive or affective illustrations (in seconds) did not contribute to more accurate recall of information (resp. $b = .04$, $SE = .07$, $p = .619$ and $b = .27$, $SE = .38$, $p = .489$). When exploring age-related differences in the relationship between attention and recall of information (RQ2b), moderation analysis revealed that the predictive power of attention to text was largest for the older adults. Whereas simple effects analysis revealed that younger adults recalled equal amounts of information regardless of the time they spent on the text ($b = 0.01$, $SE = 0.01$, $p = .210$), older adults' accurate recall of information was related to increased time spent on the text. With higher fixation time on the text, older adults recalled the same amount of information as younger adults (e.g., plus one standard deviation higher on fixation time: $b = -0.33$, $SE = 1.18$, $p = .783$). However, when fixation time on the text was low (e.g., minus

one standard deviation), older adults scored significantly lower on recall of information than older adults with a higher fixation time (b = -0.04, SE = .02, p = .052), and younger adults (b = -2.16, SE = 1.05, p = .042). The scatterplot in Figure 4.5 illustrates the interaction between attention to the text on the webpage and age on recall of information.

Furthermore, in addition to the finding that younger adults spent more time fixating on the cognitive illustrations (see above), we found a main effect of age within the cognitive illustrations condition on recall, $F(1, 91) = 6.44$, $p = .013$, $\eta_p^2 = .07$ (see also Table 4.2), indicating that younger adults recalled more information compared to older adults when cognitive illustrations were presented. Yet, moderation analysis did not reveal an interaction effect between age and attention to the cognitive illustrations on recall of information (b = 0.03, SE = 0.16, p = .863). This finding suggests that recall of information among younger adults is not fully explained by mere attention to cognitive illustrations. The relationship between attention to affective illustrations and recall of information was also not moderated by age (b = 0.30, SE = 0.83, p = .725).

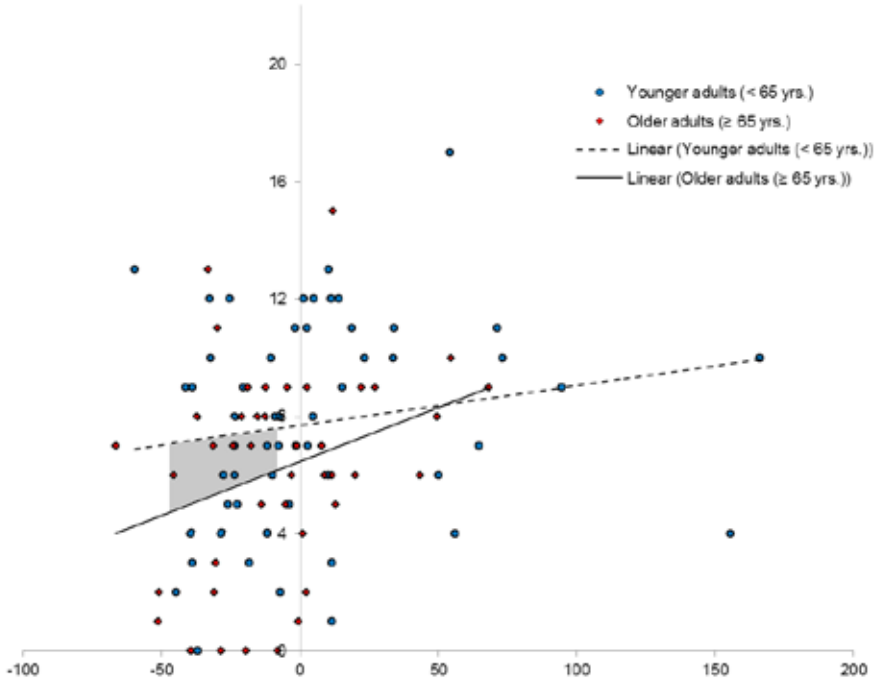

Figure 4.5. Scatterplot showing the effect of attention to the text on the webpage (x axis: total fixation time in seconds, centered to the mean) on recall of health information (y axis: ranges from 0 – 22) for younger and older adults. Johnson-Neyman significance region lies between -9.31 and -48.32, meaning that age differences in the attention-recall relationship are significant between 27.84 and 66.85 seconds of fixation time.

Discussion

This study evaluated the relationship between attention to and recall of online health messages among younger and older adults. Eye-tracking data enabled us to gain greater insight into the association between encoding information (i.e., attention to text and illustrations) and retrieval (i.e., recall of such text and illustrations), and whether the encoding process is predictive of retrieval. The results yield novel insights into the role of text and cognitive and affective illustrations as determinants of the effectiveness of online health information by exploring how attention to such parts of information predicts recall of information. Greater attention to text information on a health webpage appears to increase recall in older adults, but not in younger ones. This result shows that older adults recall as much information as younger adults when spending more time reading text. Earlier studies have shown that older adults generally need more time to process online information than younger adults (for overview studies, see Romano Bergstrom, Olmsted-Hawala, & Jans, 2013). Nevertheless, previous research has also demonstrated that when older adults are given sufficient time to process information, age differences begin to disappear (John & Cole, 1986). Our results add to these conclusions by revealing that taking time to process text information on a health webpage helps older adults to adequately recall information. Taken together, these findings underscore the importance for older adults of being able to self-pace in processing information.

We found that younger adults spent significantly more time on the cognitive illustrations than older adults, as well as recalled more information correctly in the cognitive illustrations condition than in the other two conditions. This difference in recall was not evident among older adults. These findings indicate that the proposed learning effect of cognitive illustrations is more pronounced among younger adults than older adults. Yet, our moderation analysis revealed that this effect was not explained by the extent to which attention was paid to cognitive illustrations, suggesting that mere attention to cognitive illustrations does not predict recall of information. Further research would benefit from exploring differences in how illustrations are used (e.g., ability to integrate illustrations with text) by younger and older adults to unravel what makes attention to cognitive illustrations predictive of recall of information. As cognitive and affective illustrations increase satisfaction with the attractiveness of a website (Bol, Van Weert, et al., 2014), and satisfaction might be related to recall, illustrations may also indirectly improve recall of information.

Adding illustrations to the webpage did not significantly increase the total time younger and older adults spent at the webpage; they tended to give priority to the text information (over 88% of the time spent). Similarly, an advertising study showed that the majority of the fixations on the advertisement involved text information rather than the illustrations (Rayner, Rotello, Stewart, Keir, & Duffy, 2001). This may be attributable to the fact that people can encode much more information per fixation from illustrations than from text. In other words, people do not need to spend as much time looking at illustrations as at text to recall information. We also determined that cognitive illustrations received in general more attention than affective ones. Cognitive illustrations seemingly serve a learning function whereas affective illustrations have no clear pedagogic purpose (Harp & Mayer, 1997). Cognitive illustrations therefore generally command more attention than affective illustrations, because of the relevance

of the information. Prior research has also shown that cognitive illustrations contain more information to encode (e.g., labels of illustrations) than affective illustrations (Rayner et al., 2001). Moreover, cognitive illustrations play a facilitating role in recall of information (Levie & Lentz, 1982) and might, therefore, receive more attention while one is reading text than affective illustrations. Nevertheless, future research should explore whether these results are generalizable to other cognitive and affective illustrations.

This study had several limitations. First, we used duration of fixation as a proxy for attention. Even though this index reliably relates to attention (Djamasbi et al., 2010), it can be interpreted in many ways. For instance, longer fixation to information might indicate confusion, as people tend to re-read confusing information (Olmsted-Hawala, Holland, & Quach, 2014). Future research should combine eye-tracking techniques with think-aloud methods to gain more insight into the reasons why people fixate on specific parts of information. Furthermore, we did not include the target group of the study, that is, cancer patients who will be treated with RFA. Our results might have been different if cancer patients had participated, due to their ego-involvement with the information on the webpage. Such involvement reportedly affects the way people process information (Petty & Cacioppo, 1990).

The participants excluded from our sample due to poor eye-tracking data were more likely to be older than the participants for whom data were retained. This could be due to the fact that older adults tend to wear corrective eye glasses with bi- and trifocal lenses, which affect the success of eye tracking. Hence, the excluded group of older adults might have had poorer eye health. Nevertheless, post-hoc analysis showed that the excluded older adults were not more likely to wear multifocal glasses than the included older adults, $\chi^2 = 1.73$, $p = .189$. Moreover, this specific group of older adults did not differ in recall of information compared to the older adults who were included in the sample, suggesting that our conclusions might be generalized to this population as well.

This study specifically focused on explaining the relationship between attention to online health information (i.e., text and illustrations) and recall of information, and whether age matters in this regard. Considering the great variability within attention and recall, we expect that other factors might also have played a role in how people process information, such as people's mode preference (i.e., the preference for type of format, such as text only or text with illustrations). Our results might have been different if participants would have been able to choose a preferred mode of presented information. Previous research has shown the importance of recognizing the diversity among older adults and providing them with choices of mode (Soroka et al., 2006). In addition, there may be differences in people's ability to integrate illustrations with text information (Liu et al., 2009), level of education, and level of health literacy. Older adults' inability to integrate illustrations with text appropriately might be one explanation for their paying less attention to cognitive illustrations than younger adults in this study. Moreover, older adults are more likely to be lower educated and have lower levels of health literacy in general (Baker, Gazmararian, Sudano, & Patterson, 2000), which have also been associated with information processing (Von Wagner, Semmler, Good, & Wardle, 2009). Future research should focus on such factors to gain more insight into other predictors of online information processing and to

better prepare online information for older adults. Nevertheless, this study provides expanded insight into effective online communication for older adults. Specifically, it suggests that effectively communicating online health information to older adults and aiding them in recall of information involves consideration of webpages that include effective text and cues that enhance their motivation to spend time consuming it.

Chapter 5

The effect of modality and narration style on recall of online health information: Results from a web-based experiment

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Abstract

Older adults are increasingly using the Internet for health information; however, they are often not able to correctly recall web-based information (e-health information). Recall of information is crucial for optimal health outcomes, such as adequate disease management and adherence to medical regimes. Combining effective message strategies may help to improve recall of e-health information among older adults. Presenting information in an audiovisual format using conversational narration style is expected to optimize recall of information compared to other combinations of modality and narration style. The aim of this paper is to investigate the effect of modality and narration style on recall of health information, and whether there are differences between younger and older adults. We conducted a web-based experiment using a 2 (modality: written vs. audiovisual information) by 2 (narration style: formal vs. conversational style) between-subjects design ($n = 440$). Age was assessed in the questionnaire and included as a factor: younger (< 65 years) versus older (≥ 65 years) age. Participants were randomly assigned to one of four experimental webpages where information about lung cancer treatment was presented. A web-based questionnaire assessed recall of e-health information. Audiovisual modality (vs. written modality) was found to increase recall of information in both younger and older adults ($p = .035$). Although conversational narration style (vs. formal narration style) did not increase recall of information ($p = .170$), a synergistic effect between modality and narration style was revealed: combining audiovisual information with conversational style outperformed combining written information with formal style ($p = .014$), as well as written information with conversational style ($p = .045$). This finding suggests that conversational style especially increases recall of information when presented audiovisually. This combination of modality and narration style improved recall of information among both younger and older adults. We conclude that combining audiovisual information with conversational style is the best way to present e-health information to younger and older adults. Even though older adults did not proportionally recall more when audiovisual information was combined with conversational style than younger adults, this study reveals interesting implications for improving e-health information that is effective for both younger and older adults.

Introduction

Background

Older adults have been one of the fastest growing groups using the Internet (Pernice & Nielsen, 2002). Recent figures show that the number of older adults using the Internet in Western countries, such as the United States and the Netherlands, has nearly doubled over the past few years (File & Ryan, 2014; Statistics Netherlands, 2014). More than half of these older adults used the Internet for accessing health information (Cresci, Jarosz, & Templin, 2012; Statistics Netherlands, 2014). The Internet is seen as a relevant source of gathering health information among older adults (Xie, 2009) and has helped many older adults to fulfill a wide range of information and support needs (Iredale, Mundy, & Hilgart, 2011; Ziebland, 2004). However, simply having access to online health information (subsequently called e-health information in this paper) does not necessarily mean that people find and understand such information. E-health literacy, the ability to seek, find, understand, and act on health information from electronic sources to solve a health problem (Norman & Skinner, 2006b), is considered lower among older adults (Xie, 2008). This may influence the extent to which health information is recalled. Recall of information is the ability to reproduce information and is crucial for optimal health outcomes, such as adequate disease management (Kravitz et al., 1993) and adherence to medical regimes (Ley, 1988; Linn, Van Dijk, Smit, Jansen, & Van Weert, 2013).

Thus, effective message strategies need to be found to communicate e-health information in such a way that older adults are able to recall information. However, previous research focusing on effective ways to present e-health information to older adults in particular is lacking. The cognitive theory of multimedia learning (CTML) presents strategies that might enhance recall in general and could be applied to how older adults learn from e-health materials. One strategy is to use audiovisual materials. The idea that people learn information more deeply from audiovisual materials compared to written materials is called the modality effect (Sweller, Ayres, & Kalyuga, 2011). Another strategy described by the CTML is to use conversational narration style in messages. People are expected to learn information better when presented in conversational narration style rather than formal narration style, a phenomenon referred to as the personalization effect (Mayer, Fennell, Farmer, & Campbell, 2004). Surprisingly, to the best of our knowledge, no studies to date have examined the effects of combining modality (written vs. audiovisual) and narration style (formal vs. conversational) in e-health messages on information recall. Combining such strategies might result in synergistic effects, which occur when the combined effect of these strategies exceeds the sum of their individual effects (Naik & Raman, 2003). Furthermore, although previous research has shown support for modality and narration style strategies in younger adults (Ginns, 2005; Ginns, Martin, & Marsh, 2013), empirical evidence on the effects in older adults is particularly lacking.

The aim of our study is to identify effective ways of presenting web-based information to enhance recall of e-health information among older adults in particular. We test the (synergistic) effect of modality and narration style, and whether there are differences between younger and older adults. In assessing age differences, we chose participants younger than 65 years for the younger age group and 65 years and older as the older age group. These two age groups are generally considered suitable

for separate analysis in aging research (Jorgensen, Young, Harrison, & Solomon, 2012; Silliman, Troyan, Guadagnoli, Kaplan, & Greenfield, 1997).

Modality: Written versus audiovisual information

The CTML attempts to explain how people learn and recall information in multimedia environments (Mayer, 1999). It is based on the assumption that people have separate information processing systems for visual and auditory materials (Paivio, 1971) and that people are limited in the amount of material they can process in each of these systems at one time (Baddeley, 1992). These assumptions are derived from the dual coding theory (Baddeley, 1992; Paivio, 1971) and cognitive load theory (Sweller et al., 2011). The modality principle describes that one's limited working memory capacity can be effectively expanded by addressing one or more sensory modalities, such as audiovisual information, instead of written information only (Mayer & Moreno, 2003). A meta-analysis indeed showed an overall benefit in recall of information when information was presented in an audiovisual format compared to written format (Ginns, 2005). However, this meta-analysis did not include studies that were conducted in the field of e-health information. We could nevertheless expect that audiovisual information would enhance recall of e-health information as well. We therefore suggest H1a: *Exposure to audiovisual information, compared to written information, has a positive effect on recall of e-health information*.

Whereas the modality effect among younger adults is repeatedly found in research (Ginns, 2005), fewer studies have focused specifically on its effect among older adults (Van Gerven, Paas, Van Merriënboer, Hendriks, & Schmidt, 2003). The cognitive aging principle in multimedia learning (Paas, Van Gerven, & Tabbers, 2005) provides an integrative framework where the cognitive load theory is combined with general views of cognitive aging. This theory states that older adults' limited working memory might be expanded by multimodal presentation of information. Older adults usually have a smaller "total cognitive capacity" than younger adults and might therefore benefit more from multimodal information than younger adults (Van Gerven, Paas, Van Merriënboer, & Schmidt, 2000). Previous research has demonstrated a benefit of multimedia messages for older adults by reducing cognitive load and decreasing learning time of information (Van Gerven et al., 2003). Even though this study did not present e-health information to older adults, audiovisual information might be as effective for older adults when used in a web-based context. We might therefore expect that audiovisual information positively influences older adults' memory for e-health information. Therefore, our second hypothesis H1b states: *The effects of exposure to audiovisual information, compared to written information, on recall of e-health information are greater in older adults than in younger adults*.

Narration style: Formal versus conversational style

Conversational style is often used in narrative communication, such as testimonials and personal stories or a description of an individual experience (Kreuter et al., 2007). By presenting information from a first-person perspective using a more informal approach, it feels like the person in the message is talking to you (Mayer, 2002). However, health information has been traditionally presented in a formal style, presenting factual information, such as expressing professional opinions (Reinard,

1988). Unfortunately, a substantial number of people do not understand such formal health messages well enough to make informed decisions and act accordingly (McCray, 2005). In an attempt to simplify health information, using a conversational style in narrative communication has shown to serve as an effective way of educating people about health (Kreuter et al., 2007; Kreuter et al., 2010). Conversational style is more likely to be recalled because of conversational rules, such as commitment to try to understand a narrator's story (Grice, 1975). Moreover, conversational style has been found to increase recall of information among a variety of learner profiles, that is, different levels of education (Reichelt, Kämmerer, Niegemann, & Zander, 2014). For this reason, we hypothesize H2a: *Exposure to information in a conversational style, compared to information in a formal style, has a positive effect on recall of e-health information*.

In addition to the hypothesized effect of conversational style among both younger and older adults, it is expected that older adults may benefit in particular from having e-health information presented in conversational style. Older adults tend to have better narrative recall and thus remember stories in more accurate detail than younger adults (Sparks & Nussbaum, 2008). Using conversational style in e-health information might therefore especially improve recall of information in older adults. Therefore, we expect H2b: *The effects of exposure to information in a conversational style, compared to information in a formal style, on recall of e-health information are greater in older adults than in younger adults*.

Synergistic effects: Combining modality and narration style

To our knowledge, no research to date has studied the synergistic effects of combining modality and narration style in enhancing recall of information. Nevertheless, various message strategies and styles are often combined in one health message, and it is likely that these message strategies have individual as well as synergistic effects (Kaskutas & Graves, 1994). For instance, one study found that tailoring web-based information to individual characteristics was effective in realizing smoking cessation, however, only when information was presented in audiovisual format and not in written format (Stanczyk et al., 2014). This finding indicates that combining several message characteristics might optimize the effectiveness of a message. As we hypothesized that audiovisual information will outperform written information and conversational narration style will outperform formal narration style, we might expect H3a: *Combining audiovisual information with conversational style, compared to other combinations of modality and narration style, has a positive effect on recall of e-health information*.

Moreover, as we hypothesized that especially older adults will benefit from audiovisual information and conversational narration style, we might also expect that combining these two might especially enhance older adults' recall of information. Our final hypothesis H3b therefore states: *The effects of combining audiovisual information with conversational style, compared to other combinations of modality and narration style, on recall of e-health information are greater in older adults than in younger adults*.

Methods

Design

For this experiment, a 2 (modality: written vs. audiovisual information) by 2 (narration style: formal vs. conversational style) between-subjects design was used. Age was assessed in the questionnaire and included as a factor: younger (< 65 years) versus older (≥ 65 years) age. We used a Netherlands Cancer Institute (NKI) webpage where information about radio frequency ablation (RFA) treatment was given. RFA is a minimally invasive treatment, using radio frequency waves to destroy lung tumors. Ethical approval for this study was granted by the institutional review board of the Amsterdam School of Communication Research (reference number 2012-CW-33).

Participants

Participants from the general population were selected from a large respondent pool by the ISO certified market research company PanelClix to participate in a web-based survey. This web-based setting allowed participants to engage in the experiment from their home computer, creating a natural and realistic setting to evaluate the stimulus materials. PanelClix made a random selection of their panel members to participate in the study stratified by age (< 65 years vs. ≥ 65 years). To be eligible to take part in the web-based survey, participants had to be older than 18 years, able to read and write in Dutch, and should have no prior knowledge on RFA treatment, because this could influence the recall scores. An invitation for the study was available for PanelClix members on the PanelClix website. A total of 796 unique participants entered the survey, of which 788 unique participants started the survey (participation rate = 99.0%), and 490 unique participants completed the web-based survey (completion rate = 62.2%). Duplicate entries were avoided by assigning pid-codes to participants, which were unique codes assigned to participants by PanelClix. Checking these pid-codes revealed 4 participants who completed the survey twice. In these cases, the second entry was excluded from the dataset ($n = 4$). Participants who had prior knowledge on RFA treatment, that is, scoring higher than 4 on a 7-point Likert scale ($n = 23$), were excluded as well. Since usability testing of the questionnaire showed that at least 10 minutes were needed to complete the survey, participants were excluded when they completed the survey in less than 10 minutes ($n = 15$). Furthermore, participants were excluded when they viewed the experimental stimulus for less than 4 seconds ($n = 1$), had not been exposed to the experimental stimulus due to technical issues ($n = 5$), had used another source than the experimental stimulus to answer the recall questions ($n = 1$), or reported to suffer from short-term memory loss ($n = 1$). This resulted in a total of 440 participants included in the dataset.

Procedure

When participants entered the web-based survey, they were informed about the survey length, participants' rights (e.g., anonymity), and the contact details of the research institute and principle investigator. On the next page, participants were exposed to questions about gender, age, educational level, prior medical knowledge about lung cancer and RFA treatment, and Internet use. Based on age, participants were assigned to the younger or older age strata, and were randomly assigned to one of four experimental conditions. They were instructed to pay careful attention to the RFA

information and could look at the information as long as they liked. Participants were not able to return to the written or audiovisual information (depending on condition) after continuing to the next page. The written information versions were presented on a webpage and the audiovisual information versions through a web-based video. In the audiovisual conditions, participants were instructed to turn on their speakers. After exposure to the experimental stimulus, recall questions were shown. Upon completion, participants received credit points from PanelClix.

Materials

Using the existing text (formal written condition, 245 words) of the NKI website, the conversational text was written (330 words). The formal audiovisual information was identical to the formal written information, and the conversational audiovisual information was identical to the conversational written information. The conversational versions were personalized in two ways: first, we changed the third-person perspective into a first-person perspective as if the narrator was talking to you (Mayer, 2002) (e.g., "A special needle guided by a CT scanner will be inserted into the cancerous lung tumor" vs. "A special needle guided by a CT scanner was inserted into my cancerous lung tumor"). Second, we added sentences about personal experience to make the story more conversational as well (e.g., "[…], depending on the location of the tumor" vs. "I myself received sedation, but that depended on the location of the tumor"). In the formal audiovisual conditions, a doctor was videotaped behind a desk and in the conversational audiovisual conditions, a patient was filmed sitting on a couch. The same actors starred as the doctor and patient to ensure that narration style effects could be attributed to changes in narration style rather than changes in narrator. In addition, both the formal and conversational audiovisual information was filmed twice to create a formal and conversational video starring a younger narrator as well as a formal and conversational video starring an older narrator. This resulted in four videos in which information was presented by (1) a younger doctor (2:01 min), (2) an older doctor (2:05 min), (3) a younger patient (2:53 min), or (4) an older patient (2:34 min). This was done to control for potential identification effects with a specific narrator because of age similarity. However, there were no differences in identifying with the younger and older actor, $F(1, 245) = 0.06$, $p = .861$, $\eta_p^2 = .00$), regardless of participants' own age, $F(1, 245) = 0.13$, $p = .720$, $\eta_p^2 = .00$). Therefore, this additional design factor was not considered while analyzing the data. Thus, four experimental conditions were analyzed: (1) written information in formal style, (2) written information in conversational style, (3) audiovisual information in formal style, and (4) audiovisual information in conversational style. Compared to previous research on the effects of modality and narration style, our materials were similar in terms of length (Ginns, 2005; Ginns, Martin, & Marsh, 2013).

Measures

Background characteristics

Background measures included participants' age, gender, level of education, Internet use, and prior medical knowledge. Education was divided into low level of education (primary education, lower vocational education, preparatory secondary vocational education, and intermediate secondary vocational education), middle

level of education (senior secondary vocational education and university preparatory vocational education), and high level of education (higher vocational education and university). Internet use was assessed through average number of hours spent per week on the Internet. Prior medical knowledge about lung cancer in general and RFA knowledge specifically was measured by two items asking how much knowledge participants perceived to have about lung cancer and RFA treatment respectively using a 7-point scale (1 = no knowledge at all, 7 = very much knowledge).

Recall of e-health information

Information recall was measured using the Netherlands Patient Information Recall Questionnaire (Jansen, Van Weert, et al., 2008). Questions were created from the RFA information and were pretested among 12 students. This resulted in 11 open-ended recall questions, such as "Could you please name the most common complication during an RFA treatment?" All questions were accompanied by a textbox for participants to provide their answer. Recall scores could range from 0 (not recalled), to 1 (recalled partially), to 2 (recalled correctly). A codebook was used for allocating scores to each of the recall questions. Two independent coders used this codebook and double coded 14.1% (62/440) of the recall scores. Interrater reliability appeared to be good (mean kappa = .84, range 0.65 – 1.00). The 11 items were computed into a total recall score, ranging from 0 – 22. Additionally, percentages of the recall scores were calculated by dividing the participant's total score by 22.

Statistical analysis

For testing successful randomization, analyses of variance and chi-square tests were conducted to check for unequal distribution of background variables across the 2 (modality) × 2 (narration style) × 2 (age groups) experimental design. Educational level and medical knowledge about lung cancer were found to be unequally distributed (respectively $\chi^2 = 24.72$, $p = .037$ and $F(7, 432) = 2.06$, $p = .047$, $\eta_p^2 = 0.03$). Moreover, previous studies have identified educational level and prior topic knowledge as important predictors of information recall (Wagner, Wuensch, Friess, & Berberat, 2014). We therefore included educational level and medical knowledge about lung cancer as covariates in all analyses. For testing the main effects of modality and narration style, an ANCOVA (analysis of covariance) was conducted with recall of information as dependent variable, modality, narration style, and age groups as factors, and education and medical knowledge as covariates. The synergistic effects between modality and narration style were tested in an ANCOVA using one variable for modality and narration to measure the simple contrast effects between conversational audiovisual information and the three other combinations of modality and narration style. To test whether the effect of modality and narration style was greater among older adults than younger adults, the data file was split on age group and the above described analyses were repeated.

Results

Sample characteristics

Of the participants who filled out the web-based questionnaire (53.9%, 237/440 male and 46.1%, 203/440 female), 53.6% were younger (236/440; < 65 years; $M = 41.78$, $SD = 12.69$) and 46.4% were older (204/440; ≥ 65 years; $M = 69.44$, $SD = 4.13$). Besides age, $F(1, 438) = 887.88$, $p < .001$, $\eta_p^2 = .67$), the two age groups significantly differed in educational level ($\chi^2 = 18.61$, $p < .001$; see Table 5.1 for sample characteristics).

Table 5.1. Sample characteristics ($n = 440$)[a]

	Younger adults (< 65 yrs.) $n = 236$		Older adults (≥ 65 yrs.) $n = 204$	
	n	*(%)*	*n*	*(%)*
Gender				
Male	123	(52.1)	114	(55.9)
Female	113	(47.9)	90	(44.1)
Age				
Mean (*SD*)	41.78 (12.69)		69.44 (4.13)[b]	
Range	18 – 64		65 – 85	
Education				
Low	50	(21.2)	81	(40.1)[b]
Middle	104	(44.1)	69	(34.2)[c]
High	82	(34.7)	52	(25.7)
Internet use (hours per week)				
Mean (*SD*)	18.21 (11.72)		17.83 (11.59)	
Range	1 – 60		1 – 60	
Medical knowledge about lung cancer[d]				
Mean (*SD*)	2.88 (1.41)		2.66 (1.37)	
Range	1 – 6		1 – 7	
Medical knowledge about RFA[d]				
Mean (*SD*)	1.71 (1.06)		1.54 (0.94)	
Range	1 – 4		1 – 4	

[a]Not all figures add up to 100% due to missing data. Conditions stratified by age only significantly differed on education. [b]Differs significantly from younger adults ($p < .001$). [c]Differs significantly from younger adults ($p = .044$). [d]A higher score indicates more knowledge, ranging from 1 to 7. RFA, radio frequency ablation.

Effects of modality on recall of e-health information

The first hypothesis predicted a positive effect of audiovisual information (vs. written information) on recall of e-health information (H1a), which was greater for older adults in particular (H1b). Modality significantly influenced recall of health information, $F(1, 413) = 4.48$, $p = .035$, $\eta_p^2 = .01$). As hypothesized, the audiovisual conditions ($M = 7.60$, $SE = 0.31$, 95% CI = 7.00 – 8.21) resulted in significantly higher recall scores than the written conditions ($M = 6.55$, $SE = 0.39$, 95% CI = 5.79 – 7.32). However, older adults did not recall more from audiovisual information compared to written information, $F(1, 189) = 1.59$, $p = .209$, $\eta_p^2 = .01$, than younger adults, $F(1, 223) = 3.09$, $p = .080$, $\eta_p^2 = .01$). These results, thus, partially confirm our first hypothesis. Recall scores across modality and age groups appear in Table 5.2.

Table 5.2. Main effects of modality on recall of e-health information in younger and older adults[a]

		Recall of health information	
Group	*n*[b]	*% recall*	Mean (*SE*) [95% CI]
All participants			
Written information	165	29.8	6.55 (.39) [5.79, 7.32]
Audiovisual information	273	34.5	7.60 c (.31) [7.00, 8.21]
Younger participants			
Written information	85	28.2	6.20 (.55) [5.12, 7.27]
Audiovisual information	151	34.1	7.50 (.42) [6.68, 8.32]
Older participants			
Written information	80	31.4	6.91 (.55) [5.83, 7.99]
Audiovisual information	122	35.0	7.70 (.45) [6.82, 8.59]

[a]Adjusted for education level and medical knowledge about lung cancer. Recall of information ranges from 0 – 22. Percentage of correct recall is based on mean scores divided by 22. The higher the score, the more information was recalled correctly. [b]The category sizes differ because of 2 fewer cases due to missing covariate values. [c]Differs significantly compared to written information ($p = .035$).

Effects of narration style on recall of e-health information

Our second hypothesis predicted a positive effect of conversational narration style (vs. formal narration style) on recall of e-health information (H2a), which was expected to be greater for older adults in particular (H2b). However, no main effect of narration style on recall of information was found, $F(1, 413) = 1.89$, $p = .170$, $\eta_p^2 = .01$. The means in Table 5.3 show that using conversational style does not significantly increase recall of information ($M = 7.42$, $SE = 0.35$, 95% CI = 6.74 – 8.10) compared to formal style ($M = 6.74$, $SE = 0.35$, 95% CI = 6.04 – 7.43). Furthermore, older adults did not recall more information when conversational style (vs. formal style) was used, $F(1, 189) = 1.78$, $p = .184$, $\eta_p^2 = .01$, compared to younger adults, $F(1, 223) = 0.51$, $p = .475$, $\eta_p^2 = .00$. This was not expected and, therefore, our second hypothesis was rejected. Recall scores across narration style and age groups are shown in Table 5.3.

Table 5.3. Main effects of narration style on recall of e-health information in younger and older adults[a]

		Recall of health information	
Group	*n*[b]	*% recall*	Mean (*SE*) [95% CI]
All participants			
Formal style	214	30.6	6.74 (.35) [6.04, 7.43]
Conversational style	224	33.7	7.42 (.35) [6.74, 8.10]
Younger participants			
Formal style	119	30.0	6.61 (.48) [5.67, 7.55]
Conversational style	117	32.2	7.09 (.50) [6.11, 8.06]
Older participants			
Formal style	95	31.2	6.86 (.52) [5.84, 7.88]
Conversational style	107	35.2	7.75 (.48) [6.80, 8.70]

[a]Adjusted for education level and medical knowledge about lung cancer. Recall of information ranges from 0 – 22. Percentage of correct recall is based on mean scores divided by 22. The higher the score, the more information was recalled correctly. [b]The category sizes differ because of 2 fewer cases due to missing covariate values.

Synergistic effects

Our third hypothesis concerned the synergistic effect between modality and narration style (H3a), which was also expected to be greater for older adults (H3b). We expected that combining audiovisual information with conversational style would outperform other combinations of modality and narration style. In support of our hypothesis, we found that combining audiovisual information with conversational style resulted in the most favorable recall scores compared to combining written information with formal style (contrast estimate = -1.73, $SE = 0.70$, $p = .014$, 95% CI = -3.11 to -0.35]), as well as compared to combining written information with conversational style (contrast estimate = -1.40, $SE = 0.70$, $p = .045$, 95% CI = -2.76 to -0.03). This finding suggests that conversational style especially increases recall of information when presented as audiovisual information, but not when presented as written information (see Figure 5.1).

The expected synergistic combination of audiovisual information and conversational style (e.g., vs. combining written information with formal style) did not particularly improve recall of information among older adults (contrast estimate = -1.73, $SE = 0.95$, $p = .070$, 95% CI = -3.60 to 0.15) compared to younger adults (contrast estimate = -1.80, $SE = 1.03$, $p = .083$, 95% CI = -3.84 to 0.24). Our data therefore partially confirm our third hypothesis. The synergistic effects between modality and narration style on recall of information (for all participants and stratified by age group) are provided in Table 5.4.

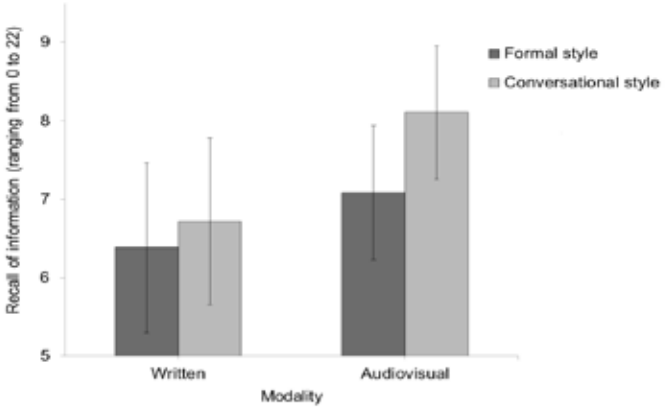

Figure 5.1. Combining audiovisual information with conversational narration style results in highest recall of e-health information among younger and older adults. The bars and error bars represent the mean recall scores and 95% confidence intervals respectively.

Table 5.4. Synergistic effects of combining modality and narration style on recall of e-health information in younger and older adults[a]

		Recall of health information	
Group	*n*[b]	*% recall*	Mean (*SE*) [95% CI]
All participants			
Written – formal	82	29.1	6.39 (.56) [5.29, 7.48]
Written – conversational	83	30.6	6.72 (.54) [5.65, 7.79]
Audiovisual – formal	132	32.2	7.09 (.44) [6.23, 7.94]
Audiovisual – conversational	141	36.9	8.12[c,d] (.43) [7.26, 8.97]
Younger participants			
Written – formal	44	28.0	6.16 (.77) [4.66, 7.67]
Written – conversational	41	28.3	6.23 (.78) [4.69, 7.77]
Audiovisual – formal	75	32.1	7.06 (.57) [5.94, 8.18]
Audiovisual – conversational	76	36.1	7.94 (.61) [6.73, 9.15]
Older participants			
Written – formal	38	30.1	6.61 (.81) [5.03, 8.19]
Written – conversational	42	32.8	7.21 (.75) [5.73, 8.68]
Audiovisual – formal	57	32.4	7.12 (.66) [5.83, 8.41]
Audiovisual – conversational	65	37.7	8.29 (.61) [7.09, 9.49]

[a]Adjusted for education level and medical knowledge about lung cancer. Recall of information ranges from 0 – 22. Percentage of correct recall is based on mean scores divided by 22. The higher the score, the more information was recalled correctly. [b]The category sizes differ because of 2 fewer cases due to missing covariate values. [c]Differs significantly compared to formal written information ($p = .014$). [d]Differs significantly compared to conversational written information ($p = .045$).

Discussion

Principal findings

In this study, we aimed to identify effective ways of presenting e-health information to enhance recall of information among older adults in particular. We examined the (synergistic) effect of modality and narration style on recall of health information, and whether there are differences between younger and older adults. Our results support the modality effect as proposed by the CTML (Sweller et al., 2011). Younger and older individuals who were exposed to audiovisual information recalled more health information than those who were exposed to written information. Our findings do not show support for the personalization effect, another principle proposed by the CTML (Mayer et al., 2004). Health information was not better recalled when presented in conversational style than in formal style. However, combining audiovisual information with conversational style led to the highest recall scores, outperforming combining written information with formal style and written information with conversational style. This underscores that conversational style is especially effective in improving recall of health information when presented audiovisually, rather than when presented as written information.

Even though we found that older adults benefited from audiovisual information with respect to better recall of information, they did not proportionally benefit more than younger adults, as proposed in the cognitive aging principle in multimedia learning (Paas et al., 2005). This might be explained by the fact that audiovisual information is not self-paced, whereas written information is. Previous research has indicated that self-pacing of information plays an important role in older adults' recall of information (Callahan, Kiker, & Cross, 2003). When older adults have the option to self-pace information, they are able to take the time they need to process information, which may result in information recall that is comparable to that of younger adults (Bol, Van Weert, Loos, et al., 2015). Likewise, another study showed that older adults need more time than younger adults to recall equivalent amounts of information (Morrow, Hier, Menard, & Leirer, 1998). Hence, older adults might benefit most from self-paced information. However, audiovisual information is traditionally not self-paced. A recent experimental study, in which self-paced written information was compared to self-paced spoken information, revealed that self-paced spoken information outperformed self-paced written information in older adults with limited health literacy (Meppelink, Van Weert, Haven, & Smit, 2015). When exposed to self-paced spoken animations (i.e., spoken information with simulated motion pictures), older adults with low health literacy recalled the same amount of information as their high health-literate counterparts. Older people with health disparities might therefore especially benefit more from audiovisual information with respect to better recall. As health literacy was not measured, and individuals with limited health literacy might have been underrepresented in the current sample, this seems worth investigating in future research.

This study provides evidence for effective web-based communication strategies by revealing the promising effects of combining message factors, such as audiovisual information and conversational narration style, to enhance information recall in both younger and older adults. In addition to this practical contribution, the results of this study also add to the current synergy literature. Our results suggest

that synergistic effects do not occur only at the level of combining multiple media as suggested by Naik and Raman (2003), but also at the level of combining multiple message characteristics, in this case, modality and narration style. Nonetheless, we need to use caution in generalizing these results as there are more message characteristics to explore and effective combinations to discover (for an overview of other message characteristics, see Mayer, 2002).

Limitations

This study has several limitations. First, the manipulation we used for narration style could be considered as a study limitation. In web-based written material, conversational style can be clearly manipulated by changing passages in the text (Mayer, 2002). However, when working with audiovisual information, we dealt with visual changes as well, that is, changing the type of narrator (doctor vs. patient). Having a doctor versus a patient explain information changes source attributes, which might have changed the perceived source expertise and the perceived level of authority (Eastin, 2001). This change might have confounded the association between conversational style and recall of information in the audiovisual conditions, providing an alternative explanation for the synergistic effect found when combining audiovisual information with conversational style. Furthermore, it should be noted that simply putting written information into spoken format will not fully ensure equivalence. Features that determine the listenability of spoken messages are not the same as the features that determine the readability of written messages (Rubin, Hafer, & Arata, 2000).

Second, although combining audiovisual information with conversational narration style led to the highest recall scores, it is important to bear in mind that the overall recall scores in this study were low. It has been estimated that 40% – 80% of medical information is immediately forgotten (Kessels, 2003), which has also been found with regard to recall of web-based medical information (Bol, Van Weert, et al., 2014; Van Weert et al., 2011). One explanation for the low recall scores in this study could be that the RFA information presented was rather complex. However, it was the original RFA information presented on the website of a specialized cancer hospital, and we know that the majority of e-health information is complex (McInnes & Haglund, 2011). As message complexity is associated with poor recall of information (Van Weert et al., 2011), it is crucial to consider message complexity when designing e-health materials to improve recall of e-health information.

Third, we did not include the target sample for testing our stimulus materials, that is, cancer patients. Patients might have been more involved and motivated because of their personal experience with cancer and seeking web-based cancer information. As involvement has often been associated with deeper processing of information (Petty & Cacioppo, 1986), including cancer patients might have resulted in higher recall scores than found in the current study. Furthermore, the younger and older adults in our healthy study sample did not differ in their Internet use. Even though older adults are increasingly using the Internet (Pernice & Nielsen, 2002), they are still using the Internet considerably less than their younger counterparts (Statistics Netherlands, 2014). This bias might explain the lack of age differences found in this study. Nevertheless, including healthy individuals still resulted in support for effectively combining audiovisual information with conversational style (vs. written information),

and these effects might even increase when tested among cancer patients and individuals less experienced with the Internet.

Implications and future research directions

This study adds to the literature by applying modality and narration style strategies to the field of e-health information. Dealing with e-health information, especially when it concerns life-threatening diseases such as cancer, often involves feelings of stress and anxiety (Farber, Weinerman, & Kuypers, 1984). In an attempt to reduce such feelings, individuals use different coping strategies (Myers, Newman, & Enomoto, 2004). For instance, "monitors" intentionally seek information to reduce stress and "blunters" avoid information to diminish stress (Myers et al., 2004). It is recommended to focus on effective communication strategies in the field of e-health information. Future research could benefit from including cancer patients in such research to examine how coping style interferes with learning material that is emotionally demanding and stressful.

Although the recall scores of both younger and older adults were low, future research should also be aimed at getting more insight into the effectiveness of e-health information by focusing on what message strategies work best for older audiences in particular. Older adults are often vulnerable to poor web-based communication, due to their limited e-health literacy and inexperience with Internet technologies (Xie, 2008). In the current climate of presenting crucial health information through the Internet, it is important to consider aging populations when designing e-health information. By better understanding how older adults process web-based information, more successful e-health information can be developed based on successful combinations of message characteristics, rather than providing a best guess combination. Previous research has highlighted the importance of recognizing the diversity of message preferences among older adults (Soroka et al., 2006), which should be considered when developing e-health materials for this older age group. Future research should focus on such (age-related) factors that might impact how e-health information is remembered to optimize e-health tools.

Chapter 6

Do videos improve website satisfaction and recall of online cancer-related information in older lung cancer patients?

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Abstract

This study investigated the effects of audiovisual information presented in conversational style in addition to text on website satisfaction and recall of online cancer-related information in older lung cancer patients. An experiment using a 3 (condition: text only vs. text with formal-styled video vs. text with conversational-styled video) by 2 (age patient: younger [< 65 yrs.] vs. older [≥ 65 yrs.]) between-subjects factorial design was conducted. Patients were randomly assigned to one of the three information conditions stratified by age group. Results showed that patients were more satisfied with the comprehensibility, attractiveness, and the emotional support from the website when information was presented as text with conversational-styled video compared to text only. Text with conversational-styled video also outperformed text with formal-styled video regarding emotional support from the website. Furthermore, text with video improved patients' recall of cancer-related information as compared to text only. Older patients recalled less information correctly than younger patients, except when we controlled for Internet use. We conclude that text with conversational-styled audiovisual information can enhance website satisfaction and information recall. Internet use plays an important role in explaining recall of information. The results of this study can be used to develop effective health communication materials for cancer patients.

Introduction

Many Western countries are rapidly aging (Garssen, 2011; World Health Organization, 2012). In 2011, 650 million people worldwide were aged over 60 years and it is expected that this age group will increase up to two billion by 2050 (World Health Organization, 2011). Along with this trend, an increase in disease rating, such as cancer incidences, is shown as well (American Cancer Society, 2012; Dutch Cancer Society, 2011). It is expected that cancer incidence among older adults will increase with 40% between 2007 and 2020 (Dutch Cancer Society, 2011). At the same time, more cancer-related information is presented through the Internet (Morrell, 2002). Older patients increasingly use the Internet to find health-related information (Cresci, Jarosz, & Templin, 2012; Statistics Netherlands, 2011a). However, it has been found that older patients often struggle with information they find on the Internet (Pernice & Nielsen, 2002). This might be explained by the complexity of online health information (McInnes & Haglund, 2011) but also by older patients' relative inexperience with the Internet and declines in functioning, such as cognitive (e.g., reduced working memory) and sensory (e.g., decreased visual acuity) impairments (Becker, 2004; Parrott, Raup, Krieger, Silk, & Egbert, 2008). The inability to correctly understand information on health websites leads to dissatisfaction (Pernice & Nielsen, 2002) and low levels of medical information recall. Website satisfaction can be defined as web users' "predispositions to respond favorably or unfavorably to web content" (Chen & Wells, 1999). Satisfaction has been found to positively influence recall of information (Bol, Van Weert, et al., 2014; Ley, 1988), which is the ability to remember and reproduce information (Van der Meulen, Jansen, Van Dulmen, Bensing, & Van Weert, 2008). The ability to correctly recall information is for instance important for patients' active role in the decision-making process (McGuire, 1996) and adherence to medical regimes (Ley, 1988).

In an attempt to make online health-related information more "senior-friendly" and consequently enhance website satisfaction and information recall, health websites can use compensatory multimedia strategies that support older patients' ability to cognitively process information (Paas, Van Gerven, & Tabbers, 2005). One multimedia strategy that is expected to compensate for cognitive declines is using audiovisual materials in addition to written information rather than using written information alone. This is called the modality effect (Sweller, Ayres, & Kalyuga, 2011). It is expected that audiovisual information, e.g., a video, leads to enhanced website satisfaction and recall of medical information, which especially benefits older patients because audiovisual information can compensate for older adults' limited cognitive capacity (Van Gerven, Paas, Van Merriënboer, Hendriks, & Schmidt, 2003). In addition, presentation strategies, such as narration style, can play an important role in increasing satisfaction and recall of information as well. This is called the personalization effect and is referred to as presenting information in a personalized conversational style rather than a nonpersonalized formal style (Mayer, 2002). Conversational style is often used in narrative communication, presenting personal stories or a description of an individual experience, e.g., providing information from a patient's perspective (Kreuter et al., 2007) and is frequently compared to formal style, which refers to presenting factual information, such as expressing professional opinions, e.g., providing information from a health professional's perspective (Reinard, 1988).

This study investigates the effects of multimedia (i.e., modality) and presentation (i.e., narration style) strategies on website satisfaction and recall of cancer-related information among older patients. We test the effect of modality and narration style among older patients as compared to younger patients in a 3 (text only vs. text with formal-styled audiovisual vs. text with conversational-styled audiovisual information) by 2 (younger vs. older age) experimental design. In assessing age differences, we chose age younger than 65 for the younger age group and age 65 and older as the older age group. These two age groups have been found worthy of separate analysis in several studies on adulthood development (Staudinger & Bluck, 2001) and disease in adulthood (Silliman, Troyan, Guadagnoli, Kaplan, & Greenfield, 1997).

Theoretical background

The cognitive theory of multimedia learning attempts to understand how people learn information in multimedia environments (Mayer, 1999). This theory is based on the assumption that people have separate information processing systems for visual and auditory materials (Paivio, 1971) and that the cognitive capacity of these visual and auditory information processing systems are highly limited (Baddeley, 1992). Multimedia messages can effectively expand one's limited cognitive capacity by providing people with well-developed multimedia messages, such as audiovisual materials combined with textual information, rather than with more traditional modes of information, such as textual information alone (Mayer & Moreno, 2003). Previous research on this so-called modality effect has indicated that presenting information audiovisually increased satisfaction with the information (Dunn, Steginga, Rose, Scott, & Allison, 2004) and elicited more positive feelings than text-only information (Chuang, Sparks, Gardner, & Bradley, 2012, May). There is also ample evidence for the personalization effect. It has been found that conversational style increases interest and is better liked (Kreuter et al., 2010; McQueen & Kreuter, 2010). One study also found enhanced satisfaction when using conversational style in online multimedia environments, such as games (Adams, Mayer, MacNamara, Koenig, & Wainess, 2012). Building on this previous research we expect that *showing text with audiovisual information will result in higher website satisfaction in younger and older patients than text-only information (H1a)* and that *showing text with conversational-styled audiovisual information will increase website satisfaction in younger and older patients compared to formal-styled audiovisual information (H1b)*.

In addition to website satisfaction, modality and narration style are also found to influence the extent to which information is recalled (Mayer, 2002). Empirical evidence has shown that audiovisual information leads to higher recall of information than written information only (Mayer & Moreno, 1998). Nevertheless, not all audiovisual messages should be expected to be equally successful in promoting recall of information. It has been found that conversational style is better recalled than formal style (Mayer, 2002). For instance, Kreuter et al. (2010) distinguished between conversational-styled (narrative) and formal-styled (informational) videos and found that conversational-styled videos resulted in better recall of cancer-related information than the formal-styled video. In a follow up study, it was also found that a conversational-styled video led to increased recall of information compared to a

formal-styled video (McQueen, Kreuter, Kalesan, & Alcaraz, 2011). We therefore hypothesize that *showing text with audiovisual information will result in higher recall of cancer-related information in younger and older patients than text-only information (H2a)* and that *showing text with conversational-styled audiovisual information will increase recall of cancer-related information in younger and older patients compared to formal-styled audiovisual information (H2b)*.

Whereas much research has been conducted on the effectiveness of multimedia learning strategies among younger adults (Mayer & Moreno, 2002; Mayer & Sims, 1994), less research has focused on the effect of multimedia strategies on older adults' recall of information (Van Gerven et al., 2003). The cognitive aging principle in multimedia learning (Paas et al., 2005) provides an integrative framework in which the cognitive load theory is combined with general views of cognitive aging. This theory states that limited working memory might be expanded by using one or more sensory modalities and thereby enhancing recall of information, especially for older adults. Older adults usually have a smaller "total cognitive capacity" and might therefore benefit more from multimodal information (Van Gerven, Paas, Van Merriënboer, & Schmidt, 2000). Previous research has demonstrated a benefit of multimedia messages for older adults by reducing cognitive load and decreasing learning time of information (Sweller et al., 2011; Van Gerven, Paas, & Van Merriënboer, 2006). We expect based on the cognitive aging principle in multimedia learning that *older patients recall less cancer-related information than younger patients, regardless of how information is presented (H3a)* and that *older patients benefit more from showing text with audiovisual information (vs. text-only information) and thereby show a greater gain in recall of cancer-related information than younger patients (H3b)*.

Method

Design

A 3 (condition: text only vs. text with formal-styled video vs. text with conversational-styled video) by 2 (age patient: younger [< 65 yrs.] vs. older [≥ 65 yrs.]) between-subject factorial design was used with website satisfaction and recall of cancer-related information as dependent variables. Patients were randomly assigned to one of the three conditions stratified by age group. Power analysis with alpha set at .05, effect size at .25, and a probability level of .80 revealed that a sample size of at least 158 patients was needed to detect meaningful differences.

Stimulus material

A webpage of The Netherlands Cancer Institute (NKI) with information on Radio Frequency Ablation (RFA) treatment was developed for this study. RFA uses radiofrequency waves to eradicate lung tumors. RFA was deliberately chosen because RFA is a relative unknown treatment and lung cancer patients of the NKI rarely receive this treatment. We used information about RFA treatment for the webpage, because the aim of the study was to examine the effects of modality and narration style in presenting online cancer-related information on website satisfaction and recall of information without contamination by prior knowledge. The validity of

the recall measurement would be warranted if patients had no prior experience with or knowledge about RFA treatment. Three different versions of the NKI webpage were created, resulting in text-only information (text-only condition), text with a formal-styled video (formal-styled video condition), and text with a conversational-styled video (conversational-styled video condition). The content of the information was kept constant across conditions. Using the written RFA content, the scripts of videos were written. The formal-styled video included a health professional explaining the RFA treatment and the conversational-styled video included a cancer survivor sharing his experience with RFA treatment. The health professional was videotaped behind his desk wearing a lab coat and the patient was filmed sitting on a couch. The content of the formal-styled video was identical to the text-only information. The conversational-styled audiovisual information contained the same factual information as the text-only information and formal-styled video, however, unlike the formal third-person style of the formal-styled information, the conversational-styled version contained sentences presented in the first person as if the narrator were talking to you. This is in line with how Mayer (2002) defines conversational style. For example, both versions included a passage on how RFA treatment is executed in which an additional sentence was added to the personalized version, stating "I suffered from lung cancer and was treated with the RFA method" (for complete script of the formal-styled and conversational-styled versions, see Appendix B). Furthermore, the same actor was used to keep the videos as similar as possible. Although we used a male actor for both videos, no differences were found between male and female patients in identification with the actor and perceived similarity to the actor, resp. $F(1, 110) = 0.31$, $p = .579$, $\eta_p^2 = .00$ and $F(1, 110) = 1.41$, $p = .238$, $\eta_p^2 = .01$.

Sample and procedure

Permission for this study was granted by the medical ethical committee of the NKI (trial number P12OLD). Lung cancer patients who were not newly diagnosed were recruited through this hospital between April 2012 and August 2012. To avoid undesired outcomes for participating patients, we used so-called "analog patients" in this study. These are patients with a personal history with cancer who imagine a hypothetical treatment (i.e., RFA). A recent meta-analysis demonstrated the validity of using analog patients as proxies for clinical patients by showing insignificant discrepancies between perceptions of analog and clinical patients (Van Vliet et al., 2012). Patients were approached in the waiting room and were asked to participate in an online survey. When patients agreed, they signed informed consent and received an e-mail at home with a link to the online survey. Patients were eligible when (1) being aged 18 years or older, (2) being diagnosed with lung cancer, (3) being able to read and write in Dutch, (4) having access to the Internet, and (5) written informed consent was provided. Patients were excluded when reporting to have prior RFA knowledge (i.e., scoring higher than 4 on a 7-point scale) and not having completed the questionnaire him or herself. Patients were also excluded when being newly diagnosed. We felt that it is unethical to provide new patients with a treatment option that would not be available to them at the NKI while still discussing treatment options with their health professional.

When entering the online survey, questions on background and medical

characteristic were shown. Next, patients were either exposed to the webpage with text-only information, text with formal-styled video, or text with conversational-styled video. The webpage was part of the online survey and could only be accessed through the survey. Patients were instructed to pay careful attention to the RFA information that was displayed on the webpage and were told that they would not be able to return to the webpage with text or text with video after turning to the next page. Patients could spend as much time on the webpage as they preferred. On average, patients spent 3.57 min on the webpage ($SD = 3.11$) and there was no difference between older and younger patients' viewing time, $F(1, 165) = 0.01$, $p = .943$, $\eta_p^2 = .00$, neither between the different conditions, $F(2, 164) = 0.54$, $p = .586$, $\eta_p^2 = .01$. On the next page, the recall questions were shown. Following the recall questions, the patients were allowed to look at the webpage again after which they filled out the three subscales of the website satisfaction questionnaire.

Measures

Website satisfaction

Patients reported their satisfaction with the website on the Website Satisfaction Scale (WSS: Bol, Van Weert, et al., 2014; Van Weert et al., 2011). The WSS was developed based on items of the website attitude scale (Chen & Wells, 1999; Van Weert et al., 2011) and the Leisure Satisfaction Scale (LSS: Beard & Ragheb, 1980) and consisted of 12 items. Principle Component Analysis (PCA) revealed three website satisfaction subscales which each showed high internal consistency: "satisfaction with comprehensibility" (3 items, $\alpha = .91$), "satisfaction with attractiveness" (5 items, $\alpha = .89$), and "satisfaction with emotional support" (4 items, $\alpha = .95$). Items included for instance "the website contains comprehensive language," "the website is enjoyable," and "the website helps dealing with stress" respectively for each subscale using a 7-point Likert response scale, ranging from 1 "totally disagree" to 7 "totally agree." These subscales were used and fully described in a previous study (Bol, Van Weert, et al., 2014).

Recall of cancer-related information

Recall was assessed based on the format of The Netherlands Patient Information Recall Questionnaire (Jansen, Van Weert, et al., 2008). Questions were produced from the RFA information text which resulted in 11 open-ended questions, such as "how much time does an RFA treatment take?" (Bol, Van Weert, et al., 2014; Bol, Van Weert, De Haes, Loos, et al., 2015). Corresponding answer options were "not discussed," "discussed, but I can't remember the details," and "discussed, namely. . .." Recall scores were allocated based on a codebook and could range from 0 (not recalled), to 1 (recalled partially), to 2 (recalled correctly). As RFA treatment is not discussed during consultations, recall scores were a result of exposure to the online information patients were provided with in this experiment. Over twenty percent ($n = 37$, 21.9%) of the recall scores were double coded by two independent coders and a good interrater reliability was realized ($\kappa = .88$, range .64 – 1.00). The 11 questions were computed into a total recall score, ranging from 0 to 22 and percentages of recall were calculated for interpretation of results.

Patient characteristics

Demographics assessed included patient's age, gender, level of education, Internet use (hours per week), and prior medical knowledge (on lung cancer and RFA treatment). Medical characteristics included date since diagnosis (in months), type of treatment, and goal of treatment (curative or palliative). Patients' frailty was assessed using the Groningen Frailty Indicator (GFI: Schuurmans, Steverink, Lindenberg, Frieswijk, & Slaets, 2004). This 15-item scale was used to determine the patient's level of frailty by screening the loss of functions and resources in physical (mobility functions, multiple health problems, physical fatigue, vision, hearing), cognitive (cognitive functioning), social (emotional isolation), and psychological functioning (depressed mood, feelings of anxiety). Each item was rated with 0 or 1 point, resulting in a sum scale ranging from 0 to 15, with higher scores indicating more frailty.

Statistical analysis

Descriptive statistics were used to describe the sample characteristics. To determine whether experimental conditions and age groups differed on gender, age, educational level, Internet use, (RFA) medical knowledge, and frailty, F-statistics and chi-statistics were conducted where appropriate. For testing the main effects of condition and age, four separate ANOVAs were conducted with satisfaction with comprehensibility, satisfaction with attractiveness, satisfaction with emotional support, and recall of information as dependent variables, and condition and age groups as factors. Additional Tukey's HSD tests were conducted to check for differences within conditions. The experimental conditions stratified by age group significantly differed on prior RFA knowledge, $F(5, 163) = 2.32$, $p = .046$, $\eta_p^2 = .07$, and Internet use, $F(5, 161) = 2.44$, $p = .037$, $\eta_p^2 = .07$. As controlling for these variables did not alter the main and interaction effects of age group and condition on website satisfaction, the unadjusted effects for website satisfaction are reported. However, the variables did alter the effects of age group and condition on recall of information and were therefore included as covariates. Both the unadjusted and adjusted effects are reported for recall of information.

Results

Patient randomization and characteristics

The recruitment flow is depicted in Figure 6.1. A total of 377 patients were approached to participate, 296 (78.5%) of which gave written informed consent. Patients were not eligible to participate when they did not have access to a computer or the Internet (13.0%, $n = 49$), felt to sick or tired (4.5%, $n = 17$), declined to fill out informed consent (3.2%, $n = 12$), were not diagnosed yet (0.5%, $n = 2$), or were analphabetic (0.3%, $n = 1$). Another 65 patients (17.2%) dropped out before randomization, due to feeling too sick or too tired (5.0%, $n = 19$), passing away (0.5%, $n = 2$), or other reasons (11.7%, $n = 44$). In total, 128 younger and 103 older patients were randomized to be exposed to either text-only information ($n = 71$), text with formal-styled video ($n = 76$), or text with conversational-styled video ($n = 84$). Thirty-nine patients (10.3%) eventually did not receive the allocated intervention due to not being able to view the video (3.4%, $n = 13$), technical problems (0.5%, $n = 2$), or other unknown reasons (6.4%, $n =$

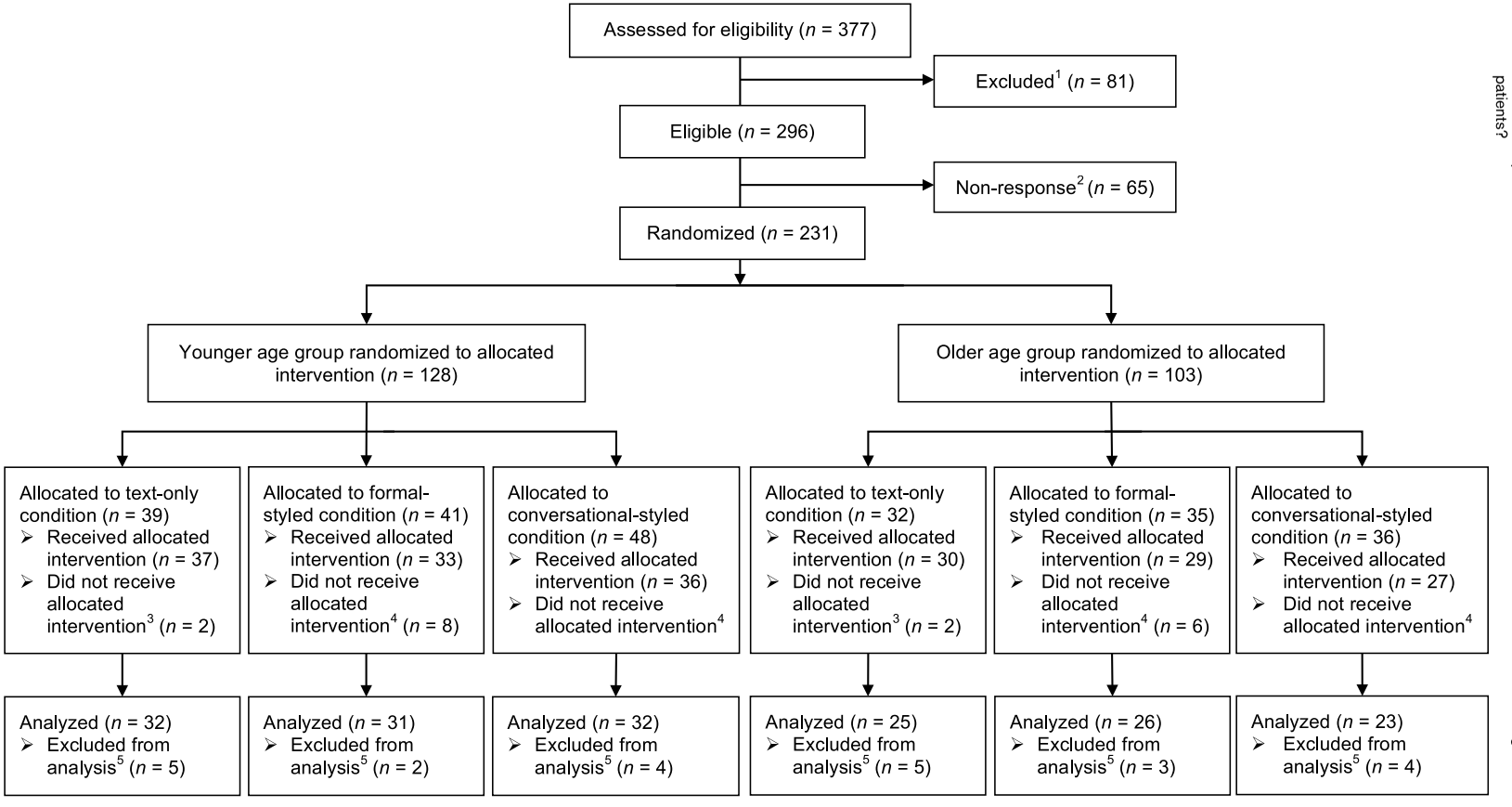

Figure 6.1. Flow chart of participant recruitment.

Notes. [1]Did not have access to Internet/computer ($n = 49$), felt too sick or too tired ($n = 17$), declined to fill out informed consent ($n = 12$), not diagnosed yet ($n = 2$), analphabetic ($n = 1$); [2]Felt too sick or too tired ($n = 19$), passed away ($n = 2$), other ($n = 44$); [3]Unknown ($n = 4$); [4]Not able to view the video ($n = 13$), technical problems ($n = 2$), unknown ($n = 24$); [5]Too much prior RFA knowledge ($n = 5$), questionnaire filled out by someone else ($n = 7$), did not understand the questionnaire ($n = 10$), duplicate ($n = 1$)

24). This resulted in 192 patients (50.9%) who fully completed the questionnaire, of which 23 patients (6.1%) were removed from analysis because of having prior RFA knowledge (1.3%, $n = 5$), having someone else filling out the questionnaire (1.9%, $n = 7$), not understanding the purpose of the questionnaire (2.7%, $n = 10$), or filling out the questionnaire twice at the same time (0.3%, $n = 1$). This resulted in a sample size of 169 patients which is sufficient to detect meaningful differences according to the power analysis. Non-response analysis revealed that patients who were included in data analysis were more likely to be male than the patients who were ineligible or dropped out in a later stage, $\chi^2 = 4.51$, $p = .032$. Participating patients did not differ in age from non-participating patients, $F(1, 375) = 1.09$, $p = .297$, $\eta_p^2 = .00$.

Over half of the participants were male (58.6%) and the mean age was 61 years old ($M = 61.32$, $SD = 10.76$). Of these participants, 95 were younger patients ($<$ 65 yrs.; $M = 54.19$, $SD = 8.57$) and 74 were older patients ($\geq$ 65 yrs.; $M = 70.47$, $SD = 4.54$; $F(1, 167) = 218.99$, $p < .001$, $\eta_p^2 = .57$). Besides age, $F(1, 167) = 218.99$, $p < .001$, $\eta_p^2 = .57$, the two age groups significantly differed on Internet use, $F(1, 165) = 9.16$, $p = .003$, $\eta_p^2 = .05$, and type of treatment (i.e., older patients were more often not treated than younger patients, $\chi^2 = 4.47$, $p = .034$, and younger patients received chemotherapy more often than older patients, $\chi^2 = 10.71$, $p = .001$). Patients were on average diagnosed 3.5 years ago ($M = 44.02$ [months], $SD = 57.87$) and equally received treatment with curative (49.7%) or palliative intent (45.0%). Patient characteristics are shown in Table 6.1.

Table 6.1. Background and medical characteristics ($n = 169$)

	Younger patients (< 65 yrs.) $n = 95$		Older patients (≥ 65 yrs.) $n = 74$		p
Variable	*n*	*(%)*	*n*	*(%)*	
Gender					.143
Male	51	(53.7)	48	(64.9)	
Female	44	(46.3)	26	(35.1)	
Age					< .001
Mean (*SD*)	54.19 (8.57)		70.47 (4.54)		
Range	21 – 64		65 – 85		
Education					.108
Low	27	(28.4)	33	(44.6)	
Middle	28	(29.5)	18	(24.3)	
High	37	(38.9)	22	(29.7)	
Internet use (hours per week)					.004
Mean (*SD*)	11.63 (8.43)		7.96 (6.75)		
Range	0 – 40		0 – 35		
Medical knowledge about lung (scale 1 – 7)[a]					.076
Mean (*SD*)	3.04 (1.47)		2.65 (1.35)		
Range	1 – 6		1 – 6		
Medical knowledge about RFA (scale 1 – 7)[a]					.338
Mean (*SD*)	1.46 (0.91)		1.34 (0.75)		
Range	1 – 4		1 – 4		
Time since diagnosis (months)					.296
Mean (*SD*)	39.86 (45.24)		49.39 (70.93)		
Range	0 – 188		0 – 433		
Type of treatment					
Surgery	45	(47.4)	33	(44.6)	.720
Chemotherapy	81	(85.3)	47	(63.5)	.001
Radiation therapy	57	(60.0)	40	(54.1)	.438
Hormone therapy	6	(6.3)	5	(6.8)	.908
Immunotherapy	1	(1.1)	0	(0.0)	.376
Radio Frequency Ablation (RFA)	0	(0.0)	0	(0.0)	NA[c]
None	5	(5.3)	11	(14.9)	.034
Other	17	(17.9)	13	(17.6)	.956
Unknown	1	(1.1)	0	(0.0)	.376

Goal of treatment					.209
Curative	45	(47.4)	39	(52.7)	
Palliative	47	(49.5)	26	(39.2)	
Unknown	3	(3.2)	6	(8.1)	
Frailty (scale 0 – 15)[b]					.192
Mean (*SD*)	3.73 (2.46)		3.22 (2.52)		
Range	0 – 9		0 – 11		
Time spent on the website (in minutes)					.943
Mean (*SD*)	3.59 (3.88)		3.55 (1.75)		
Range	1.70 – 36.53		1.69 – 9.58		

Note. Not all figures add up to 100% due to missing data. Conditions stratified by age did only significantly differ on RFA knowledge and Internet use. *SD*, standard deviation. [a]A higher score indicates more knowledge. [b]A higher score indicates higher frailty. [c]Not applicable due to empty cells, i.e., no patient received RFA treatment

Website satisfaction

We hypothesized that text with audiovisual information would lead to enhanced website satisfaction compared to text-only information (H1a) and that text with conversational-styled audiovisual information would increase website satisfaction compared to text with formal-styled audiovisual information (H1b). We found a main effect of condition on satisfaction with the comprehensibility of the website, $F(2, 163) = 6.31$, $p = .002$, $\eta_p^2 = .07$, satisfaction with the attractiveness of the website, $F(2, 163) = 4.97$, $p = .008$, $\eta_p^2 = .06$, and satisfaction with the emotional support from the website, $F(2, 163) = 4.53$, $p = .012$, $\eta_p^2 = .05$ (see Table 6.2 for means). Text with conversational-styled audiovisual information resulted into higher satisfaction with comprehensibility and satisfaction with attractiveness than text-only information, but not into higher satisfaction compared to the text with formal-styled audiovisual information. Furthermore, conversational-styled audiovisual information outperformed both text only and text with formal-styled audiovisual information in satisfaction with emotional support. We therefore found evidence for the modality effect (H1a) in satisfaction with the comprehensibility, attractiveness, and emotional support from the website. Furthermore, text with conversational-styled audiovisual information significantly increased emotional support from the website compared to text with conversational-styled information, partially supporting the personalization effect (H1b). No main effects of age nor interaction effects of age and condition were found on website satisfaction.

Table 6.2. Satisfaction with comprehensibility, attractiveness, and emotional support from the website stratified by condition and younger (< 65 yrs.) and older (≥ 65 yrs.) patients ($n = 169$)

		Satisfaction with comprehensibility			Satisfaction with attractiveness			Satisfaction with emotional support		
	n	*M*	*SE*	95% CI	*M*	*SE*	95% CI	*M*	*SE*	95% CI
Text only	57	5.21	.16	[4.91, 5.52]	4.12	.15	[3.82, 4.42]	3.49	.19	[3.11, 3.87]
Younger patients	32	5.25	.21	[4.84, 5.66]	4.11	.20	[3.71, 4.51]	3.30	.26	[2.79, 3.81]
Older patients	25	5.17	.23	[4.71, 5.63]	4.13	.23	[3.68, 4.58]	3.68	.29	[3.11, 4.26]
Formal-styled video	57	5.65	.16	[5.34, 5.95]	4.52	.15	[4.22, 4.83]	3.32	.19	[2.94, 3.70]
Younger patients	31	5.75	.21	[5.34, 6.17]	4.43	.21	[4.02, 4.83]	3.50	.26	[2.98, 4.02]
Older patients	26	5.54	.23	[5.09, 5.99]	4.62	.22	[4.18, 5.07]	3.14	.29	[2.57, 3.70]
Conversational-styled video	55	6.00[a***]	.16	[5.69, 6.31]	4.80[a**]	.16	[4.50, 5.11]	4.11[a*,b*]	.20	[3.72, 4.51]
Younger patients	32	6.16	.21	[5.75, 6.56]	4.78	.20	[4.38, 5.18]	4.25	.26	[3.74, 4.76]
Older patients	23	5.84	.24	[5.36, 6.32]	4.83	.24	[4.36, 5.30]	3.98	.30	[3.38, 4.58]
Total	169	5.62	.09	[5.44, 5.80]	4.48	.09	[4.31, 4.66]	3.64	.11	[3.42, 3.86]
Younger patients	95	5.72	.12	[5.48, 5.96]	4.44	.12	[4.21, 4.67]	3.68	.15	[3.39, 3.98]
Older patients	74	5.52	.14	[5.25, 5.79]	4.53	.13	[4.26, 4.79]	3.60	.17	[3.26, 3.93]

Note. Website satisfaction subscales range from 1 to 7. A higher mean indicates more satisfaction with the website. *M*, mean; *SE*, standard error; CI, confidence interval. [a]Mean differs significantly compared to the text-only condition (main effect). [b]Mean differs significantly compared to the text with formal-styled video condition (main effect). * $p < .05$. ** $p < .01$. *** $p < .001$.

Recall of cancer-related information

H2a postulated that text with audiovisual information would result in higher recall of information than text only. We found support for this modality effect: text with nonpersonalized audiovisual condition and text with personalized audiovisual condition resulted into higher recall scores as compared to the text-only condition, $F(2, 163) = 8.85$, $p < .001$, $\eta_p^2 = .10$ (see Table 6.3 for adjusted and unadjusted means). Although the text with conversational-styled video resulted into the highest recall scores, Tukey's HSD showed that the recall scores were not significantly higher than the recall scores in the text with formal-styled video condition. Therefore, the personalization effect cannot be supported (H2b). H3a expected that older patient

would recall less information correctly than their younger counterparts. Our results confirmed that older patients recalled less cancer-related information than younger patients, $F(1, 163) = 4.95$, $p = .027$, $\eta_p^2 = .03$. However, when controlling for Internet use, these age differences disappeared, $F(1, 159) = 3.04$, $p = .083$, $\eta_p^2 = .02$, indicating that Internet use plays an important role in recalling online cancer-related information. Post-hoc analyses showed that Internet use was positively related to information recall ($r = .17$, $p = .029$) and negatively related to aging ($r = -.23$, $p = .003$), which further supports the role of Internet in explaining the effect on recall of information. Ultimately, simple effect analysis showed that older patients did not benefit more from text with audiovisual information, $F(2, 160) = 3.04$, $p = .051$, than younger patients, $F(2, 160) = 6.08$, $p = .003$, $\eta_p^2 = .00$, rejecting H3b.

Table 6.3. Percentages of information recalled correctly stratified by condition and younger (< 65 yrs.) and older (≥ 65 yrs.) patients ($n = 169$)

		Recall of cancer-related information					Adjusted recall of cancer-related information[a]			
	n	% *recall*	*M*	*SE*	95% CI	*n*[b]	% *recall*	*M*	*SE*	95% CI
Text only	57	33.5	7.36	.62	[6.13, 8.59]	56	33.5	7.38	.64	[6.12, 8.65]
Younger patients	32	35.6	7.84	.83	[6.21, 9.48]	32	35.2	7.75	.83	[6.12, 8.65]
Older patients	25	31.3	6.88	.94	[5.03, 8.73]	24	31.9	7.02	.96	[5.12, 8.92]
Formal-styled video	57	46.2	10.17[c**]	.62	[8.95, 11.40]	56	46.0	10.11[c**]	.63	[8.87, 11.36]
Younger patients	31	51.8	11.39	.84	[9.73, 13.05]	31	50.5	11.11	.86	[9.42, 12.81]
Older patients	26	40.7	8.96	.92	[7.15, 10.77]	25	41.4	9.11	.95	[7.24, 10.98]
Conversational-styled video	55	49.5	10.90[c***]	.64	[9.64, 12.16]	55	49.8	10.96[c***]	.64	[9.70, 12.23]
Younger patients	32	52.9	11.63	.83	[9.99, 13.26]	32	52.5	11.56	.83	[9.93, 13.19]
Older patients	23	46.2	10.17	.98	[8.25, 12.10]	23	47.1	10.36	.98	[8.42, 12.31]
Total	169	43.1	9.48	.36	[8.76, 10.20]	167	43.1	9.49	.37	[8.77, 10.21]
Younger patients	95	46.8	10.29	.48	[9.34, 11.23]	95	46.1	10.14	.49	[9.18, 11.10]
Older patients	74	39.4	8.67d*	.54	[7.60, 9.75]	72	40.1	8.83	.56	[7.73, 9.94]

Note. Recall of information ranges from 0 to 22. The higher the score the more information was recalled correctly. *M*, mean; *SE*, standard error; CI, confidence interval. [a]Adjusted for prior RFA knowledge and Internet use. [b]The category sizes differ because of 2 fewer cases due to missing covariate values. [c]Mean differs significantly compared to the text-only condition (main effect). [d]Mean differs significantly compared to younger patients (main effect). ** $p < .01$. *** $p < .001$.

Discussion and conclusion

Discussion

This study examined ways of effectively presenting health information to cancer patients by adding conversational-styled audiovisual materials to online textual information. The results of this study indicate that supporting textual cancer-related information with audiovisual information improves recall of cancer-related information and information with conversational-styled audiovisual information enhances website satisfaction. Furthermore, satisfaction with emotional support from the website is more increased by exposure to text with conversational-styled audiovisual information than to text with formal-styled audiovisual information. We thus found empirical evidence for the modality effect and the personalization effect (Mayer, 2002) suggesting that text with audiovisual information improves recall of information and text with conversational-styled audiovisual information enhances website satisfaction in cancer patients.

We also found that older patients recalled less cancer-related information than younger patients. However, when taking Internet use into account, the differences in recall between younger and older patients disappeared. Previous research has also revealed that Internet use is a more decisive factor than chronological age (Loos, 2011). This is an important finding because it is expected that Internet use among older populations will grow due to the process of generational change and the use of computer and Internet facilities. Today's younger adults will be the future's older adults (Duimel, 2007). Together with our findings, this provides evidence for the notion that Internet use plays a crucial role in the effectiveness of health communication in older adults.

In conflict with the cognitive aging principle in multimedia learning, older patients did not benefit more from multimedia strategies such as modality and narration style than younger patients. This might be due to the fact that older patients spent equal time in viewing the webpage as younger patients, and it is found that time spent learning the information is a crucial ingredient of higher recall scores in older adults (Morrow, Hier, Menard, & Leirer, 1998).

We used audiovisual information in addition to text information to compare to text-only information. This is in line with the cognitive theory of multimedia learning assuming that information is better learned when presented both visually (e.g., text information) and auditory (e.g., audiovisual information) (Sweller et al., 2011). However, as we had no audiovisual only condition, it is difficult to conclude whether the added value of combining text with audiovisual information is because the additional video explained information in a different mode or because the same information was presented twice. There is research indicating that repeating information might increase recall of information (Morrow, Leirer, Carver, Tanke, & McNally, 1999). Nevertheless, in a previous similar experiment among healthy adults, we found that the same audiovisual materials, presented as audiovisual only without additional text information, increased recall of information when the audiovisual information was presented in conversational style, but not when the audiovisual information was presented in formal style (Bol, Van Weert, De Haes, et al., 2015). This indicates that in the current study a modality and personalization effect occurred rather than a repetition effect.

Although this research contributes to our understanding of effective health messages, some limitations should be acknowledged. First, we did not include

a conversational-styled text-only condition. Previous literature has acknowledged the positive effect of conversational-styled written information as well (Hinyard & Kreuter, 2007). Hence, we cannot tell whether we are dealing with a modality effect, a personalization effect or an interaction of modality and narration style to explain website satisfaction and recall of information. Furthermore, the questionnaire was administered online and patients were required to have a computer with access to the Internet. As we found that taking Internet use into account diminished age differences in information recall, we might have overestimated older adults' abilities to understand online information. Furthermore, there were no age differences in patients' frailty in this sample. Both older and younger patients were on average little to moderately frail as they scored (just) below the cut-off point of 4.0 on average (Schuurmans et al., 2004). Therefore, we may not have reached the most vulnerable group of older patients. Thus, it is recommended to involve these patients as well when researching and developing effective health communication tools.

Conclusion

We found support for the modality effect which suggests that information should preferably be presented as text with additional audiovisual information rather than text-only information. Text with audiovisual information was found to improve satisfaction with the comprehensibility and attractiveness of the website (H1a) and recall of information (H2a). We also found evidence for the personalization effect, stating that conversational-styled information is preferred over formal-styled information. The personalization effect was found in satisfaction with satisfaction with emotional support from the website (H1b), indicating that conversational style is a powerful mechanism in perceiving emotional support from a website. Conversational style did not increase recall of cancer-related information (H2b). Ultimately, we found, as expected, that older patients recalled less cancer-related information correctly than their younger counterparts (H3a). Furthermore, older patients did not benefit more from multimedia strategies such as modality and narration style than younger patients (H3b). When taking patients' Internet use into account, the age differences disappeared. Even though no interaction effects between age and Internet use were found, this result indicates that Internet use may minimize the differences between younger and older patients and may therefore be seen as an important factor in explaining recall of cancer-related information in multimedia environments.

Practice implications

Current multimedia environments are promising health communication tools in the provision of relevant health information. This study shows that health information can be optimized in terms of enhancing patients' satisfaction with a website and recall of information by adding audiovisual materials to textual online cancer-related information. Especially conversational-styled audiovisual information, e.g., providing information from a patient's perspective, improved website satisfaction and recall of cancer-related information. Hence, website designers are encouraged to use these multimedia strategies to optimize the provision of health information.

Chapter 7

The effect of narration style and age congruency in narrative communication on website satisfaction and recall of online health information

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The Dutch version of this article won the 2013 best article award for the best article published in Tijdschrift voor Communicatiewetenschap.

Abstract

The effect of narration style and age congruency on website satisfaction and recall of information was tested in a 2 (narration style: conversational style vs. formal style) × 2 (age congruency: congruent vs. incongruent) experimental design (n = 275). Conversational style was found to be an effective communication tool to predict recall of information. Age congruency had an effect on satisfaction with the emotional support from the website. Narrative engagement predicted both website satisfaction and recall of information, but did not mediate the relationship between narration style and the outcome variables. However, significant conditional mediation effects revealed that age congruency plays a moderating role in explaining the effects of narration style on website satisfaction and recall of online health information via narrative engagement. This study provides practical implications for developing online health messages for older adults.

Introduction

The Internet offers a viable source for disseminating cancer information. In addition to finding information through online search engines, many hospitals also refer their patients to information on the Web, such as patient portals and hospital websites. This means that much information is primarily available online, and sometimes even exclusively online, which forces people to use the Internet to obtain crucial cancer information (Lippincott, 2004). This may be problematic for some groups, such as for an aging population. Although 81% of people aged between 65 and 75 had access to the Internet in 2012 (Statistics Netherlands, 2012), this does not necessarily mean that these older adults understand online health information. Not being able to understand online health information can lead to decreased satisfaction with the content of the health-related website (Parrott, Raup Krieger, Silk, & Egbert, 2008). Website satisfaction is a website user's "predispositions to respond favorably or unfavorably to web content" (Chen & Wells, 1999, p. 28). Website satisfaction is an important motivator for processing and learning information (Park & Lim, 2007). Furthermore, not being able to understand health information can also negatively influence recall of information (Wilson et al., 2010), which is the ability to correctly remember and reproduce information. Recall of information plays a crucial role in adequate disease management and adherence to medical regimes (Kravitz et al., 1993; Ley, 1988; Linn, Van Dijk, Smit, Jansen, & Van Weert, 2013).

In order to enhance website satisfaction and recall of information among older adults, there is a need to develop effective strategies to present online health information in an attractive and clear manner. Health information is often provided at a too high reading level and is therefore not understandable for lay persons (McCray, 2005). One way to present information in a more comprehensible manner is through narrative health videos (Kreuter et al., 2007). A narrative is "a representation of connected events and characters that has an identifiable structure, is bounded in space and time, and contains implicit or explicit messages about the topic being addressed" (Hinyard & Kreuter, 2007, p. 778). Narrative health videos have been found to be an effective way to educate people about cancer-related information (Kreuter et al., 2010). As narrative engagement plays an important role in the effectiveness of the narrative (Wirth, 2006), it is important to study the role of narrative engagement (i.e., involvement with the narrator and involvement with the narrative) in online audiovisual health information. Therefore, the first aim of this study is to gain more insight into the effect of narrative engagement on website satisfaction and recall of cancer-related information.

Narrative communication often uses conversational style, which is a strategy where information is presented from a first-person perspective (Mayer, 2002). Although numerous studies have focused on the effects of narrative health communication (Hinyard & Kreuter, 2007), to date, the effects of conversational style remain unclear. Moreover, there is a lack of knowledge about how narratives can be effectively used as communication tools to provide older adults in particular with cancer information. Therefore, the current study will focus on the role of narration style and age congruency. Age congruency refers to the perceived similarity between the age of the narrator of the message and the age of the recipient of the message. We expect an interaction effect to occur between narration style and age congruency. Thus, the second aim of

this study is to examine the (interaction) effect of narration style and age congruency on website satisfaction and recall of cancer-related information.

Narrative engagement could also mediate the effect of narration style and age congruency on website satisfaction and recall of information. Our third and final aim of this study is to explore whether narrative engagement mediates the (interaction) effect of narration style and age congruency on website satisfaction and recall of cancer-related information.

To summarize, the current study investigates the effect of narration style and age congruency on website satisfaction and recall of information in audiovisual health information and the mediating role of narrative engagement. We will test this using a conditional mediation model, as proposed in Figure 7.1.

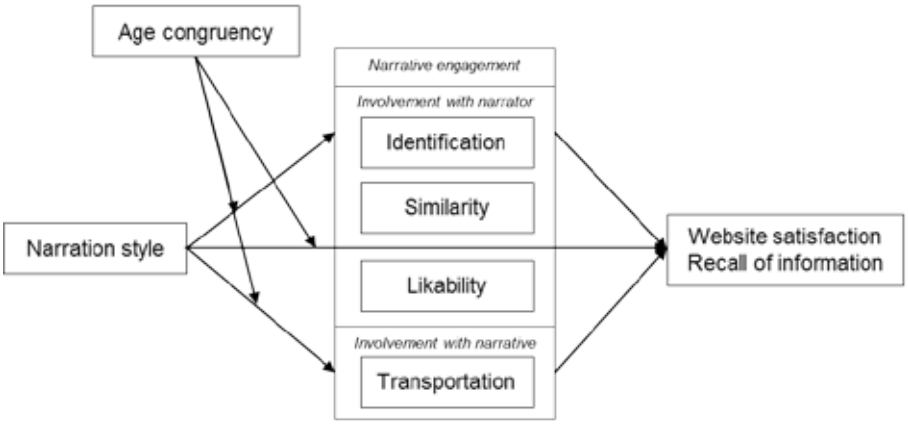

Figure 7.1. Conditional mediation model: The effect of narration style and age congruency on website satisfaction and recall of information via narrative engagement (i.e., involvement with the narrator: identification, perceived similarity, likability, and involvement with the narrative: transportation).

The role of narrative engagement in narrative communication

The effectiveness of a narrative health video is, among other factors, influenced by the extent of narrative engagement (Wirth, 2006). Within narrative engagement, we can distinguish between involvement with the narrative's character (the video narrator) and involvement with the narrative's story (the narrative) (Slater & Rouner, 2002).

Involvement with the video narrator

Involvement with the video narrator can be conceptualized in a variety of ways. Murphy, Frank, Moran and Patnoe-Woodley (2011) distinguish between 1) identification with the narrator; 2) perceived similarity with the narrator; and 3) the likability of the narrator. Identification is defined as the imaginary process in which people merge with characters and share their knowledge, emotions, and goals (Cohen, 2001). Perceived similarity refers to the extent to which people perceive themselves as being similar (e.g., similar way of thinking) to the video narrator (Slater & Rouner, 2002).

Furthermore, likability is often defined as the extent to which the narrator in the video is seen as likable, friendly, and warm (Maccoby & Wilson, 1957; Reysen, 2005). Previous work has shown that involvement with the video narrator is an important predictor of satisfaction and recall of information. For instance, it was found that the more a person identified with a narrator, liked the narrator, and perceived the narrator as similar (i.e., involvement with the narrator), the more satisfied this person was with the information provided and the more this person recalled (Murphy et al., 2011). Therefore, we hypothesize that *involvement with the video narrator is positively related to website satisfaction (H1a) and recall of cancer-related information (H1b)*.

Involvement with the narrative

Other than involvement with the narrator of a story, involvement with the narrative itself is seen as an important predictor of narrative effects. The transportation-imagery model refers to this as transportation, which is the mental process in which people are immersed in the world of a story (Green & Brock, 2000). This model asserts that readers experience, to some extent, mental absorption into the story, whereby their thoughts, feelings, and attention are focused on the events occurring in the story (Green & Brock, 2000). Transportation can make abstract information, such as information about a lung cancer treatment, seem more like a real experience because of the concrete examples and vividness of the story's events (Green, 2004). Previous research has shown that involvement with the narrative is the best predictive narrative mechanism of satisfaction and recall of information (Murphy et al., 2011). Therefore, we expect that *involvement with the narrative is positively related to website satisfaction (H1c) and recall of cancer-related information (H1d)*.

The role of narration style in narrative communication

According to the cognitive theory of multimedia learning, conversational style refers to presenting information in a personalized conversational style in order to increase satisfaction and recall of information (Mayer, 2002). This strategy is often used in narrative communication, using personal stories or a description of an individual experience, e.g., providing information from a patient's perspective (Kreuter et al., 2007). A personalization effect occurs when people learn more deeply when information is presented in conversational style rather than in formal style (Mayer, 2002). Previous research has shown that conversational style can increase satisfaction with the message (Adams, Mayer, MacNamara, Koenig, & Wainess, 2012) and recall of information (McQueen, Kreuter, Kalesan, & Alcaraz, 2011). Therefore, we predict that *conversational style has a positive effect on website satisfaction (H2a) and recall of cancer-related information (H2b)*.

The role of age congruency in narrative communication

Perceived similarity between the video narrator and its recipient and identification are considered important predictors of involvement with the video narrator. Because of this perceived likeness, recipients are more likely to accept a message (Hinyard & Kreuter, 2007). This means that the effectiveness of narrative communication is determined by characteristics of the video narrator as well as by characteristics of the recipient. The

homophily literature explains that individuals with similar traits are more likely to have contact and share behavior patterns (McPherson, Smith-Lovin, & Cook, 2001). Age congruency could therefore play a role in the relationship between involvement with the video narrator (i.e., identification and perceived similarity) and website satisfaction and recall of information. Although this has not yet been examined, based on the homophily literature, we can expect that *age congruency has a positive effect on website satisfaction (H3a) and recall of cancer-related information (H3b)*.

Furthermore, we can expect an interaction effect between narration style and age congruency on website satisfaction and recall of information. Since we expect conversational style and age congruency to have a positive effect on website satisfaction and recall of information, we can assume that outcomes might be optimized when age congruency occurs while watching an audiovisual message presented in conversational style. Therefore, we hypothesize that *age-congruent audiovisual information presented in conversational style has a positive effect on website satisfaction (H4a) and recall of cancer-related information (H4b)*.

The mediating role of narrative engagement

Narrative engagement (i.e., involvement with the video narrator and involvement with the narrative) is expected to be higher for audiovisual information presented in conversational style because this type of information is often perceived as more attractive than audiovisual information presented in formal style (Slater & Rouner, 2002). Therefore, we also hypothesize that *the effect of narration style on website satisfaction (H5a) and recall of cancer-related information (H5b) is mediated by narrative engagement*. Furthermore, *the effect of age congruency on website satisfaction (H5c) and recall of cancer-related information (H5d) is also expected to be mediated by narrative engagement*. Moreover, we predict that *the interaction effect between narration style and age congruency on website satisfaction (H5e) and recall of cancer-related information (H5f) is also mediated by narrative engagement*.

Method

Design

The effect of narration style and age congruency on website satisfaction and recall of information was tested in a 2 (narration style: conversational-styled vs. formal-styled audiovisual information) by 2 (age congruency: congruent vs. incongruent age) experimental design with narrative engagement as a possible mediator of these effects. For this experiment, we used a webpage of the Netherlands Cancer Institute (NKI) on which Radio Frequency Ablation (RFA) treatment was explained. RFA is a minimal invasive method to treat lung cancer. A special needle is inserted into the lung tumor to create heat and to destroy the cancer cells. Since RFA is a relatively unknown treatment, we expect the participants of this study to have little prior knowledge about the treatment, which enhances the validity of the recall measurement.

Stimulus material

Four versions of the NKI webpage were created for this study. Each version presented a different video in which RFA treatment was explained, respectively, by, a younger physician, an older physician, a younger patient, and an older patient. Two professional actors played the roles of the physicians and patients, in which the first actor (39 years old) played the roles of the younger physician and patient, and the second actor (67 years old) played the roles of the older physician and patient. Narration style was manipulated by presenting information either through a formal, didactical manner by letting a physician presenting the RFA information (formal-styled condition), or by presenting information from a conversational, personal perspective by showing a patient's personal story regarding the RFA information (conversational-styled condition). The content and length of these four videos was kept constant across conditions. However, the conversational-styled video versions were presented from a first-person perspective and contained additional sentences to make the story more narrative (e.g., "fortunately, I did not experience any of those [complications]"). The physician was videotaped behind his desk, and the patient was filmed sitting on a couch. Although only male narrators were used in this experiment, no gender differences were found in participants' level of identification with the narrator, $F(1, 269) = 0.06$, $p = .814$, $\eta_p^2 = .00$, and their perceived similarity with the narrator, $F(1, 269) = 0.09$, $p = .764$, $\eta_p^2 = .00$.

Participants and procedure

The online panel Panelclix was used to draw a representative sample of the Dutch population stratified on gender and age ($<$ 65 vs. $\geq$ 65). The younger age group ($<$ 65) was on average 41.19 years old ($SD = 12.71$), and the older age group ($\geq$ 65) was on average 68.77 years old ($SD = 3.58$). In total, 53.5% of the participants were male. Participants were excluded if they had prior knowledge about RFA treatment (i.e., scoring higher than 4 on a 7-point Likert scale about perceived RFA knowledge, $n = 9$). After stratification, participants were randomly assigned to a video starring a younger doctor ($n = 63$), an older doctor ($n = 69$), a younger patient ($n = 68$), or an older patient ($n = 75$). This video was part of the NKI webpage including textual information about RFA, and was only accessible through the online questionnaire that was sent out to the participants. To ensure that information was learned from the video rather than the textual information on the webpage, participants were first exposed to the video-only information without the context of the NKI webpage. After exposure to the video, questions about the content of the video followed (recall). Next, participants were able to view the complete NKI webpage including both video and textual information, followed by questions on website satisfaction. The questionnaire ended with questions on background characteristics, narrative engagement, and a manipulation check.

Measures

Website satisfaction

Website satisfaction was measured by the Website Satisfaction Scale (Website Satisfaction Scale, WSS: Bol et al., 2013), which is based on items of the website attitude scale (Chen & Wells, 1999) and items of the Leisure Satisfaction Scale (LSS:

Beard & Ragheb, 1980). The scale consists of three reliable subscales: satisfaction with the comprehensibility of the website (3 items, α = .90), satisfaction with the attractiveness of the website (5 items, α = .80), and satisfaction with the emotional support from the website (4 items, α = .94). Examples of items of these subscales are, respectively, "the readability of the website is good," "the website looks nice," and "the website increases self-confidence," measured on a 7-point Likert scale (1 = totally disagree, 7 = totally agree).

Recall of cancer-related information

Recall of information was measured by an adapted version of the Netherlands Patient Information Recall Questionnaire (NPIRQ: Jansen, Van Weert, et al., 2008). Using the RFA text information, eleven open-ended questions were developed, such as "How much time does RFA treatment take?". All questions were provided with the answer options "not discussed," "discussed, but I can't remember the details," and "discussed, namely…." Based on a codebook, recall scores were allocated to all answers (0 = not recalled, 1 = recalled partially, 2 = recalled correctly). Recall scores of 43 cases (15.6%) were double coded by two independent coders and this resulted in good inter-rater reliability (mean κ = .85, range .59 – 1.00). The 11 questions were computed into a total recall score, ranging from 0 to 22. Additionally, recall scores were transformed into percentages of correctly recalled information for interpretation purposes.

Narrative engagement

Narrative engagement was measured using four measures of narrative engagement constructs: identification, perceived similarity, and likability (involvement with the video's narrator), and transportation (involvement with the narrative). As a test of conceptual distinction, a PCA was conducted with items of all scales which confirmed the distinction between the four theoretical constructs. However, two items – one perceived similarity item and one transportation item – showed overlap with another dimension (i.e., "the video affected me emotionally" and "Person X thinks like me"). To increase the convergence validity of the four scales, these two items were removed from further analysis. The four scales explained 70.3% of the variance in the 19 items.

Identification. Identification with the video narrator was measured using six items of the identification scale of Cohen (2001). Four items were not included since they did not apply well to stories presented in video form (Kreuter et al., 2008). Identification items included "while viewing I could feel the emotions Character X portrayed" and were measured on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). All six identification items loaded on one factor, explaining 40.9% of the variance and represented a reliable identification scale (α = .92).

Perceived similarity. The extent to which people perceive themselves as similar to the video narrator was measured using three items of the attitude homophily scale (McCroskey, Richmond, & Daly, 1975). The scale included items such as "Person X is like me" and all items were measured on a 7-point Likert scale (1 = totally disagree, 7 = totally agree). The items in the scale loaded on one factor explaining 8.5% of the variance (EV = 1.62) and formed a reliable scale (α = .67).

Likability. The validated Reysen likability scale was used to measure the likability of the video's narrator (Reysen, 2005). This scale consists of four items, such as "Person X is friendly" measured on a 7-point Likert scale (1 = totally disagree, 7 = totally agree) and was found to be a reliable scale (α = .94). The scale explained 9.2% of the variance in the four items (EV = 1.75).

Transportation. Involvement with the narrative (i.e., transportation) was measured with the transportation scale (Green & Brock, 2000). Four items that were not applicable to the narratives presented in video form were not included into the scale. Therefore, the transportation scale consisted of six items, such as "I was mentally involved in the video's narrative while watching it" using a 7-point Likert scale (1 = not at all, 7 = very much). The transportation scale explained 11.7% of the variance and the six transportation items produced an internally consistent scale (α = .84).

Manipulation check

As a test of successful manipulation, two measures for narration style and age congruency were included in the questionnaire. Narration style was measured using nine items, including both conversational style items (5 items, e.g., "the video shows personal experience," α = .86) and formal style items (4 items, e.g., "the video shows professional expertise," α = .73). Age congruency was assessed through a single-item question "Person X has a similar age like me." Using this question and the participant's age, it was checked whether the younger video narrator was perceived as younger than the older video narrator, and vice versa. All items were measured on a 7-point Likert scale (1 = totally disagree, 7 = totally agree).

Background variables

The following background characteristics of the participants were assessed: gender, age, education level, Internet use, and prior knowledge about lung cancer and RFA treatment. Internet use was assessed by the number of hours spent per week on average using the Internet. Prior knowledge about lung cancer and RFA were measured with two seven-point Likert scale questions about the perceived medical knowledge participants had about lung cancer and RFA treatment (1 = no knowledge, 7 = much knowledge).

Statistical analysis

To assess successful randomization, F-statistics and Chi-square statistics were executed. We used Hayes' PROCESS macro, Model 12 (Hayes, 2012) to test the conditional mediation model. This macro allows us to calculate the path coefficients of a model in which multiple mediators and moderators are simultaneously tested. PROCESS provides coefficients of the *direct* effects of the independent variables on the mediators (a-paths), the mediators on the dependent variables (b-paths), the independent variables on the dependent variables (c-paths), as well as the coefficients of the *indirect* effects of the independent variables on the dependent variables through the mediators (c'-paths). In this study, the a-paths referred to the (interaction) effects of narration style and age congruency on narrative engagement. The b-paths reflected the effects of narrative engagement on website satisfaction and recall of information.

The c-paths were the (interaction) effects of narration style and age congruency on website satisfaction and recall of information. The c'-paths referred to the indirect (conditional) effects of narration style and age congruency on website satisfaction and recall of information through narrative engagement. All total and indirect effects were subjected to bootstrap analyses with 5,000 bootstrap samples and a 95% Confidence Interval (CI). Since age congruency consisted of two factors (i.e., age of the video narrator and age of the recipient), three independent variables were simultaneously included in the model to test the effect of narration style and age congruency. Because PROCESS only allows one independent variable in the model, narration style (dichotomous variable, 0 = formal style, 1 = conversational style) was chosen as the independent variable, age of the video's narrator (dichotomous variable, 0 = younger narrator, 1 = older narrator) as moderator of the direct and indirect effects of narration style, and age of the recipient (dichotomous variable, 0 = younger [< 65 yrs.], 1 = older [≥ 65 yrs.]) as moderator of the interaction effects between narration style and age of the video narrator. We tested the model four times: one for each dependent variable, i.e., satisfaction with the comprehensibility, satisfaction with the attractiveness, satisfaction with the emotional support from the website, and recall of information. Identification, perceived similarity, likability, and transportation were considered as parallel mediators in the model.

Results

Randomization

The four experimental conditions did not significantly differ in gender, χ^2 (3) = 2.45, p = .485, age, $F(3, 271) = 0.92$, $p = .430$, $\eta_p^2 = .01$, education level, χ^2 (6) = 4.50, p = .610, Internet use, $F(3, 262) = 0.57$, $p = .639$, $\eta_p^2 = .01$, prior knowledge about lung cancer, $F(3, 271) = 1.32$, $p = .269$, $\eta_p^2 = .01$, and prior knowledge about RFA, $F(3, 271) = 0.43$, $p = .735$, $\eta_p^2 = .01$. Based on these results, no covariates were taken into further analysis.

Manipulation checks

The videos in which a doctor (formal-styled versions) explained RFA information differed from the videos in which a patient (conversational-styled versions) explained the same information on both formal style items, $F(1, 268) = 6.20$, $p = .013$, $\eta_p^2 = .02$, and conversational style items, $F(1, 268) = 12.24$, $p = .001$, $\eta_p^2 = .04$. As intended, the patient videos were evaluated as being more conversational than the doctor videos (resp. $M = 4.76$, $SD = 1.16$ and $M = 4.27$, $SD = 1.13$), whereas the doctor videos were rated as being more formal than the patient videos (resp. $M = 5.38$, $SD = 1.03$ and $M = 5.10$, $SD = 0.99$). Successful manipulation was also found for age congruency, $F(1, 267) = 52.56$, $p < .001$, $\eta_p^2 = .16$. Simple effects analysis showed that younger recipients perceived their age as significantly similar to the younger video narrator compared to older recipients, $F(1, 268) = 31.94$, $p < .001$ (resp. $M = 3.68$, $SD = 1.43$ and $M = 1.89$, $SD = 1.06$). Likewise, older recipients perceived their age as significantly similar to the older video narrator compared to younger recipients, $F(1, 268) = 11.08$, $p = .001$ (resp. $M = 4.25$, $SD = 1.61$ and $M = 3.30$, $SD = 1.88$).

Direct effects of narrative engagement on website satisfaction and recall of information

Mixed results were found with respect to the effects of involvement with the video narrator on website satisfaction (H1a) and recall of information (H1b). Identification with the video narrator was negatively associated with satisfaction with the comprehensibility of the website (b = -0.14, SE = 0.05, p = .010) and recall of information (b = -1.30, SE = 0.25, p < .001), but positively related to satisfaction with the emotional support from the website (b = 0.31, SE = 0.07, p < .001). These findings suggest that satisfaction with the comprehensibility and attractiveness of the website decreased and recall of information declined when recipients identified more with the video narrators. Nevertheless, identification also led to higher levels of satisfaction with the emotional support from the website. Likability predicted both website satisfaction and recall of information in a positive sense. The more likable the video narrator was perceived, the more satisfied recipients were with the comprehensibility (b = 0.35, SE = 0.07, p < .001), attractiveness (b = 0.32, SE = 0.06, p < .001), and emotional support (b = 0.38, SE = 0.08, p < .001), and the more they recalled of the information (b = 0.93, SE = 0.30, p = .003). Perceived similarity had no significant effect on website satisfaction and recall of information.

Involvement with the narrative (transportation) positively predicted satisfaction with the comprehensibility (b = 0.36, SE = 0.06, p < .001), satisfaction with the attractiveness (b = 0.13, SE = 0.05, p = .013), and recall of information (b = 2.60, SE = 0.27, p < .001). An increased level of transportation resulted in higher satisfaction with the comprehensibility and attractiveness of the website (H1c) as well as better recall of information (H1d).

Direct effects of narration style and age congruency on website satisfaction and recall of information

In contrast with our expectations of H2a, conversational-styled information did not significantly increase website satisfaction compared to formal-styled information ($b_{comprehensibility}$ = -0.25, SE = 0.20, p = .224; $b_{attractiveness}$ = -0.27, SE = 0.19, p = .160; $b_{emotional\ support}$ = -0.38, SE = 0.25, p = .129). Results did show a main effect of narration style on recall of information (H2b). Recall of information significantly improved when RFA information was presented in conversational style compared to formal style (b = 1.99, SE = 0.95, p = .037). As expected, age congruency predicted website satisfaction (H3a). Specifically, age congruency positively influenced satisfaction with the emotional support from the website (b = 0.89, SE = 0.39, p = .023). Older adults perceived more emotional support from the website when viewing an older video narrator than when viewing a younger narrator (b = 0.55, SE = 0.20, p = .008). Moreover, older recipients were also more satisfied with the emotional support from the website when viewing an older video narrator than when younger recipients viewed an older narrator (b = 0.50, SE = 0.19, p = .008). This age congruency effect is visualized in Figure 7.2. Furthermore, although we expected to find improved recall of information as a result of age congruency between the recipient's age and narrator's age (H3b), our data did not support this expectation (b = -1.88, SE = 1.47, p = .204).

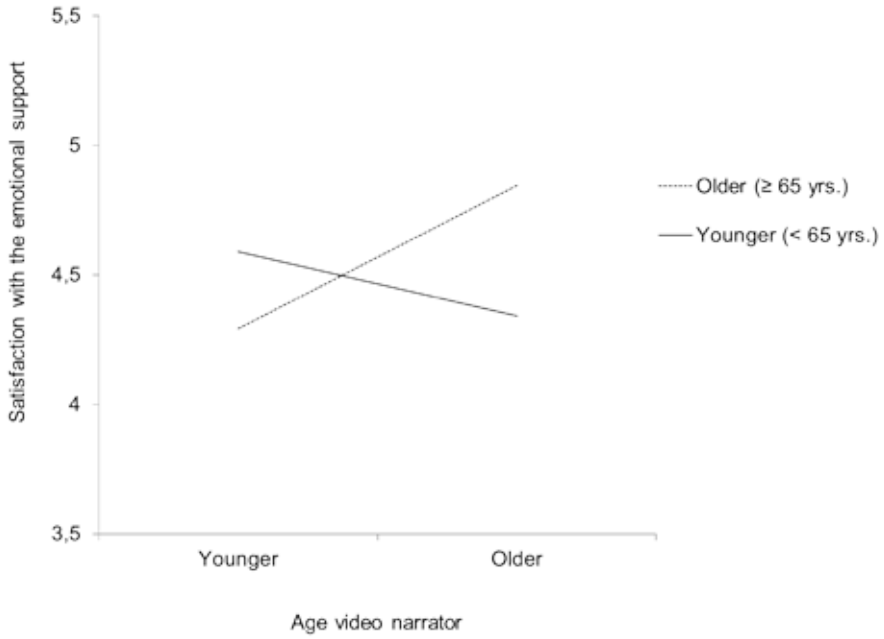

Figure 7.2. The effect of age congruency on satisfaction with the emotional support from the website.

The predicted interaction effect between narration style and age congruency on website satisfaction (H4a) was not supported. Nevertheless, we found an interaction effect between narration style and age congruency on recall of information (H4b). Recall of information significantly improved when younger recipients viewed a conversational-styled video starring a younger video narrator compared to any other combination of the recipient's age and the video narrator's age ($b = 1.99$, $SE = 0.95$, $p = .037$). Table 7.1 presents all direct effects of narration style, age congruency, and narrative engagement on website satisfaction and recall of information.

Table 7.1. Direct effects of narration style, age congruency, and narrative engagement (involvement with the video narrator: identification, perceived similarity, likability, and involvement with the narrative: transportation) on website satisfaction (comprehensibility, attractiveness and emotional support) and recall of information

	Comprehen-sibility	Attractive-ness	Emotional support	Recall of information
	b (SE)	*b (SE)*	*b (SE)*	*b (SE)*
Constant	2.78 (0.31)	2.72 (0.29)	1.50 (0.39)	-4.55 (1.47)
Independent variables				
Narration style (NS)	-0.25 (0.20)	-0.27 (0,19)	-0.38 (0.25)	1.99 (0.95)*
Age congruency (AC)	0.36 (0.31)	0.19 (0,30)	0.89 (0.39)*	-1.88 (1.47)
NS × AC	-0.13 (0.43)	0.27 (0,41)	-0.25 (0.53)	2.50 (2.01)
Mediators				
Identification	-0.14 (0.05)**	-0.01 (0.05)	0,31 (0.07)***	-1.30 (0.25)***
Perceived similarity	0.03 (0.05)	0.00 (0.05)	0,01 (0.06)	-0.19 (0.23)
Likability	0.35 (0.07)***	0.32 (0.06)***	0,38 (0.08)***	0.93 (0.30)**
Transportation	0.36 (0.06)***	0.13 (0.05)*	0,04 (0.07)	2.60 (0.27)***

Note. The unstandardized b-coefficients reflect c-paths for the (interactions between) independent variables and b-paths for the mediators (standard error between parentheses). Significant b-paths and c-paths are elaborated upon in the text. Abbreviations. NS, narration style. AC, age congruency. * $p < .05$. ** $p < .01$. *** $p < .001$.

Indirect and conditional indirect effects on website satisfaction and recall of information

The effect of narration style on website satisfaction (H5a) and recall of information (H5b) was not mediated by narrative engagement. This was also the case for the relationship between age congruency and website satisfaction (H5c) and recall of information (H5d). Nevertheless, we found conditional mediation effects: the relationship between narration style, website satisfaction and recall of information appeared to depend upon age congruency (H5e and H5f). The conditional mediation effects were only found when a younger recipient viewed a younger video narrator. Under those conditions, the effects of narration style on satisfaction with the comprehensibility of the website and recall of information were negatively mediated by identification with the video narrator (resp. $b = -0.08$, $SE = 0.05$, 95% BC [-0.22, -0.01] and $b = -0.75$, $SE = 0.38$, 95% BC [-1.64, -0.12]), whereas satisfaction with the emotional support from the website was positively mediated by identification ($b = 0.18$, $SE = 0.10$, 95% BC [0.02, 0.43]). These findings suggest that conversational-styled health information videos starring a younger narrator increase levels of identification among younger recipients. Consequently, this resulted in enhanced satisfaction with the emotional support from the website, but in decreased satisfaction with the comprehensibility and declined recall of information. Furthermore, the effect of narration style was positively mediated by the likability of the video narrator. Similarly, this was only the case for younger recipients viewing a younger video narrator. These

mediating effects were found for satisfaction with the comprehensibility ($b = 0.15$, $SE = 0.08$, 95% BC [0.01, 0.34]), satisfaction with the attractiveness ($b = 0.13$, $SE = 0.07$, 95% BC [0.01, 0.30]), satisfaction with the emotional support ($b = 0.16$, $SE = 0.09$, 95% BC [0.01, 0.39]), and recall of information ($b = 0.39$, $SE = 0.26$, 95% BC [0.02, 1.07]). For younger recipients, conversational-styled information led to higher levels of identification and likability of the video narrator. Consequently, this resulted in enhanced satisfaction with the emotional support from the website, and for likability as well in enhanced satisfaction with the attractiveness and comprehensibility of the website and improved recall of information. An overview of the (conditional) mediation effects can be found in Table 7.2.

Table 7.2. Indirect and conditional indirect effects of narration style and age congruency on website satisfaction (comprehensibility, attractiveness and emotional support) and recall of information via narrative engagement (involvement with the video narrator: identification, perceived similarity, likability, and involvement with the narrative: transportation)

	Comprehen-sibility		Attractive-ness		Emotional support		Recall of information	
	b (SE)	[95% BC]	*b (SE)*	[95% BC]	*b (SE)*	[95% BC]	*b (SE)*	[95% BC]
Identification	-0.12 (0.10)	[-0.41; 0.02]	-0.01 (0.06)	[-0.19; 0.07]	0.26 (0.21)	[-0.09; 0.74]	-1.10 (0.84)	[-2.92; 0.43]
Conditional effect	-0.08 (0.05)	[-0.22; -0.01]	-0.01 (0.04)	[-0.10; 0.05]	0.18 (0.10)	[0.02; 0.43]	-0.75 (0.38)	[-1.64; -0.12]
Perceived similarity	0.00 (0.03)	[-0.06; 0.09]	0.00 (0.03)	[-0.07; 0.07]	0.00 (0.21)	[-0.08; 0.74]	-0.01 (0.17)	[-0.48; 0.27]
Likability	0.22 (0.19)	[-0.12; 0.63]	0.20 (0.17)	[-0.09; 0.57]	0.23 (0.06)	[-0.11; 0.24]	0.58 (0.55)	[-0.23; 1.93]
Conditional effect	0.15 (0.08)	[0.01; 0.34]	0.13 (0.07)	[0.01; 0.30]	0.16 (0.09)	[0.01; 0.39]	0.39 (0.26)	[0.02; 1.07]
Transportation	0.13 (0.21)	[-0.25; 0.58]	0.05 (0.09)	[-0.07; 0.30]	0.02 (0.04)	[-0.05; 0.10]	0.94 (1.51)	[-2.01; 3.95]

Note. 5,000 bootstrap samples with a 95% confidence interval. The unstandardized b-coefficients in this table reflect the c' paths of the indirect effects of the independent variables on the dependent variables via the mediators. The conditional indirect effects of narration style on the dependent variables were only significant when it concerned a younger age of both the video narrator and receiver. Effects were significant when confidence intervals did not overlap zero. BC, bias corrected confidence interval.

Discussion

This study examined the effects of narration style and age congruency and the role of narrative engagement on website satisfaction and recall of online health information. The first aim of this study was to examine the role of narrative engagement in narrative communication. We expected that involvement with the video narrator would lead to enhanced website satisfaction (H1a) and improved recall of information (H1b). Our results showed that likability of the video narrator led to both higher satisfaction with the comprehensibility, the attractiveness, and emotional support from the website, as well as better recall of information. Identification with the video narrator also increased satisfaction with the emotional support from the website; however, at the same time, it decreased satisfaction with the comprehensibility and recall of information. Involvement with the narrative was positively associated with website satisfaction (H1c) as well as recall of information (H1d).

The second aim of this study was to test the (interaction) effects of narration style and age congruency. Our study showed that conversational-styled health videos were not beneficial for increasing website satisfaction (H2a), but did improve recall of information (H2b). Thus, we found support for the assumption that online health media presented in conversational style foster deeper learning of information, as proposed in the cognitive theory of multimedia learning (Mayer, 2002). On the contrary, age congruency positively influenced website satisfaction (H3a), but not recall of information (H3b). Furthermore, we found that older recipients were especially satisfied with the emotional support from the website when they viewed an older video narrator. Although age congruency did not affect recall of information (H3b), we did find an interaction effect between narration style and age congruency: younger recipients recall information better when they were exposed to a conversational-styled video starring a younger narrator (H4b). This interaction effect was not found with regard to website satisfaction (H4a).

The third and final aim of this study was to investigate whether narrative engagement would mediate the (interaction) effect between narration style and age congruency on website satisfaction and recall of information. Although narrative engagement did not mediate the interaction of narration style and age congruency with website satisfaction (H5a and H5c, respectively) and recall of information (H5b and H5d, respectively), results showed conditional mediation effects. Conversational-styled information only affected website satisfaction (H5e) and recall of health information (H5f) under the condition that younger recipients viewed a younger video narrator. These conditional effects were found when the recipients was involved with the video narrator; in other words, when the recipient identified with and liked the narrator. Higher levels of identification and likability resulted in enhanced satisfaction with the emotional support from the website. Furthermore, likability enhanced satisfaction with the comprehensibility and attractiveness of the website and improved recall. Identification also led to lower levels of satisfaction with the comprehensibility and lower recall of information.

The results of this study give insight into how to use narration style, age congruency, and narrative engagement in health videos to improve online health information for older adults. These results, however, do not provide a complete overview of other elements that might be used to optimize the effectiveness of narrative

communication. Previous research has indicated that preexisting similarity between a narrative character and the recipient of a narrative especially increase narrative effects when the preexisting similarity is on a story-relevant dimension rather than on a simple demographic characteristic (Green, 2006). A study among older adults showed that people attach more value to affective aspects in life as one ages (Carstensen, Fung, & Charles, 2003). Compared to our informational perspective taken in the video, the narrative effects might have been stronger for the older adult sample if the online health video had contained more affective elements, such as story elements about emotional connections with family members or friends. Future research should focus on other narrative elements that contribute to effective online health communication to effectively tailor narrative communication to the intended audience (Green, 2008).

Despite these limitations, our results show that conversational-styled information improves recall of information, age congruency enhances satisfaction with the emotional support from the website, and likability of the video narrator increases satisfaction with comprehensibility, attractiveness, and emotional support, as well as recall of information. These findings are worth reporting, considering the lack of empirical studies investigating narration style and age congruency in narrative communication. From a theoretical perspective, our findings provide insight into the underlying mechanisms of website satisfaction and recall of health information. The effect of conversational style emphasizes the importance of personalized elements in online health communication (Mayer, 2002). In addition, age congruency plays an important role in the way information could be effectively presented, in particular to enhance satisfaction with the emotional support from the website among older adults. These older-aged recipients were more satisfied with the emotional support when they viewed a younger video narrator. Moreover, it seems crucial to select likable video narrators to optimize website satisfaction and recall of information. These results provide practical implications for the development of online health videos. This study, therefore, shows novel insight into effective communication strategies to present online health information to older adults.

Chapter 8

Older cancer patients' recall of online cancer information: Do ability and motivation matter more than chronological age?

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Abstract

The Internet is becoming an increasingly important source of cancer information. However, older patients often inadequately recall information from online cancer sources. Yet, little is known about what age-related factors other than chronological age are relevant for their ability and motivation to recall online information. We therefore aim to provide a more comprehensive understanding of the contribution of chronological age and age-related factors explaining recall in older patients by proposing and testing a theory-based model. A sample of 197 (ex-)cancer patients aged 65 years or older completed an online survey in which they viewed a webpage containing information about radio frequency ablation (RFA) treatment. After viewing the webpage, recall of the online information was assessed. Furthermore, the survey contained questions on chronological age and age-related ability and motivation factors (individual and message experience characteristics) that are expected to influence recall of information. Results revealed that recall of online information was influenced by age-related factors reflecting both ability and motivation, but not by chronological age. With these age-related ability and motivation factors, we were able to explain 37.9% of the variance in recall of information. Recall of online cancer information was positively influenced by health literacy, involvement with the webpage, and satisfaction with the emotional support. Furthermore, recall was negatively affected by frailty, anger, future time perspective and perceived cognitive load. Our study shows that older cancer patients' recall of online cancer information is not a matter of chronological age per se, but rather a matter of ability and motivation. This poses relevant opportunities for tailoring interventions. As chronological age cannot be changed by such interventions, addressing relevant age-related factors may help improve information provision for older cancer patients.

Introduction

Patients need cancer-related information to support their existing healthcare resources. This is even more true for older patients as they often deal with multiple diseases besides having cancer (World Health Organization, 2014). For finding such information, patients increasingly turn to the Internet (Fiksdal et al., 2014). However, using online technologies for cancer information is not evident for all individuals. Especially older patients often lack sophisticated online search skills that can help them to make maximal use of online resources (Xie, 2008). This may hamper accurate uptake and recall of information.

Recall of information, the ability to reproduce and remember information, is a prerequisite to follow up on health instructions that are needed for daily life disease management (Kravitz et al., 1993). Patients should have sufficient understanding of their situation to make informed decisions and adhere to medical regimens. Recall of information has therefore been associated with better medication adherence (Linn, Van Dijk, Smit, Jansen, & Van Weert, 2013; Puts et al., 2014) and improved well-being (McGuire, 1996). Accurate recall of information is especially important among older patients. However, older age is often associated with poorer recall performance (Jansen, Butow, et al., 2008), also when it concerns recall of online cancer information (Bol, Smets, et al., 2015).

At the same time, older individuals differ in how much they recall from online cancer sources. This might be explained by the fact that individual differences increase when people get older. Especially the older aged are very heterogeneous (Dannefer, 1988). Therefore, "age alone is a meaningless demographic," (Lippincott, 2004, p. 160). Chronological age may simply function as a catch-all term that consists of many different factors that together help to understand why older adults have poor recall performances in general. In recognizing the heterogeneity of older cancer patients, this paper therefore aims to explore whether chronological age itself or age-related factors predict accurate recall of online information. To this end, we will (1) introduce a theory-based model based on concepts that, according to previous studies, may be particularly predictive of recall of (online) information in older adults, and (2) unravel which of these factors relate to accurate recall of online cancer information among an older cancer patient population.

Recall of online cancer information in older patients

According to the elaboration likelihood model (Petty & Cacioppo, 1986) and the limited capacity model of motivated mediated messages (A. Lang, 2000), information processing is influenced by two factors: ability and motivation. The ability to process information depends on one's skills and proficiencies, while motivation refers to one's desire and willingness to process information (MacInnis, Moorman, & Jaworski, 1991). Besides the individual's ability and motivation, the limited capacity model of motivated mediated messages also posits that information processing is influenced by how the message is experienced (A. Lang, 2006). We can add to this literature by focusing on the important and vulnerable group of older patients that are increasingly expected to take responsibility of their own health using online technologies, but often forget substantial amounts of cancer-related information. To address our first goal,

we conducted a scoping review to identify recall predicting factors (see Appendix C for scoping review details). In the next sections, we will elaborate upon these factors in the context of how they predict older patients' recall of online cancer information.

Individual characteristics

Ability

Our literature review revealed numerous individual characteristics that explain one's ability to recall information. First, older persons often experience simultaneous loss of resources in several domains of functioning, which leads to a declining reserve capacity for dealing with stressors (Schuurmans, Steverink, Lindenberg, Frieswijk, & Slaets, 2004). As this so-called *frailty* is a strong predictor of adverse outcomes, such as declined self-management abilities (Schuurmans et al., 2004), it could be expected to also negatively influence one's ability to recall information. Furthermore, age-related decline in *working-memory* capacity has been associated with poor recall of information (Brown & Park, 2003). At the same time, being diagnosed with cancer may elicit feelings of anxiety, stress, depression, and anger (here: *emotional state*), which might also negatively affect recall of information (Christianson, 1992; Schwabe & Wolf, 2010). According to the attentional narrowing hypothesis, emotionally arousing situations require attentional resources, which leaves fewer resources available for peripheral information, such as information about treatment (Christianson & Loftus, 1991; Kessels, 2003). However, as one ages, people are generally better able to *regulate their emotions* (Carstensen, Fung, & Charles, 2003), which might compensate for cognitive decline in memory (Carstensen & Mikels, 2005), and thus positively affects recall. Moreover, older adults have substantial *knowledge* and experience with illness, which may compensate for age-related decline in online information processing as well (Brown & Park, 2003). On the other hand, older adults' *health literacy,* i.e., "the degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make informed health decisions (Berkman, Davis, & McCormack, 2010, p. 16)," declines with age (Baker, Gazmararian, Sudano, & Patterson, 2000), which consequently affects recall negatively (McCray, 2005). Likewise, older adults have low levels of *e-health literacy*, that is "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem (Norman & Skinner, 2006b, e9)." This may in turn influence recall negatively. Additionally, older adults often vary in their highest attained *educational level* (Bostock & Steptoe, 2012), which has been found to influence recall of information (Wagner, Wuensch, Friess, & Berberat, 2014). Given the heterogeneous nature of the older aged, it is expected that older individuals highly differ on the aforementioned age-related ability factors, which consequently explains the variance in recall of online cancer information. We expect that frailty and emotional state are inversely related to recall, while working memory, emotional regulation, prior knowledge, health literacy, e-health literacy, and educational level are positively associated with adequate recall of online cancer information.

Motivation

Secondly, motivation influences older patients' recall of information. Individual factors, such as *future time perspective*, *need for cognition*, and *monitoring coping style* reflect one's motivation and could therefore influence recall of information. On the one hand, older adults generally perceive less time left in life, which causes a shift from having knowledge-related goals, acquisitive behavior geared toward learning, to having more emotional-related goals, behavior related emotion regulation (Carstensen, Isaacowitz, & Charles, 1999). Those older adults experiencing little time left in life might therefore hold less knowledge-related goals. This implies that they might be less willing to process information, possibly resulting in lower recall of information. On the other hand, some older people are more motivated to recall information since they generally have a higher need for cognition, that is, the tendency to engage in and enjoy effortful cognitive endeavors (Cacioppo, Petty, & Kao, 1984). Hence, older adults with a higher need for cognition are more likely to recall online information. Furthermore, monitoring coping style, i.e., the extent to which individuals are approaching potentially negative information about health, also influences information processing preferences (Miller, 1995): having a higher monitoring coping style could positively affect recall of online cancer information. We thus expect that future time perspective, need for cognition, and a monitoring coping style are positively related to adequate recall of online cancer information.

Message experience characteristics

Ability

Message experience is also relevant for information processing (A. Lang, 2006). Regardless of what a message looks like, individuals can vary in their experience with a message, which may influence the ability to adequately recall information. Since people have limited information processing capacity, it is necessary to be critical in allocating resources to processing information. Cognitive load theory states that the human working memory is limited in the amount of information it can hold and recall (Van Gerven, Paas, Van Merriënboer, Hendriks, & Schmidt, 2003), meaning that recall of information can be hindered if information requires patients to allocate many resources to information processing and causes cognitive overload. As older adults' "total cognitive capacity" is in general smaller (Van Gerven, Paas, Van Merriënboer, & Schmidt, 2000), but is expected to vary across individuals, factors such as *required cognitive resources* and *perceived cognitive load* might thus affect one's ability to process information and, consequently, accurate recall of information. We expect that more required resources and higher perceived cognitive load are inversely associated with adequate recall of online cancer information.

Motivation

In addition, a message experience can contribute to individuals' motivation to engage in effortful information processing (A. Lang, 2006), and consequently recall of information. How individuals experience a message might therefore also determine the level of motivation to recall information. For instance, *involving* and *emotionally satisfying* messages are known to increase patients' motivation to put more cognitive effort into processing online information. Being more involved is found to enhance

deeper processing of information (Petty & Cacioppo, 1986), and higher satisfaction with the emotional support from the website improves recall of information among older adults in particular (Bol, Van Weert, et al., 2014). Older adults that are more involved and more satisfied with the emotional support from the website might thus recall more information. We thus expect that increased involvement and satisfaction with the emotional support from online information are positively related to adequate recall of online cancer information.

The current study

To summarize, we discussed several individual and message experience characteristics that are relevant for older adults' ability and motivation to recall online cancer information. To address our first goal, we now introduce a theory-based model that includes all age-related concepts discussed in the previous sections; the conceptual model of ability and motivation to recall online cancer information (see Figure 8.1). To address our second goal, we will empirically test which of the discussed potential predictors contribute to accurate recall of information among an older cancer patient population.

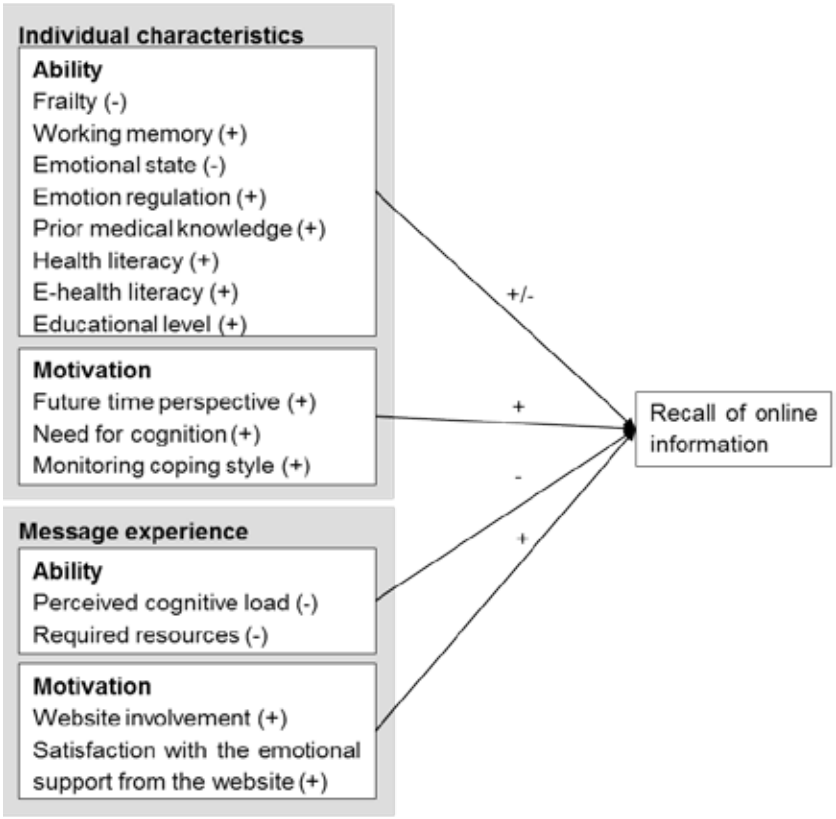

Figure 8.1. Conceptual model of ability and motivation factors to recall online cancer information categorized as individual and message experience characteristics.

Methods

Participants

Patients with various forms of cancer participated in the study. Eligible patients were aged 65 years or older, had sufficient command of Dutch, had no cognitive impairments, had access to the Internet, had not participated in a previous study related to this study's research line, and had at least had one consultation with their oncologist. We found it unethical to include patients that had not yet discussed their treatment options with their oncologist, as the information provided for this study might not be among the available treatment options. Patients were recruited from two hospitals, the Netherlands Cancer Institute and the Deventer hospital, a large online panel of cancer patients in the Netherlands (kanker.nl), and a panel from the University of Amsterdam (PanelCom) to create a heterogeneous sample. Hospital patients who had a follow-up consultation between March 2013 and March 2015 were selected by the local oncology assistants and approached for study participation by telephone. After briefly informing patients about the study, those interested received an email including information about the study and a link to the online questionnaire. For the online panels, the panel managers invited eligible patients by an email that included the same information and link to the online questionnaire.

Procedure

The study was approved by the institutional review board of the Amsterdam School of Communication Research (2015-CW-28), as well as the medical ethics committee of the Netherlands Cancer Institute (P14ASC) and the local feasibility advisory committee of the Deventer hospital (ME 15-14). All patients provided digital informed consent through the online survey. They were then asked to attentively study a webpage containing information about radio frequency ablation (RFA). RFA is a minimally invasive method to treat metastases in the lung. Recall of information was assessed after patients viewed the webpage. Furthermore, we assessed age-related individual and message experience characteristics relevant for ability and motivation as introduced in our conceptual model. Upon completion, participants indicated whether they completed the survey by themselves or with help.

Webpage materials

Normally, patients can actively look for their preferred information mode of delivery on the Internet. To mimic this situation, five different versions of the RFA webpage were presented on a storyboard within the online questionnaire. The five webpages contained exactly the same information about RFA, but differed in mode of delivery as follows (see Figure 8.2): (1) a webpage with text-only information; (2) a webpage with text and cognitive illustrations (i.e., illustrations that explain text); (3) a webpage with text and affective illustrations (i.e., illustrations that are text irrelevant but aim to enhance enjoyment); (4) a webpage with text and a formal-styled video in which a doctor explained the RFA treatment; and (5) a webpage with text and a conversational-styled video in which a patient explained the RFA treatment. In the latter two versions, the videos reflected the text. For the video with the doctor, the spoken text was equal to the written text on the webpage. For the video with the patient, the content was the same, however, stylistic changes were made (i.e., information was presented from

a first-person perspective) and additional sentences were added to make the story more personal (e.g., "fortunately, I did not experience any of those" [complications]) (for video scripts, see Bol et al., 2013). We presented the five webpage options in a random order on the storyboard. Patients were asked to imagine having to undergo RFA treatment and that they would consult a webpage about this treatment. They were asked to choose the version they liked most. This way, we were able to unravel associations between age-related factors and recall of information, which would reflect patients' natural behavior when visiting an online website, instead of examining the effects of manipulating mode of delivery.

Main outcome measure

Recall of information was assessed by eleven open-ended questions reflecting the content of the webpage (Bol, Van Weert, et al., 2014; Bol, Van Weert, De Haes, Loos, & Smets, 2015). Questions included "How much time does RFA treatment take?" and "During RFA treatment you will be sedated. Can you name the types of sedations that are possible?", and answers to the questions were to be reported in a text box below each question. Answers were manually scored based on a codebook. Scores were based on the Netherlands Patient Information Recall Questionnaire (NPIRQ: Jansen, Van Weert, et al., 2008), giving each answer a score of 0 (not recalled), 1 (partially recalled), or 2 (completely recalled). Around 20% of all recall scores (19.3%, $n = 38$) were scored by a second coder to measure intercoder reliability (mean kappa = .96, range = .88 – 1.00). Percentages of accurate recall were calculated based on the total recall sum score (range = 0 – 22).

Figure 8.2. Webpages containing RFA treatment information presented in text and cognitive illustrations (top left), text and affective illustrations (top right), text and a formal-styled video (bottom left), and text and a conversational-styled video (bottom right). Webpage with text-only information is not displayed, since it is equal to the webpages shown in this figure without the illustrations or videos.

Individual characteristics

Ability

Frailty was assessed using the Groningen Frailty Indicator (GFI: Schuurmans et al., 2004), which assesses patients' frailty in the physical, cognitive, social, and psychosocial domain. Scores range between 0 and 15, where higher scores indicate higher levels of frailty. *Working memory* was measured with 11 items of the BRIEF-SR (adapted version: Guy, Gioia, & Isquith, 2004). Items included "I have difficulties memorizing things, even for a few minutes," and were provided with the answer options "never," "sometimes," and "always." Higher scores suggest lower levels working memory ($\alpha = .83$). *Emotional state* was measured using the six-item short-form of the State-Trait Anxiety Inventory (STAI-6: Marteau & Bekker, 1992) and the Emotion Thermometers Tool (Mitchell, Baker-Glenn, Granger, & Symonds, 2010) assessed current emotional states using visual-analogue scales guided with the question "How much stress/anger/depression have you experienced during the past week on a scale of 0 to 10?", anchored at 0 with "none" and at 10 with "an extreme amount." STAI-

6 items included "I feel calm" and "I feel tense," measured on a 4-point scale (1 = "not at all," 2 = "somewhat," 3 = "moderately," 4 = "very much," α = .85). *Emotion regulation* was measured as a component of executive function (adapted version of the BRIEF-SR: Guy et al., 2004). This scale included 10 items, such as "I get upset by minor things" (1 = "never," 2 = "sometimes," 3 = "always"). Higher scores suggest lower levels of emotion regulation (α = .81). Patients were asked about their *prior medical knowledge* (i.e., general medical knowledge, medical knowledge about lung cancer, and medical knowledge about RFA treatment) on a 7-point scale (1 = "no knowledge," 7 = "much knowledge," α = .79). *Health literacy* was measured with the SAHL-D (Pander Maat, Essink-Bot, Leenaars, & Fransen, 2014), which consists of 22 health-related words, such as psoriasis, hemophilia, and defibrillation, of which the correct meaning could be selected out of four multiple choice options, including the answer option "I don't know." One point was allocated for each correct answer, resulting in a scale ranging from 0 to 22. *E-health literacy* was measured using the eHEALS (Norman & Skinner, 2006a), an 8-item scale with items such as "I know how to use the Internet to answer my health questions," reported on a 5-point scale (1 = "strongly disagree," 5 = "strongly agree,"α = .94). *Educational level* was divided into two categories: lower educational level (0 = primary, lower vocational, preparatory secondary vocational, intermediate secondary vocational education, senior secondary vocational and university preparatory vocational education), and higher educational level (1 = higher vocational education and university).

Motivation

Future time perspective was measured by ten items, such as "There are only limited possibilities in my future," to be evaluated on a 7-point Likert scale ranging from "not at all true" to "very much true" (F. R. Lang & Carstensen, 2002). Higher scores indicate more perceived time left in life (mean scale, α = .90). A shortened version of the *need for cognition* scale was used to measure the tendency to enjoy and engage in thinking (Cacioppo & Petty, 1982; Pieters, Verplanken, & Modde, 1987). Items included "I find satisfaction in deliberating hard and for long hours," assessed on a 7-point scale, ranging from "strongly disagree" to "strongly agree" (8 items, α = .78). *Monitoring coping style* was measured with an adapted version of the Threatening Medical Situation Inventory (TMSI: Miller, 1987; Van Weert et al., 2009), using three items, such as "I planned to read as much as possible about my disease," measured on a 5-point scale (1 = "not at all applicable to me," 5 = "strongly applicable to me").

Message experience characteristics

Ability

Perceived cognitive load was assessed by one item asking "How much effort did it take to study the web content about RFA?", to be rated on a 7-point scale ranging from "very little effort" to "a lot of effort" (Paas, Tuovinen, Tabbers, & Van Gerven, 2003). *Required cognitive resources* were assessed by items of Keller and Block's (1997) required resources scale, asking patients to rate the webpage information on a 5-point semantic differential. Items were "easy to comprehend/difficult to comprehend," and "easy to follow/difficult to follow." We added two items to the scale, asking whether the information "included no medical jargon/much medical jargon," and "required no prior knowledge/much prior knowledge." The scale was reliable (α = .87).

Motivation

Four items, such as "was highly involved in evaluating the site," reflected *webpage involvement* (Dutta-Bergman, 2004), and were computed into a mean scale (α = .89). *Satisfaction with the emotional support from the website* was assessed by the same name subscale of the Website Satisfaction Scale (WSS: Bol, Van Weert, et al., 2014). The four items included, e.g., "The website increases self-confidence" and were measured on a 7-point scale ranging from "totally disagree" to "totally agree" (α = .96).

Statistical analysis

Analyses were performed using SPSS version 20 (SPSS, Inc., Chicago, IL) and results were considered significant at a *p*-value of $< .05$. Chi-square statistics and F-statistics were used to compare patients who were recruited in hospital versus those recruited online[2]. To examine predictors of accurate recall of information, we conducted a multiple linear regression analysis. The following five blocks were entered as separate blocks: (1) chronological age, (2) "individual characteristics relevant for ability" variables, (3) "individual characteristics relevant for motivation" variables, (4) "message experience characteristics relevant for ability" variables, and (5) "message experience characteristics relevant for motivation" variables. Chronological age was included as a predictor to test its contribution in predicting recall as compared to age-related ability and motivation factors. Initially, the choice patients made regarding the mode of delivery of the webpage was included as a predictor as well to account for possible variety in recall due to variety in mode of delivery. However, web choice was not included in the final model, as inclusion did not change the results of the final model. Furthermore, as the analysis revealed a violation of the assumption of homogeneity of variance for the variables "knowledge" and "required resources," we log transformed these variables. After log transformation, assumptions of linearity, normality, homoscedasticity, independent errors (Durbin-Watson = 2.191), and multicollinearity (VIF < 10) were met for all variables. One case showed a standardized residual greater than 3 and was therefore removed. Rerunning the analysis, however, did not change the results.

[2] The multiple linear regression model was also executed for the subsample of patients recruited from hospitals to assure that sampling patients online had not affected our final model. The analysis showed only a slight difference between the two models, i.e., when only considering patients from hospitals, involvement did no longer significantly predict recall.

Results

Sample characteristics

Figure 8.3 shows the recruitment flow and reasons for exclusion and non-response. Of the 794 patients from the Netherlands Cancer Institute and Deventer hospital, 410 patients (51.6%) were approached to participate in the survey. We first asked whether patients had access to the Internet to participate in the study. Of the approached patients, 243 (59.3%) met all inclusion criteria, of which 217 (89.3%) agreed to participate. Of consenting patients, 149 (68.7%) completed the survey. Of the completed surveys, 12 (8.1%) were excluded. For the online panels, 344 patients were approached. In total, 136 patients (39.5%) started the online survey of which 77 (56.6%) completed the survey. Of those, 17 (22.1%) were excluded for analysis.

Patients from online panels ($n = 60$) were on average younger ($p = .011$), higher educated ($p = .002$), more health literate ($p < .001$), and more e-health literate ($p < .001$) than patients from hospitals ($n = 137$). Moreover, patients from online panels experienced more future time perspective ($p = .002$), had a higher need for cognition ($p < .001$), had a more monitoring coping style ($p < .001$), and perceived less cognitive load from processing the RFA webpage than hospital patients ($p = .014$) (see Table 8.1).

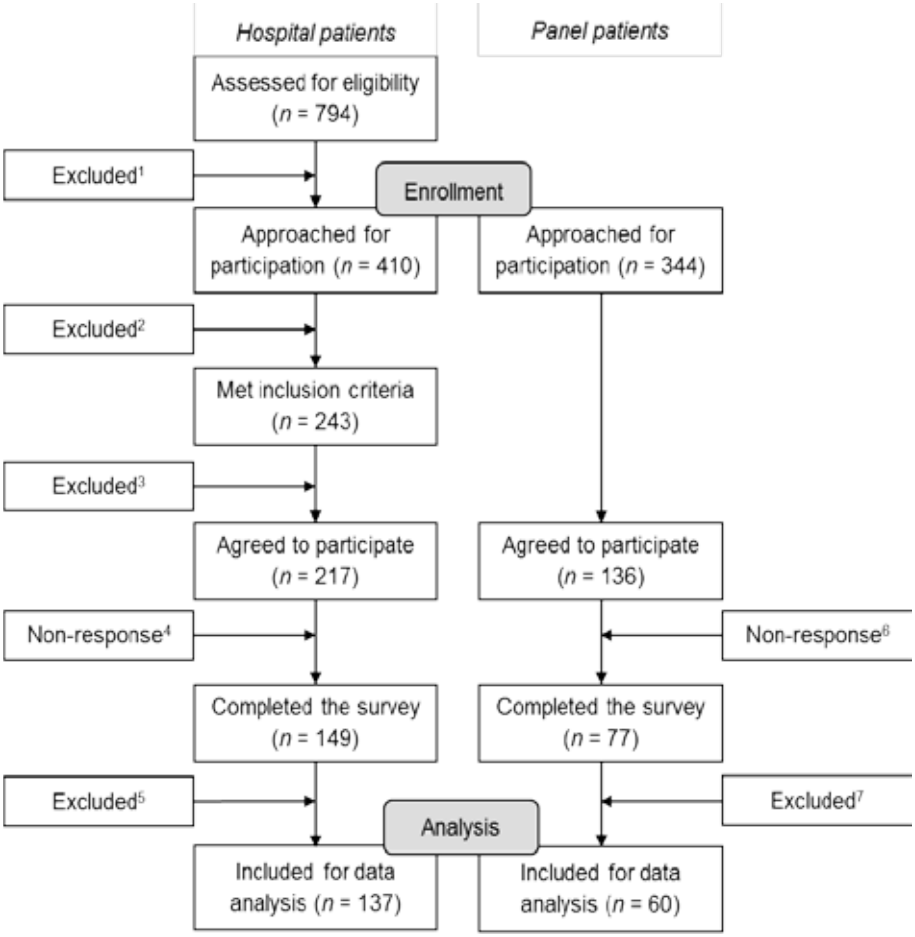

Figure 8.3. Flowchart of participant recruitment

Notes. [1]Newly diagnosed with cancer ($n = 238$), deceased ($n = 110$), participated in previous study ($n = 27$), cognitive impairment according to medical status ($n = 9$). [2]Deceased ($n = 57$), no access to Internet or computer ($n = 56$), could not be reached through telephone ($n = 52$), did not speak Dutch ($n = 2$). [3]Struggles with Internet use ($n = 13$), felt too sick or too tired ($n = 6$), had no time ($n = 5$), unknown ($n = 2$). [4]Started but did not finish for unknown reasons ($n = 52$), felt too sick or too tired ($n = 5$), deceased ($n = 5$), had no access to Internet or computer ($n = 3$), had no cancer ($n = 2$), struggled with questionnaire ($n = 1$). [5]Questionnaire filled out by someone else ($n = 7$), not exposed to webpage material ($n = 2$), used other source to answer recall questions ($n = 1$). [6]Started but did not finish for unknown reasons ($n = 52$), did not meet age criterion (< 65 yrs.; $n = 11$). [7]Did not meet age criterion (< 65 yrs.; $n = 14$), used other source to answer recall questions ($n = 2$), duplicate entry ($n = 1$).

Table 8.1. Individual and message experience characteristics stratified by patients recruited from hospital and panels

	Hospital patients, $n = 137$	Panel patients, $n = 60$
Variable	Mean (*SD*), range	Mean (*SD*), range
Background/Control variables		
Gender		
Male, *n* (%)	83 (60.6)	45 (75.0)
Female, *n* (%)	54 (39.4)	15 (25.0)
Age*	71.55 (4.41), 66 – 86	69.83 (4.22), 65 – 83
Web choice		
Text-only information, *n* (%)	10 (7.3)	1 (1.7)
Text and cognitive illustrations, *n* (%)*	61 (44.5)	37 (61.7)
Text and affective illustrations, *n* (%)	16 (11.7)	4 (6.7)
Text and formal-styled video, *n* (%)	46 (33.6)	14 (2.3)
Text and conversational-styled video, *n* (%)	4 (2.9)	4 (6.7)
Individual characteristics – Ability		
Frailty	3.40 (2.60), 0 – 11	2.93 (2.51), 0 – 12
Working memory[a]	1.54 (0.37), 1 – 2.44	1.53 (0.33), 1 – 2.33
Emotion regulation[b]	1.35 (0.32), 1 – 2.56	1.41 (0.36), 1 – 2.33
Anxiety (STAI-6)	37.93 (12.85), 20 – 67	35.94 (12.35), 20 – 73
Stress	2.74 (2.56), 0 – 10	2.52 (2.65), 0 – 9
Depression	1.55 (2.30), 0 – 9	1.57 (2.56), 0 – 10
Anger	1.78 (2.66), 0 – 10	1.75 (2.63), 0 – 9
Health literacy***	14.84 (5.34), 0 – 22	18.38 (3.00), 8 – 22
E-health literacy***	3.05 (0.87), 1 – 5	3.65 (0.69), 2.25 – 5
Education**		
Low, *n* (%)	87 (63.5)	23 (38.3)
High, *n* (%)	50 (36.5)	37 (61.7)
Medical knowledge	2.28 (1.34), 1 – 7	2.42 (1.10), 1 – 5.67
Individual characteristics – Motivation		
Future time perspective**	3.22 (1.20), 1 – 6.70	3.82 (1.33), 1 – 7
Need for cognition***	4.29 (1.02), 1.75 – 7	5.12 (0.98), 3.25 – 6.88
Monitoring coping style***	3.40 (1.02), 1 – 5	4.16 (0.84), 2 – 5
Message experience characteristics – Ability		
Perceived cognitive load*	2.93 (1.36), 1 – 6	2.50 (1.07), 1 – 6
Resources required	1.87 (0.90), 1 – 5	1.65 (0.89), 1 – 5
Message experience characteristics – Motivation		

Involvement	4.08 (1.52), 1 – 7	3.99 (1.62), 1 – 6.75
Satisfaction with emotional support	3.83 (1.78), 1 – 7	3.88 (1.63), 1 – 7

Note. Not all data add up to 197 patients due to missing data. Higher means of scale variables indicate higher levels of the variable under consideration, unless indicated otherwise. Abbreviations: *SD*, standard deviation. [a]Higher scores indicate poorer working memory. [b]Higher scores indicate poorer emotion regulation. * $p < .05$. ** $p < .01$. *** $p < .001$

Recall of information

Overall, patients adequately recalled 33.6% of the information on average ($M = 7.38$, $SD = 4.78$, range = 0 – 20). Whereas patients from online panels recalled on average 38.5% of the information correctly ($M = 8.47$, $SD = 4.30$, range = 0 – 15), patients from hospitals had a lower average recall score of 31.4% ($M = 6.91$, $SD = 4.91$, range = 0 – 20), $F(1, 195) = 4.54$, $p = .034$, $\eta_p^2 = .02$.

Predictors of recall of information

The first block with age accounted for 2.0% of the variance in recall ($\Delta R^2 = .002$, $p = .551$), indicating that chronological age did not predict recall of information. The block with "individual characteristics relevant for ability" variables accounted for 28.9% of the variance in recall ($\Delta R^2 = .289$, $p < .001$), suggesting a large contribution to the model. The block with "individual characteristics relevant for motivation" variables did not predict information recall ($\Delta R^2 = .020$, $p = .174$). The fourth block covering "message experience characteristics relevant for ability" variables accounted for 7.6% of the variance in recall ($\Delta R^2 = .076$, $p < .001$). The final block addressing "message experience characteristics relevant for motivation" variables accounted for 5.5% of the variance in recall ($\Delta R^2 = .055$, $p < .001$).

The final linear model (see Table 8.2) including all potential predictors of information recall accounted for 37.9% of the variance in accurate recall of information ($p < .001$). Chronological age did not predict recall of information ($\beta = .01$, $p = .876$). Instead, age-related individual and message experience factors relevant for ability and motivation predicted recall of information. Among individual characteristics that influenced ability, lower levels of frailty ($\beta = -.17$, $p = .049$) and anger ($\beta = -.20$, $p = .022$), as well as higher levels of health literacy ($\beta = .18$, $p = .016$) were predictive of recall. Among individual characteristics that influenced motivation, future time perspective ($\beta = -.16$, $p = .020$) was related to recall: the less perceived future time, the more patients recalled correctly. Of the experienced message variables that influenced ability, perceived cognitive load was negatively related to recall ($\beta = -.28$, $p = .001$), suggesting that the less perceived cognitive load, the more recall. Of the message experience variables that influenced motivation, involvement ($\beta = .12$, $p = .046$) and satisfaction with the emotional support from the website ($\beta = .19$, $p = .003$) were positively associated with recall, indicating that high levels of involvement and satisfaction are positively related to better recall of information. The model showed that recall of online cancer information is not a matter of chronological age per se, but rather a matter of ability and, to some extent, motivation.

Table 8.2. Final linear model of individual and message experience predictors of accurate recall of information

	B	*SE*	β	*p*-value
Block 1: Age		$\Delta R^2 = .002$, $p = .551$		
Intercept	0.41	5.81		.944
Age	0.01	.07	.01	.876
Block 2: Individual characteristics – Ability		$\Delta R^2 = .289$, $p < .001$		
Frailty	-0.31	.16	-.17	.049
Working memory	0.69	.96	.05	.475
Anxiety	0.01	.04	.04	.689
Stress	0.31	.19	.17	.104
Depression	-0.21	.18	-.11	.238
Anger	-0.36	.16	-.20	.022
Emotion regulation	0.94	1.09	.07	.391
Medical knowledge[a]	1.93	2.01	.06	.340
Health literacy	0.17	.07	.18	.016
E-health literacy	-0.29	.38	-.05	.449
Education (1 = high, 0 = low)	0.55	.66	.06	.402
Block 3: Individual characteristics – Motivation		$\Delta R^2 = .020$, $p = .174$		
Future time perspective	-0.59	.25	-.16	.020
Need for cognition	0.52	.33	.12	.122
Monitoring coping style	0.36	.32	.08	.266
Block 4: Message experience characteristics – Ability		$\Delta R^2 = .076$, $p < .001$		
Perceived cognitive load	-1.16	.36	-.28	.001
Resources required[a]	-1.13	2.79	-.03	.686
Block 5: Message experience characteristics – Motivation		$\Delta R^2 = .055$, $p < .001$		
Involvement	0.37	.19	.12	.046
Satisfaction with emotional support	0.52	.17	.19	.003

Note. 95% confidence intervals reported in parentheses. Final model: $F(19, 171) = 7.12$, $p < .001$; $R^2a = .379$. [a]Medical knowledge and resources required scores were log transformed due to violation of the assumption of homogeneity of variance.

Discussion

We proposed and tested a theory-based model to provide a more comprehensive understanding of the contribution of chronological age and age-related factors in explaining recall of online cancer information among older patients. Potential recall predicting variables were categorized in terms of individual and message experience characteristics relevant for older patients' ability and motivation. Testing our theory-based model among 197 older adult cancer patients revealed that recall of online cancer information is not a matter of chronological age per se, but indeed rather a matter of ability and motivation, both constituting of individual as well as message experience characteristics. With these age-related ability and motivation factors, we were able to explain 37.9% of the variance in recall of information. The results showed that individual characteristics relevant for ability contributed most to recall of information, followed by message experience characteristics relevant for ability, and message experience characteristics relevant for motivation. Chronological age and individual characteristics relevant for motivation did not contribute to recall of information independently. These results indicate that, in older age, recall of online cancer information is determined by a wide variety of age-related factors rather than chronological age.

Our final model showed that of the individual characteristics relevant for ability, frailty and anger negatively impacted recall of information, whereas higher levels of health literacy had a positive effect. This was in line with our expectations. Furthermore, our findings showed that of the individual characteristics relevant for motivation, future time perspective was negatively related to recall of information. This finding was contrary to our expectation, as we argued that older adults experiencing little time left in life might be less willing to process information, resulting in lower recall. As the current literature had not tested the relationship between future time perspective and recall, we based this expectation on the theoretical assumptions of the socioemotional selectivity theory. Now, we alternatively argue that information is essential especially for patients approaching the end of life, as they have to decide what treatment strategy is preferred given their limited time perspective. This might have enhanced their willingness to process information, and consequently recall information. In terms of message experience characteristics relevant for ability, experiencing higher levels of perceived cognitive load led to lower levels of recall. Moreover, perceived cognitive load was the strongest recall predictor in our model. In addition, message experience characteristics relevant for motivation positively contributed to accurate recall of information. In line with our predictions, we found that involvement and satisfaction with the emotional support from the website were positively associated with recall, suggesting that the more involved with processing online content and the more satisfied with the perceived emotional support from such content, the better patients recalled information from online cancer sources.

Regardless of the theoretical and empirical foundation of our expectations, several individual characteristics relevant for ability (i.e., working memory, anxiety, stress, depression, emotion regulation, prior medical knowledge, e-health literacy, educational level) and motivation (i.e., need for cognition, monitoring coping style), as well as message experience characteristics relevant for ability (i.e., required cognitive resources), did not predict recall of information in the final model. Nevertheless, our

results revealed relevant predictors of information recall among older patients, which might capture the most important age-related processes in recall of online cancer information. If we would have asked patients to navigate on a website searching for information rather than viewing one webpage only, we could have gained an even more nuanced understanding of important age-related predictors. For example, e-health literacy might have played a larger role when patients had to visit a full website rather than one webpage. This could mean that some age-related factors might only predict recall under certain conditions, but it could also mean that some do not predict recall at all. We suggest to test the proposed model in different study settings to assess the applicability of all age-related factors within the model.

Implications for theory

Our findings relate to the elaboration likelihood model and the limited capacity model of motivated mediated messages, which explicate that information processing is influenced by ability and motivation (Lang, 2000; Petty & Cacioppo, 1986). In line with the limited capacity model of motivated mediated messages, we acknowledge individual and message experience characteristics as important factors influencing the ability and motivation to recall online cancer information. Our study provides evidence confirming the importance of considering ability and, to some extent, motivation from both an individual and message experience perspective. Importantly, we made a first attempt to specify age-related individual and message experience factors that are relevant for ability and motivation. Whereas earlier work focused on conceptualizing ability and motivation (e.g., A. Lang, 2000; Petty & Cacioppo, 1986), we focused on categorizing important recall-predicting concepts to operationalize ability and motivation to recall online cancer information among older patients.

Our theory-based model can be applied to any health-related field of interest to investigate recall of other information types as well. In this study, we only presented patients with a single webpage containing information about RFA treatment. However, it could be expected that information type might interact with several age-related factors, meaning that testing our framework in different settings may lead to different outcomes. For instance, presenting information about prognosis has been found to hamper accurate recall of information, which might be explained in terms of levels of anxiety (Jansen, Butow, et al., 2008). Our study materials did not include emotional content, which might explain why anxiety was not a significant predictor of recall. This suggests the need for further research to better understand under what circumstances which age-related factors influence recall of online information in older patients in order to extend and adapt our current theory-based model.

Implications for practice

By identifying ability and motivation factors that predict accurate recall of information, we are able to use these as criteria to select those older patients that are most at risk for poor recall of online cancer information and, consequently, for other health outcomes. These criteria tell us more about the process of aging than chronological age per se. The latter is only a proxy for many age-related processes that better capture how online information is recalled by older adults. Our research findings suggest that we should consider age-related factors such as frailty, anger, health literacy, future

time perspective, perceived cognitive load, involvement, and satisfaction with the emotional support from the website. This poses relevant opportunities for tailoring interventions. As chronological age cannot be changed by such interventions, addressing relevant age-related factors may help improve information provision for older cancer patients. In interpersonal communication, healthcare professionals could also consider these age-related factors by tailoring communication to patients' ability (e.g., frailty and health literacy) and motivation (e.g., future time perspective). Further research is needed to explore how these age-related factors can be translated into practical tools that can support healthcare practitioners to tailor communication to the individual older patient.

With respect to online communication, web designers should create online content that is easy to digest for people with different levels of health literacy and motivates users to be actively engaged in using the website content. Moreover, these results can also be used to systematically develop new online information tools targeted at older adults. As such tools seem promising in facilitating immediate, intermediate, and long-term outcomes in older patients by providing information, enhancing information exchange, and promoting self-management (Bolle et al., 2015), it is important to create effective designs that help older patients to better use online information for disease management. Future research should gain insight into how online information should be presented when considering the predicting age-related factors we revealed in this study.

Limitations

This study also has limitations. First, the design was cross-sectional, meaning that a causal relationship between age-related factors and recall of information cannot be assumed. Longitudinal or experimental data should therefore be used to assess causal relationships to confirm our findings. Although we were able to confirm our model for our entire patient sample and the subsample of patients recruited from hospitals, further research is also desirable to test the generalizability of our model by confirming our model for the subset of patients that were recruited from panels (i.e., we were unable to test the model with this data due to a low sample size). To generalize these results to a heterogeneous group of cancer patients, it is crucial to test our model among different subsets of cancer patients to examine the robustness of our proposed model.

Furthermore, we conducted our study among patients not newly diagnosed with cancer, as we did not want to interfere with patients' treatment plan as long as available treatment options had not been discussed with the oncologist. This way, however, we asked patients to imagine that they would have to consult the study's webpage to gain information about RFA treatment. Even though previous research has shown that giving (ex-)patients such a scenario leads to similar outcomes compared to newly diagnosed patients (Van Vliet et al., 2012), some limitations of using so-called analog patients abound. For instance, the emotional state we assessed during this survey might not reflect the emotional state patients were in when being recently diagnosed. Our patients reported on average little negative emotional states (see Table 8.1), for instance, patients did not indicate very high anxiety in general (i.e., mean STAI score of 37.33, whereas $>$ 44 indicate high anxiety: Millar, Jelicic, Bonke,

& Asbury, 1995). Emotional state might have played a more visible role at diagnosis than in our scenario, which might have led to an underestimation of the effects of emotions on recall of information in our study.

Moreover, our theoretical framework is limited by message characteristics that are experienced by the message recipient. For the purpose of this study, we wanted to keep the information provided on the webpage as constant as possible to ensure that recall was a function of our proposed age-related factors rather than a function of various message-related factors that would interfere with the age-related factors. For instance, if we would have wanted to determine the role of text complexity, length, or type, we would have had to create different types of informational webpages. However, creating such groups calls for different research designs, such as experiments (e.g., Bol, Van Weert, et al., 2014; Van Weert et al., 2011). Otherwise, it is impossible to detect whether differences in recall are caused by variance in age-related factors or interactions between age-related factors and message types. Nevertheless, the framework could be extended by these factors and could be additionally examined in experimental research designs.

Conclusions

We conducted this study to gain a more comprehensive understanding of online cancer information recall among older cancer patients. Although our proposed model explained a substantial amount of variance in online information recall, further research should explore other factors, such as message factors, to optimize the current model of ability and motivation to recall information among older cancer patients. Moreover, ways to translate these findings into practice are needed to tailor communication to older cancer patients' ability and motivation to recall online cancer information. As the Internet is increasingly used as a source of cancer information, new strategies for delivering cancer information on the Internet must be developed that accommodate a diverse and heterogeneous group of older cancer patients. Our findings pose relevant opportunities for tailoring interventions. As chronological age cannot be changed by such interventions, addressing relevant age-related factors may help improve communication with older cancer patients.

Chapter 9

Summary and general discussion

Summary

Providing information to cancer patients is crucial within cancer care. In the current technology age, information is increasingly presented through the Internet. As cancer is often a disease of older adults, it is important to consider aging populations when designing online cancer information materials. Although people aged 65 years and older increasingly use the Internet (File & Ryan, 2014; Statistics Netherlands, 2014), most older people see themselves as less able and are often less motivated to utilize the Internet for health information (Bodie & Dutta, 2008). This might be due to, among other reasons, low health literacy levels and low computer usage, which are more prevalent among aging populations (Bodie & Dutta, 2008). It is therefore important to present online cancer information in such a way that older patients are able and motivated to process information online. The objective of this dissertation was therefore to explore how online cancer information can be optimally presented to older patients. This ultimately contributes to better online cancer information provision for older cancer patients. This was done by examining the added value of illustrations and videos on cancer-related websites to enhance website satisfaction and recall of information. We thereby focused on how these visuals aid older adults in particular, and examined the role of chronological age and age-related factors in the effectiveness of online visual cancer materials. The central question to this dissertation is: "How can online cancer information be optimally presented to older patients?" To answer the central question to this dissertation, we formulated three research questions:

(1) How can illustrations be used to enhance older adults' website satisfaction and recall of online cancer information?
(2) How can videos be used to enhance older adults' website satisfaction and recall of online cancer information?
(3) Does age matter when presenting online cancer information to enhance older adults' website satisfaction and recall of online cancer information?

Summary of the main findings

In **Chapter 2**, we examined the effect of adding cognitive and affective illustrations to online cancer information (vs. text only) on older adults' website satisfaction and recall of cancer-related information. Previous research has shown that illustrations can effectively improve satisfaction and recall, however, it has not yet been investigated what types of illustrations yield these effects among older adults in particular. In an online experiment, 271 younger ($<$ 65 yrs.) and 165 older ($\geq$ 65 yrs.) healthy adults were exposed to a webpage about radio frequency ablation treatment (RFA). These adults were randomly assigned to a webpage with text-only information, text with cognitive illustrations, text with affective illustrations, or text with both cognitive and affective illustrations. Results of this experiment showed that illustrations did not improve recall of information. Cognitive as well as affective illustrations increased participants' satisfaction with the attractiveness of the website as compared to text-only information. While younger adults were more satisfied with the comprehensibility of the website than older adults in general, older adults were more satisfied with perceived emotional support from the website than younger adults. Consequently, being more emotionally satisfied with the website led to better recall of information

among older adults, but not among younger adults. *These findings suggest that both cognitive and affective illustrations can be used to enhance website satisfaction. More importantly, perceived emotional support from the website may lead to increased recall of online cancer-related information among older adults in particular*.

Chapter 3 describes an online experiment in which we aimed to replicate our findings on the effects of illustrations in online cancer information among older colorectal cancer patients. We included 62 younger (< 65 yrs.) and 112 older (≥ 65 yrs.) colorectal cancer patients who were randomly exposed to a webpage about transanal endoscopic microsurgery (TEM) containing either text-only information, text with cognitive illustrations or text with affective illustrations. We found that adding cognitive illustrations compared to text-only information improved satisfaction with the attractiveness of the website in both younger and older patients. Despite older patients recalled less information overall compared to younger patients (39% vs. 50%), no age differences in recall were found when cognitive illustrations were added to online text. In addition, older patients were more satisfied with the emotional support from the website than younger patients, especially when affective illustrations were added to the webpage. *These results indicate that effective online cancer information for aging populations involves including both cognitive and affective illustrations to enhance website satisfaction and recall of cancer information*.

To explore the mechanisms behind how online text and illustrations are processed, **Chapter 4** presents an eye-tracking study in which we examined how online cancer information is processed by younger and older healthy adults. Previous research has focused on the effects of using illustrations in cancer-related messages (e.g., on recall of information), however, none to date has considered the process that precedes these effects. Even though it has been acknowledged that attention is a prerequisite for accurate recall of information, little is known about the association between attention to text and illustrations and recall of such text and illustrations. Moreover, it is unclear whether age matters in this regard. This gap was addressed by investigating the relationship between attention and recall among younger (< 65 yrs.) and older (≥ 65 yrs.) adults. Using eye tracking, 97 participants (55 younger and 42 older adults) received a webpage consisting of text-only information, text with cognitive illustrations, or text with affective illustrations. The eye-tracking data revealed that more attention to text led to more recall of information among older adults, whereas it did not among younger adults. On the other hand, younger adults paid more attention to cognitive illustrations than older adults, and also recalled more information from text with cognitive illustrations than older adults. *These results suggest that effective online cancer information for older adults involves webpages that include text and cues that enhance their motivation to spend time consuming it*.

In addition to investigating the effectiveness of illustrations, we also focused on the effectiveness of videos in online cancer materials. This was first examined in **Chapter 5** among a healthy population. We investigated the effect of modality and narration style on recall of online cancer information, and whether these effects are different for younger and older adults. By testing combinations of modality and narration style, we aimed to identify effective ways of presenting online cancer information to older adults. To address this aim, we conducted an online between-subjects design experiment to assess the effects of modality (text vs. video modality)

and narration style (formal vs. conversational style) among 236 younger and 204 older adults. Participants were randomly assigned to one of four webpages on which information about RFA treatment was presented. An online questionnaire assessed recall of information. Results showed that video modality (vs. text modality) increased recall of information in both younger and older adults, but conversational narration style (vs. formal narration style) did not. Nevertheless, a synergistic effect between modality and narration style was revealed, indicating that combining audiovisual information with conversational style outperformed combining written information with formal style, as well as written information with conversational style. This finding shows that conversational style especially increases recall of information when presented audiovisually. *We conclude that combining audiovisual information with conversational style is the best way to present cancer information to younger and older adults*.

Chapter 6 describes a replication study in which we investigated the effects of audiovisual information presented in conversational style in addition to text on website satisfaction and recall of online cancer information in older lung cancer patients. In an online experiment, 95 younger ($<$ 65 yrs.) and 74 older ($\geq$ 65 yrs.) lung cancer patients were either exposed to a webpage with text-only information, text with formal-styled video, or text with conversational-styled video. Patients randomly received one of the three versions of the webpage stratified by younger and older age. The results showed higher satisfaction with the attractiveness, comprehensibility, and the emotional support from the website when information contained text with conversational-styled video compared to text only. Text with conversational-styled video also increased satisfaction with emotional support from the website compared to text with formal-styled video. Furthermore, regardless of narration style, text with video improved patients' recall of online cancer information as compared to text only. Older patients recalled generally less information correctly than younger patients, except when controlling for Internet use. *These findings suggest that text with conversational-styled audiovisual information is especially effective in enhancing website satisfaction and recall of information. Furthermore, Internet use can help to explain recall of online cancer information in older patients*.

To explore the mechanisms behind the effectiveness of conversational-styled videos, **Chapter 7** examined the role of narrative engagement in explaining website satisfaction and recall of information. The narrative communication literature has described that narrative engagement plays an important role in explaining effects. Narrative engagement includes involvement with the story (i.e., transportation into the story) as well as involvement with the characters (i.e., identification, similarity, likability) presented in the story. In an online experiment (using data from Chapter 5), we investigated the mediating role of narrative engagement in the relationships between narration style (formal vs. conversational style) and website satisfaction and recall of information. In addition, age congruency was considered a moderating factor. Age congruency refers to the perceived similarity between the age of the narrator of the message and the age of the recipient of the message, which might influence involvement with the character presented in the narrative. The findings revealed that age congruency had an effect on satisfaction with the emotional support from the website, especially among older adults. Specifically, older adults were more satisfied

with the emotional support from the website when viewing an older narrator compared to younger adults, but also compared to when viewing a younger narrator. Furthermore, narrative engagement – especially transportation into the story and likability of the character – was positively associated with both website satisfaction and recall of information, but did not mediate the relationship between narration style on the one hand and the website satisfaction and recall on the other hand. However, significant conditional mediation effects revealed that age congruency plays a moderating role in explaining the effects of narration style on website satisfaction and recall of online health information via narrative engagement. *This study revealed the importance of narrative engagement in enhancing website satisfaction and recall of information. For older adults in particular, age-congruent narrators increase satisfaction with the emotional support from the website. We conclude that effective online video materials contain older narrators that are likable and able to transport the viewer into the narrative world to enhance older adults' website satisfaction and recall of online cancer information*.

Chapter 8 deepened our understanding of how chronological age and age-related factors contribute to the effectiveness of online cancer information. Older patients often poorly recall information from online cancer sources. Yet, little is known about what age-related factors besides chronological age are relevant for their ability and motivation to recall online information. We therefore aimed to provide a better understanding of the contribution of chronological age and age-related factors explaining recall in older patients by proposing and testing a theory-based model, in which we captured individual and message experience characteristics relevant for ability (e.g., frailty and perceived cognitive load) and motivation (e.g., future time perspective and involvement). A total of 197 (ex-)cancer patients aged 65 years or older participated in an online survey in which they received a webpage about RFA treatment, and were asked to answer questions on how much they could recall of the content. The survey also contained questions on chronological age and age-related factors that are expected to influence the ability and motivation to recall information. The findings showed that recall of online cancer information is not a matter of chronological age per se, but rather a matter of ability and motivation. The ability to adequately recall cancer information was influenced by individual characteristics, such as frailty, anger, health literacy, but also by message experience characteristics, such as perceived cognitive load. Recall of online cancer information was also influenced by patients' motivation. This was influenced by individual characteristics, such as future time perspective, as well as by message experience, such as involvement and satisfaction with the emotional support. *Our study shows that older cancer patients' recall of online cancer information is not simply a matter of chronological age, but appears to be a rather complex outcome that is influenced by a variety of age-related ability and motivation factors*. This poses relevant opportunities for tailoring interventions. As chronological age cannot be changed by such interventions, addressing relevant age-related factors can help improve online cancer information for older cancer patients.

General discussion

The Internet provides the opportunity to present information in a variety of ways, such as text, illustrations, and videos. There is ample evidence that combining text information with visuals, such as illustrations and videos, improves website satisfaction and recall of information. Yet, it is unknown how such visuals can be used to optimally present online cancer information to older patients. This dissertation therefore presented seven chapters based on six empirical studies that aim to investigate the effects of using illustrations and videos in online cancer information on website satisfaction and recall of information, and how this especially affects older adults. This way, we investigated how we can enhance older patients' *ability* and *motivation* to deal with online cancer information. The three aforementioned research questions will be used to structure the general discussion on the findings of this dissertation.

How can illustrations be used to enhance older adults' website satisfaction and recall of online cancer information?

Earlier studies have provided theoretical and empirical evidence for the multimedia principle that describes the effectiveness of combing text information with illustrations (e.g., Houts, Doak, Doak, & Loscalzo, 2006; Mayer, 1999). Despite the scarce and inconsistent empirical evidence of using illustrations for older adults in particular, the cognitive theory of multimedia learning (CTML) has stressed that the added value of illustrations for older people seems promising as well (Paas, Van Gerven, & Tabbers, 2005). In three empirical studies, this dissertation now tested the added value of cognitive and affective illustrations on older adults' website satisfaction and recall of information. In these studies, 533 healthy adults and 174 colorectal cancer patients representing both younger ($<$ 65 yrs.) and older ($\geq$ 65 yrs.) ages were involved. These studies showed that illustrations address older adults' *motivation* to process online cancer information rather than their *ability* to process such information. In contrast with the multimedia principle, adding cognitive illustrations to text information did not facilitate older adults' *ability* to process information in terms of increased recall of information. Even though both healthy participants and cancer patients of all ages forgot as much as between 50 and 72 percent of information on average, older patients appeared to forget even larger amounts of information than younger adults. Among colorectal cancer patients, cognitive illustrations seemed to decrease age differences in recall (Chapter 3). Nevertheless, cognitive illustrations did not improve recall of information compared to other ways of presenting information, such as text only or text with affective illustrations. Moreover, cognitive illustrations did not decrease the difference in recall between younger and older adults in our healthy study samples (Chapter 2 and 4). One explanation is that older adults tend to pay less attention to cognitive illustrations than younger adults. Attention to information is a critical first step to process and recall information (Wedel & Pieters, 2000). Moreover, older adults often have difficulties to integrate text and illustrations (Liu, Kemper, & McDowd, 2009), which might also explain why cognitive illustrations did not enhance recall of information compared to other ways of presenting online cancer information. The decrease of age differences among the colorectal cancer patient sample as a result of adding cognitive illustrations could also be alternatively explained by the fact that younger patients recalled relatively poor amounts of information within

the cognitive illustrations condition compared to other conditions of information presentation, which made it seem that older adults perform particularly well when cognitive illustrations are present.

On the other hand, illustrations did enhance older adults' *motivation* to process information by increasing their website satisfaction. Besides the increased satisfaction with the attractiveness of the website caused by adding cognitive (Chapter 2 and 3), affective (Chapter 2) or both types of illustrations (Chapter 2), affective illustrations also enhanced satisfaction with the emotional support from the website among older adults in particular (Chapter 3). As our findings also showed that enhanced satisfaction with the emotional support improves recall of information among older adults in particular (Chapter 2), affective illustrations might indirectly benefit information processing among older people. Theoretically, these results support the positivity bias in older age described in the socioemotional selectivity theory: older adults' emphasis on emotionally relevant material and reallocation of processing resources toward the positive aspects of information might explain their willingness to process online cancer information that is perceived as emotionally gratifying (Mather & Carstensen, 2005). Since affective illustrations might serve as such positive aspects, these could serve as important motivational cues for older adults to process online cancer information. Nevertheless, affective illustrations did only enhance satisfaction with the emotional support among older adults compared to younger adults, not compared to other ways of presenting online cancer information, such as text only and text with cognitive illustrations. When comparing effective ways of presenting online cancer information, cognitive illustrations might be more helpful, as it was found more than once that adding cognitive illustrations enhances satisfaction with the attractiveness of the website compared to presenting information in text-only format.

How can videos be used to enhance older adults' website satisfaction and recall of online cancer information?

The CTML also provides theoretical ground for the modality principle, which explains the effectiveness of combining spoken information with moving visuals, that is, videos (Sweller, Ayres, & Kalyuga, 2011). Older adults are expected to particularly benefit from such videos, as their limited total cognitive capacity can be effectively expanded by information that addresses both visual and auditory working memory systems (Paas et al., 2005). However, the effect of using videos on recall of information has not yet been examined among older adults. Therefore, two studies described in three chapters in this dissertation explored the effects of adding videos to online cancer information on older adults' website satisfaction and recall of information. A total of 440 healthy adults and 169 lung cancer patients representing both younger ($<$ 65 yrs.) and older ($\geq$ 65 yrs.) ages were involved in these studies. The findings provided evidence for the modality principle by revealing that videos address both older adults' *ability* and *motivation* to process online cancer information. In line with our expectations, using videos versus text-only information promoted older adults' *ability* to process information in terms of information recall. Again, substantial amounts of information were forgotten by both healthy participants and cancer patients of all ages (between 54 and 72 percent on average). However, older adults did not seem to

forget substantially more than younger adults. Both younger and older healthy adults and patients better recalled information when information was presented in video format, especially when this video was presented in conversational narration style (Chapter 5, 6 and 7). The latter finding emphasizes the importance of conversational narration style when presenting information, which is consistent with the assumptions put forth in the personalization principle.

At the same time, videos presented in conversational style were also effective in enhancing older adults' *motivation* to process information by increased website satisfaction. Conversational-styled videos were most effective in enhancing satisfaction with the attractiveness, comprehensibility, and emotional support from the website. Conversational-styled videos increased satisfaction with the attractiveness, comprehensibility, and emotional support from the website compared to text-only information, as well as satisfaction with the emotional support from the website compared to formal-styled videos (Chapter 6). This might also be explained by the fact that a patient conveyed information instead of a doctor. Older adults perceived even more emotional support from the website when this information was presented by an older than by a younger narrator (Chapter 7). As this effect was not found for younger adults, we can assume that age congruency is important when older adults process online cancer information but not so much when younger adults do. From a homophily perspective, we can understand why age congruency plays an important role in one's motivation to actively process online cancer information. The homophily literature explains that individuals with similar traits are more likely to have contact and share behavior patterns (McPherson, Smith-Lovin, & Cook, 2001). Moreover, the socioemotional selectivity theory could explain why this perceived similarity is especially important for older adults by assuming that age congruency plays an important role in meeting emotional goals when processing online cancer information. Older adults generally perceive less time left in life, which makes them more likely to pursue goals related to deriving emotional meaning and experiencing emotional satisfaction (Carstensen, Isaacowitz, & Charles, 1999). When this occurs, people are also highly selective in their choice of social partners that they perceive as familiar and predictable (Carstensen et al., 1999), which might explain older adults' explicit preference for an older narrator when viewing videos about cancer-related information.

Does age matter when presenting online cancer information to enhance older adults' website satisfaction and recall of online cancer information?

Despite the various interesting and relevant findings regarding the effects of using visuals in online cancer information presented in this dissertation, the contribution of chronological age remains relatively moderate. This is likely due to the wide range of age-related factors other than chronological age that influence older adults' information processing. Moreover, older adults' information processing not only depends on the type of message they receive, but potentially also on their individual characteristics and how they experience the message. A final study was therefore conducted to gain more insight into what predicts older patients' recall of online cancer information. In this study, 197 older patients with various forms of cancer were involved. A theory-based model was proposed and tested to provide a more comprehensive understanding of

the contribution of chronological age and age-related factors in explaining recall of online cancer information. Testing our theory-based model revealed that adequate recall of online cancer information is a matter of both *ability* and *motivation*, which are influenced by both individual and message experience characteristics. In terms of individual characteristics, frailty, anger, and health literacy were *ability* factors that were related to recall of online cancer information, and future time perspective was a *motivation* factor that influenced recall of information. While frailty and anger inhibited patients from recalling online cancer information, health literacy and having limited future time perspective positively impacted recall. In terms of message experience characteristics, cognitive load negatively influenced the *ability* to adequately recall information, whereas involvement and satisfaction with the emotional support from the website positively contributed to the *motivation* to accurate recall information. This study along with the aforementioned studies showed that adequate recall of information among older patients results from a complex interplay between several individual and message experience factors. This suggests that cognitive aging theories should be incorporated in research that aims at gaining a better understanding of how older people process information. When people get older, one's *ability* and *motivation* to spend effort on certain behaviors appears to change in two ways. On the one hand, older adults feel less confident about their *ability* when having to rely on their cognitive ability, and, on the other hand, they become less *motivated* to spend effort on activities that they perceive as less relevant to achieving their goals (Strough, Bruine de Bruin, & Peters, 2015). In addition, the socioemotional selectivity theory posits that older adults tend to avoid negative information to pursue their desire to experience positive emotions (Carstensen et al., 1999). The latter is important to consider when it comes to online cancer information provision, as negative aspects of information might be overlooked or ignored by older patients in order to control regulation of emotional states (Löckenhoff & Carstensen, 2004). We may therefore conclude that older patients' *ability* and *motivation* should be taken into account instead of chronological age when designing online cancer materials. Focusing on older patients' frailty, emotional state, health literacy, and future time perspective might provide practical suggestions for adapting online cancer materials to older patients' *ability* and *motivation* to process information. This may help to retain the benefits and avoid the pitfalls of web design for older adults.

Strengths and limitations

This dissertation has several strengths and limitations that put our study findings into perspective. A strength of this dissertations is the external validity and generalizability of the results. Conducting several replication studies provided solid evidence for the effectiveness of using visuals in online cancer information for older people. Our study samples involved a large heterogeneous group of both healthy adults and cancer patients that represented a wide range of ages (18 – 90 yrs.), were recruited through different sampling methods, such as hospitals, online panels and snowballing, and were tested in different settings, such as 'lab' settings and at home. Furthermore, we used experimental designs as well as survey and eye-tracking methodology to approach our research questions from different methodological angles in order to

strengthen the validity of our results. Moreover, when conducting research among cancer patients, we included patients with various forms of cancer to create a heterogeneous sample of patients (e.g., lung cancer, colorectal cancer). Being able to replicate our findings multiple times among these heterogeneous study samples indicates consistent and strong evidence. However, it should be noted that a number of people could not be included in the study sample due to not having access to the Internet. Even though older adults are the fastest growing group of Internet users, they are still underrepresented on the Internet compared to younger adults (File & Ryan, 2014; Statistics Netherlands, 2014). This might have implications for the external validity of the results, as "offline" older adults might not have been included in our studies. Nonetheless, it is expected that Internet use among older populations will grow due to the process of generational change and the use of information and communication technologies. As today's younger adults will be the future's older adults, the lower Internet use in the older generation will thus be resolved in time (Duimel, 2007). Moreover, extremely vulnerable older patients are probably underrepresented in our studies, as feeling to sick or too tired was a frequent reason for declining to participate and dropping out at a later stage. Furthermore, lung cancer patients were overrepresented in our samples. This raises the question whether this group of cancer patients is representative for all cancer patients, and whether our results are generalizable to a broader cancer patient population. For instance, survival rates are low for lung cancer patients (Dutch Cancer Society, 2011), and poor prognosis is predictive of poor information recall (Jansen, Butow, et al., 2008), which could have biased our results. Moreover, cigarette smoking is by far the most important risk factor for lung cancer (American Cancer Society, 2015), and smokers are more likely to be socioeconomically disadvantaged, which in turn negatively impacts many health outcomes (Hiscock, Bauld, Amos, Fidler, & Munafo, 2012). Yet, the fact that the model presented in our final study remained the same for lung cancer patients and the entire, more heterogeneous, cancer patient sample provides some support for the premise that our results could be generalized to a broader cancer patient population. Whether our findings are generalizable to other diseases, such as chronic diseases (e.g., diabetes, asthma), needs further research.

Another strength of this dissertation is the high internal validity of the results. By conducting several experimental studies, we were able to systematically test various types of illustrations (i.e., cognitive and affective) as well as various types of videos (i.e., formal-styled and conversational-styled). Most studies have only considered cognitive illustrations in their research (e.g., Mayer, 2002), while affective illustrations are often used in cancer materials as well (King, 2015). Examining both cognitive and affective illustrations allowed us to compare the effects of both types of illustrations, broadening our understanding of how we can effectively use illustrations in online cancer information. This is an important step, as different types of illustrations (i.e., cognitive vs. affective) serve different types of functions (i.e., facilitating learning vs. enhancing enjoyment) and can therefore trigger different types of processes and outcomes (i.e., recall of information vs. satisfaction). Likewise, using videos in cancer communication has been previously investigated (e.g., Dunn, Steginga, Rose, Scott, & Allison, 2004; Kreuter et al., 2008), but knowledge on what type of video is most effective was still lacking. Our studies provided insight into the uses and

implications of using conversational narration style in videos and broadened our view on effective ways of presenting online cancer information. Moreover, a more in-depth study critically appraised theoretical assumptions about the effectiveness of using illustrations in online cancer information using novel research methods, such as eye tracking, and another explored underlying mechanisms to explain the effectiveness of using conversational narration style in video materials. This way, we also gained novel insights into why and how visuals are effective in online cancer information for older adults, and provided us with practical suggestions for designing visuals for online cancer information.

However, it should be noted that the results presented in this dissertation are limited by the scope of our research. In our studies, we presented participants with information about relatively unknown treatment options to ensure that prior knowledge about the topic would not vary among participants causing alternative explanations for our study findings. This means, however, that we can only draw conclusions about the effectiveness of illustrations and videos in the specific context of RFA and TEM treatment. Although generalizability of the results can be expected as we kept the content of the information on our webpages constant when testing the added value of illustrations and videos, future research should explore whether these results are also generalizable to other types of information. We could speculate that information about relatively unknown treatments such as RFA and TEM was rather complex, and resulted therefore in poor recall performances overall. Furthermore, in all our studies we asked participants to imagine they had to consult such treatment information. Even though previous research has shown that giving (ex-)patients such scenarios leads to similar outcomes compared to newly diagnosed patients (Van Vliet et al., 2012), using so-called analog patients might have affected our results. These analog patients might have perceived the study materials as less personally relevant as the treatment information did not apply to their current situation, and might therefore have recalled less information on average than target group patients. Moreover, all our study participants did not have prior knowledge on the topic to enable reliable comparison between experimental conditions. However, a recent review noted that older adults' motivation to put effort into behaviors depends on the perceived relevance of the presented information as well as on their self-efficacy or confidence in applying their ability and knowledge (Strough et al., 2015). Our specific study setting might have undermined these two motivational factors in older adults particularly, resulting in a potential underestimation of our results. Methodologically, our study designs provide valuable empirical evidence for the relations between predictors and outcome variables, but do not so for the absolute value of the outcome variables. This means that we are able to draw conclusions about *what causes* information processing among older adults, but not about *the extent to which* they were able and motivated to process online cancer information. By comparing older adults with a younger subset in our study, we were still able to indicate the level of older adults' *ability* and *motivation* to process online cancer information compared to younger adults, but further research is desirable to determine true levels of *ability* and *motivation*.

Implications for clinical practice

Since cancer-related information is needed to prepare for treatment, to cope with illness, and to manage disease in daily life (De Haes & Bensing, 2009), the Internet can play an important complementary role in providing crucial cancer information to patients. The Internet is the most preferred source for additional health information besides the healthcare professional (Medlock et al., 2015). Moreover, it has been found that online information tools can improve several intermediate and long-term clinical outcomes in older patients (Bolle et al., 2015). It is thus important to combine 'online' and 'offline' sources to optimize cancer communication with older patients. Combining online with interpersonal communication is expected to result in synergistic effects, meaning that the combined effect exceeds the sum of their individual effects (Linn, 2013; Naik & Raman, 2003). To this end, patients should inform their healthcare professionals about the information they found online, and healthcare professionals should provide patients with relevant online sources to help patients find and use online sources of good quality. Such online sources can help patients to prepare for treatment, to cope with illness, and to manage disease in daily life. The effect of providing older patients with a website to prepare for consultations is currently being investigated in a follow-up project to find out if and how such online sources affect offline communication with healthcare professionals and clinical outcomes. This way, we can deepen our understanding of how online sources can benefit clinical practice with the ultimate goal to optimize "online" and "offline" communication with older cancer patients.

Moreover, we should also invest in translating our research findings into clinical practice to effectively tailor cancer communication to older patients' *ability* and *motivation* to process information. Before information can be provided to patients, healthcare providers should gather information from patients, which refers to accurate and efficient history taking as well as determining the nature of the patients' problem (De Haes & Bensing, 2009). As adequate information gathering is expected to result in accurate diagnosis and treatment and, consequently, better patient health, optimizing the gathering process could prevent undertreatment of vital older patients as well as overtreatment of frail older patients. To this end, online screening tools might help to identify patients' potential age-related problems that aim to tailor advice to the individual needs and preferences of older patients. The results presented in this dissertation may provide insights into potential age-related factors on which cancer information for older adults can be tailored. The results revealed that accurate recall of information is not a matter of chronological age per se, but rather a matter of age-related *ability* and *motivation* factors, such as frailty, anger, health literacy, future time perspective, perceived cognitive load, involvement, and satisfaction with the emotional support. With regard to treatment decisions, a call for screening on age-related factors rather than chronological age has been made before (e.g., Schuurmans, Steverink, Lindenberg, Frieswijk, & Slaets, 2004), suggesting that chronological age is no longer a valid tool to make decisions about older patients' health. With regard to communication, we can use our findings to develop screening tools aimed at systematically assessing several potential problems in older cancer patients, such as losses in different domains of functioning (e.g., assessed by frailty), lack of understanding of cancer-related materials (e.g., assessed by health literacy),

and prioritization of positive information leading to avoidance of negative information (e.g., assessed by future time perspective). This way, we gain better insights into how cancer communication can be effectively tailored to the diverse and heterogeneous group of older cancer patients.

Recommendations for future research

Future research is needed to explore how we can apply and further improve online sources to optimize health outcomes in older patients. As synergistic effects can be expected when online and interpersonal sources are combined, further research should focus on how we can apply online sources to such offline settings to test the added value of, for instance, using websites to help patients prepare for their consultation with a healthcare professional. In doing so, findings from our experimental studies might be confirmed by more externally valid designs, such as observational studies and clinical trials, and might thus be generalized to offline clinical settings as well. Presenting information in various ways especially helps older adults to better process information (Sparks & Turner, 2008), thus combining online sources (e.g., the Internet) with offline sources (e.g., interpersonal communication) could be an important step forward to improve cancer communication with older patients.

To further improve online sources, future research could also focus on other effective ways of presenting online information to older patients. The focus of this dissertation was to investigate how online information can be effectively presented to older cancer patients, but we can only draw conclusions about the ways to present online information we examined. The Internet provides the opportunity for interactivity, tailoring of information, and facilitating interpersonal interaction and social support (Cline & Haynes, 2001), suggesting other potential effective ways of presenting online cancer information. The potential of tailoring information to individuals' background, needs, and preferences has particularly gained ground in the last decades, and new ways of tailoring have been proposed (Smit, Linn, & Van Weert, 2015). One new way of tailoring is mode tailoring, which relates very well to the scope of this dissertation. Mode tailoring is adjusting (online cancer) information to individuals' preferred mode of delivery, such as text, audio and/or visual information (Smit et al., 2015). A recent study showed that mode tailoring leads to more attention to online information, which consequently results in better recall of information, especially among older adults (Nguyen, Van Weert, Bol, Loos, & Smets, 2015). As these new ways of tailoring already show promising results, we strongly encourage conducting more research in this area, to take the opportunities of how to present online cancer information forward.

Lastly, besides improving online sources, research should also focus on how we can empower older patients to be active participants in the cancer communication context, and use online sources for their health in daily life. A substantial number of older adults are still "offline," meaning that a proportion of older cancer patients cannot access crucial online cancer sources. Further interventions could therefore also target this offline population, and involve those older adults in user-centered research designs to increase universal access and usability of online sources.

Final conclusion: How can online information be optimally presented to older cancer patients?

This dissertation contributes to current knowledge on the effectiveness of using visuals in online cancer information for older patients. The lack of studies and inconsistent findings with regard to older populations called for more extensive research on how to present online cancer information to older patients in particular. By comparing the results of older adults to those of younger adults, we examined the effects of illustrations and videos on website satisfaction and recall of information. Given the findings of our studies, we can now make theory and evidence-based recommendations on how online information can be optimally presented to older cancer patients. Our results show that we can highly encourage using conversational-styled videos to enhance older adults' *ability* and *motivation* to process online information. Compared to other presentation strategies, using conversational-styled videos on a website enhanced older adults' website satisfaction as well as recall of online cancer information. If conversational-styled videos include an older narrator presenting the information, older adults are especially more satisfied with the emotional support from a website than younger adults, which could consequently lead to better recall of information as well. Nevertheless, it is important to pretest the story line and the likability of video narrators of the story's narrator, as transportation into the narrative story and perceived likability are important predictors of website satisfaction and recall of information. To summarize, when aiming to improve the *ability* and *motivation* to process online cancer information in older patients, a website should include video materials that are presented in conversational style in which an older, likable narrator is telling a compelling story.

In addition, we can recommend using illustrations in online cancer information. The findings of our studies reveal that even though cognitive and affective illustrations do not directly contribute to older adults' *ability* to process information (recall), they might be helpful by indirectly influencing older adults' *ability* to process information through enhancing *motivation* to process information (satisfaction). Illustrations might therefore function as motivational cues that increase older adults' willingness to process information, which is a fundamental first step to enable recall information. Moreover, cognitive illustrations might especially be helpful for some older adults, such as for those with lower levels of health literacy (Meppelink, Smit, Buurman, & Van Weert, 2015). As health literacy declines with age (Baker, Gazmararian, Sudano, & Patterson, 2000), it is important to consider cognitive illustrations for older adults, and further examine under what conditions cognitive illustrations might be beneficial for older patients. Similar to video materials, it is also essential to pretest illustrations among the target audience to ensure the appropriateness, clarity, and right amount of detail of illustrations. For illustrations to function as motivational cues to process information, they should match older adults' needs and preferences regarding cognitive and affective illustrations. To summarize, older adults' willingness to process online cancer information could be enhanced by using cognitive and affective illustrations that increase their *motivation* to process information.

Taken together, we conclude that effective online cancer information for older patients involves using conversational-styled videos as well as cognitive and affective illustrations to enhance their website satisfaction and recall of online

cancer information. At the same time, variety in older adults' *ability* and *motivation* to process online cancer information should be acknowledged and considered when designing online cancer information for older patients. Our final empirical chapter of this dissertation showed that a variety of age-related factors, such as frailty and health literacy, are related to recall of online cancer information rather than chronological age. It therefore seems important to identify patients' potential age-related problems to provide older patients with information that matches their *ability* and *motivation* to process online cancer information.

Concluding remarks

One of the proposed solutions for improving online cancer materials for older patients is adding visuals, such as illustrations and videos, to online materials. Until now, not much was known about how online information can be optimally presented to older cancer patients. This dissertation showed that effective online cancer information for older patients involves using conversational-styled videos in which an older, likable narrator tells a compelling story. Combining these active ingredients enhances older adults' website satisfaction and recall of information. Furthermore, cognitive and affective illustrations can be incorporated in online cancer materials, as long as they are extensively pretested among the target audience. To advance online cancer materials, age-related factors such as frailty and health literacy should be considered when adapting online cancer information to patients' *ability* and *motivation* to process online information. By using the recommendations provided in this dissertation, web designers can develop online cancer materials in such a way that older patients can effectively use and process cancer information from the Internet.

Appendices

Appendix A: Development of stimulus material (Chapter 3)

Selecting appropriate cognitive and affective illustrations required two pretests. First, eight cognitive and eight affective illustrations were pretested among colorectal cancer patients ($n = 48$, 52.1% women, mean age of 59.35 years old [$SD = 10.59$]). All illustrations were rated with three cognitive and three affective items which appeared to be two distinct dimensions in principal component analysis and formed reliable subscales (cognitive component: $\alpha = 0.96$ and affective component: $\alpha = 0.92$). Cognitive items included, for instance, "the illustration clarifies the text" and affective items included "the illustration is attractive," and were all measured on a 7-point Likert scale (1 = "totally disagree," 7 = "totally agree").

One of the TEM illustrations scored significantly higher on the cognitive dimension than other illustrations, and was therefore selected to illustrate the first part of the text on the webpage ($p < .001$). For the stoma, we found that two illustrations were rated significantly higher than the others. Of these two, based on the mean score and ranking, one illustration was evaluated better than the other one, and thus selected to illustrate the second part of the text on the webpage ($M = 5.43$, $SD = 1.27$ and in 55.3% of the cases ranked first vs. $M = 5.15$, $SD = 1.32$ and in 27.7% of the cases ranked first). One affective illustration (i.e., male doctor presenting an anatomical model of a colon) was clearly rated higher than the others, and got ranked first by most of the patients ($M = 3.78$, $SD = 1.51$ and in 43.8% of the cases ranked first). This illustration was thus selected as the upper illustration on the affective illustrations webpage.

As the first pretest did not reveal a second particularly well-evaluated affective illustration, we conducted a second pretest. The two runner-up affective illustrations (i.e., 1: female doctor visiting a male patient who is lying in bed; 2: female doctor with a stethoscope) were chosen based on their scores in first pretest ($M = 3.72$, $SD = 1.74$ and $M = 3.56$, $SD = 1.76$), and were combined with the most favorable affective illustration on two test webpages. These webpages were compared in the second pretest among a new sample of colorectal patients ($n = 16$). We found that one affective illustrations webpage performed better than the other ($M = 3.90$, $SD = 1.31$ vs. $M = 3.73$, $SD = 1.18$). Even though the cognitive illustrations webpage outperformed all other webpages in the ranking test (in 60.0% of the cases ranked first), we found that the better performing affective illustrations webpage was more often ranked first and second than the other affective illustrations webpage (in 20.0% of the cases ranked first and in 53.3% of the cases ranked second, vs. 13.3% and 26.7%). Based on this second pretest, we selected the webpage with two affective illustrations that showed a male doctor presenting an anatomical model of a colon (upper illustration) and a female doctor visiting a male patient who is lying in bed (bottom illustration). For snapshots of entire webpages including the cognitive and affective illustrations, see Figure 3.1 and 3.2 respectively (p. 41).

Appendix B: Conversational-styled version for the patient script (Chapter 5)

I suffered from lung cancer and was treated with the RFA method. [RFA is a minimally invasive method, which] This means that they approached my [the] lung tumor through a very small nick. A special needle guided by a CT scanner was [will be] inserted into my [the] cancerous lung tumor. The needle was [is] connected to an electrical generator which produces electrical currents. And the electrical currents passing through the needle created [ing] heat that destroyed [s] the cancer cells. The treatment was [is] performed percutaneous which means that the needle electrodes are inserted through the skin.

The treatment takes about one and a half hour and will be performed using spinal anesthesia or sedation. I myself received sedation, but that depended [ing] on the location of the tumor.

No surgical procedure is without risk, and also this procedure carries risks [and]. Despite all precautionary measures there is always a small risk of thrombosis, a blood clot inside a blood vessel, lung infection or wound infection.

In addition, RFA [this procedure] also carries the risk of other complications. During my surgery for instance, my lung collapsed. This is also known as a pneumothorax and occurs because of a hole that develops in the lung, which allows air to escape in the space around the lung. This is the most common complication. However, because I was sedated, I did not notice anything. A chest drain was immediately [will be] inserted into the chest cavity to remove the air. This drain helped [s] to reinflate my [the] lung and gradually expanded [s] to its original size.

Then, other complications can also occur, such as [are] (severe) bleeding, air-leak from the lung, pneumonia, and upper respiratory tract infection. Fortunately, I did not experience any of those.

By taking precautionary measures in the hospital, they [we] do everything in their [our] power to minimize risks. This means that they explain very precisely what will happen in advance. And this was very pleasant, because in this way I knew what to expect.

Note. Underlined portions were added to the conversational-styled version (or replaced the bracketed words).

Appendix C: Scoping review details (Chapter 8)

Description of scoping review

Four databases were scanned: PubMed, PsycINFO, Medline and Communication and Mass Media Complete (CMMC). This, respectively, resulted in 1822, 2087, 2017, and 484 articles (total: 6410). We scanned titles and excluded articles based on the following criteria: (1) recall was not the outcome variable; (2) could not be applied to information processing in medical context; (3) not in English or Dutch; (4) study sample was not comparable to a healthy cognitive aging population (e.g., samples with Alzheimer's disease); (5) retracted articles. This resulted in the inclusion of, respectively, 512, 98, 11, and 35 (total: $n = 756$) of which full texts were downloaded. Of those 756 articles, 145 (19.2%) were not accessible online. The remaining 611 articles were scanned on recall predicting factors until data saturation was achieved (i.e., no new recall predictors were identified). To this end, 129[3] articles were scanned.

We distinguished between six types of predictors: (1) individual characteristics; (2) message characteristics; (3) message experience characteristics, (4) biological/physiological individual characteristics; (5) characteristics of other types of sources/messengers; (6) study-specific variables. Examples are: (1) age, educational level, health literacy; (2) illustrations vs. text-only, type of information, length of information; (3) perceived text complexity, topic involvement, prior knowledge; (4) hippocampus volume, skin conductance level, thinner parietal, and frontal cortices; (5) interactivity of consultation, communication training for doctors, extrinsic motivation (money); (6) previous travel, background music, having an older child. For this study, we focused on the variables that can be measured in an online survey without having to manipulate the stimulus material we will be conveying, i.e., *individual characteristics* and *message experience characteristics*. Table C1 in Appendix C provides an overview of these characteristics and shows reasons for not including certain characteristics in our study.

Search strategy

((“Memory”[Mesh:NoExp] OR “Memory, Episodic”[Mesh] OR “Memory, Long-Term”[Mesh] OR “Memory, Short-Term”[Mesh] OR “Mental Recall”[Mesh] OR “Repetition Priming”[Mesh] OR “Retention (Psychology)”[Mesh] OR “Spatial Memory”[Mesh]) AND (wechsler memory scale*[tiab] OR wechsler scale*[tiab] OR patient information recall questionn*[tiab])) OR (“recall of information”[tiab] OR recalled information[tiab] OR recalled medical information[tiab] OR “recalled medication information” OR information recall[tiab] OR “recall of medical information”[tiab] OR “recall of surgical information” OR “recall of medical advice” OR instruction recall[tiab] OR remember information[tiab] OR remembered information[tiab] OR remember health information[tiab] OR remembered health information[tiab] OR remember medical information[tiab] OR “recall of medication information”)

[3] Pubmed: 58/429 (13.5%); PsycINFO: 22/64 (34.4%); Medline: 23/92 (25%); CMMC: 26/26 (100%)

Table C1
Overview of individual and message experience characteristics that resulted from the scoping review

Variable	Included/excluded	Reason excluded
Individual characteristics		
Age	Included	
Frailty	Included	
Emotional goals[a]	Included	
Educational level	Included	
IQ	Excluded	1, 2
Gender	Included	
Ethnicity	Excluded	3
Working memory capacity	Included	
Processing speed	Excluded	1
Health literacy	Included	
Internet use/experience	Included	
Need for cognition	Included	
Emotional states[b]	Included	
Message experience characteristics		
Prior topic knowledge	Included	
Understanding[c]	Included	
Previous experience with topic	Excluded	3
Involvement with topic	Included	
Systematic message processing	Excluded	3
Reading information (exposure)	Excluded	3
Personal relevance	Excluded	3
Satisfaction with emotional support from the website	Included	
Perceived complexity[c]	Included	
Undivided attention to the message	Excluded	1

Note. Reasons not to include characteristics include: (1) could not be validly assessed through an online questionnaire; (2) too time consuming; (3) not relevant for the setting in this study.
[a]Included as future time perspective, as theory argues that perceive time left in life determines whether emotional goals are pursuit. [b]We included stress, anxiety/fear, depression and anger as emotional states, as these were found as four important predictor domains (Mitchell, Baker-Glenn, Granger, & Symonds, 2009). [c]Resource allocation included items about understanding and perceived complexity.

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Dutch summary (Nederlandse samenvatting)

Goede informatievoorziening is essentieel voor effectieve en efficiënte zorgverlening aan patiënten met kanker. Goed geïnformeerde patiënten kunnen zich beter voorbereiden op behandelingen en zijn beter in staat om te gaan met de ziekte in het dagelijks leven. Maar liefst 60% van de patiënten met kanker is 65 jaar of ouder en dit percentage zal door de vergrijzing de komende jaren fors toenemen. Informatievoorziening aan ouderen wordt echter bemoeilijkt door leeftijdsgerelateerde cognitieve, motorische en visuele problemen, waardoor goede informatievoorziening aan ouderen extra complex is. Het internet kan een belangrijke rol spelen in het verbeteren van de informatievoorziening aan ouderen. Steeds meer ouderen gebruiken het internet voor gezondheidsinformatie, bijvoorbeeld als aanvullende bron naast de informatie die ze via hun zorgverlener ontvangen. Daarnaast wordt veel gezondheidsinformatie primair of zelfs exclusief online aangeboden, waardoor ouderen gedwongen worden het internet te gebruiken voor informatie die belangrijk voor hen is. Onderzoek wijst echter uit dat veel ouderen niet goed om kunnen gaan met online computertechnologieën. Dit kan komen door een gebrek aan ervaring met het internet dat veel ouderen hebben, maar ook doordat veel webdesigners geen rekening houden met ouderen als doelgroep wanneer zij online informatie ontwikkelen. Het gebrek aan ervaring en het niet rekening houden met ouderen als online doelgroep leidt ertoe dat veel ouderen zich minder *bekwaam* en *gemotiveerd* voelen om het internet te gebruiken voor het verkrijgen van gezondheidsinformatie; met andere woorden, het internet niet *kunnen* en *willen* gebruiken.

Gezien het belang van goede informatievoorziening, het stijgend aantal ouderen met kanker en het potentieel van online informatie aan deze groep patiënten, is onderzoek nodig naar hoe online informatie het best gepresenteerd kan worden zodat ouderen deze informatie *kunnen* en *willen* gebruiken. Een manier om online informatie te verbeteren voor ouderen is de toevoeging van illustraties en video's. Het in dit proefschrift beschreven onderzoek richt zich daarom op hoe illustraties en video's ervoor kunnen zorgen dat ouderen meer tevreden zijn met online informatie over kanker ('website satisfaction') en deze informatie beter begrijpen, onthouden en kunnen reproduceren ('recall'). Daarnaast wordt ook onderzocht welke invloed leeftijd – zowel kalenderleeftijd als leeftijdsgerelateerde factoren – heeft. De vraag die centraal staat in dit proefschrift is: "Wat is de beste manier om online informatie te presenteren aan ouderen met kanker?". Daartoe werd uitgegaan van drie hoofdvragen:

(1) Hoe kunnen illustraties gebruikt worden om de tevredenheid met en het onthouden van online informatie over kanker bij ouderen te verhogen?
(2) Hoe kunnen video's gebruikt worden om de tevredenheid met en het onthouden van online informatie over kanker bij ouderen te verhogen?
(3) Welke invloed heeft leeftijd op de tevredenheid met en het onthouden van online informatie over kanker bij ouderen?

Hoe kunnen illustraties gebruikt worden om de tevredenheid met en het onthouden van online informatie over kanker bij ouderen te verhogen?

Hoewel eerder onderzoek reeds ondersteuning gaf voor de effectiviteit van illustraties, zijn de bevindingen onder ouderen niet consistent. Daarnaast richt weinig onderzoek zich op welke verschillende soorten illustraties mogelijk effectief zijn, zoals bijvoorbeeld het onderscheid tussen cognitieve en affectieve illustraties. Cognitieve illustraties helpen informatie beter te begrijpen en onthouden door (delen van) tekstuele informatie uit te leggen, terwijl affectieve illustraties niet relevant zijn voor beter begrip, maar tot doel hebben een goed gevoel over de informatie te geven. Dit proefschrift bevat drie artikelen waarin onderzoek wordt beschreven naar de vraag *of* en *hoe* cognitieve en affectieve illustraties bijdragen aan de tevredenheid met en het onthouden van informatie over kanker bij ouderen. Hierbij wordt onderscheid gemaakt tussen tevredenheid met de aantrekkelijkheid, begrijpelijkheid en emotionele steun van de website.

In **Hoofdstuk 2** wordt de eerste hoofdvraag onderzocht. Bij 271 jongeren ($<$ 65 jaar) en 165 ouderen ($\geq$ 65 jaar) werd een online vragenlijst afgenomen met daarin een webpagina waarop een behandeling voor longkanker werd uitgelegd. De deelnemers kregen ofwel een webpagina te zien met daarop alleen tekst, tekst en cognitieve illustraties, tekst en affectieve illustraties, of tekst en zowel cognitieve als affectieve illustraties. Zowel cognitieve als affectieve illustraties dragen bij aan de tevredenheid met de aantrekkelijkheid van de webpagina, maar zorgden er niet voor dat informatie beter werd onthouden. Daarnaast zijn jongeren in het algemeen meer tevreden met de begrijpelijkheid van de webpagina dan ouderen, terwijl ouderen juist meer tevreden zijn met de emotionele steun van de webpagina dan jongeren. Een hogere tevredenheid met de emotionele steun van de webpagina zorgt er onder ouderen ook voor dat informatie beter onthouden wordt, terwijl dit bij jongeren niet het geval is. *Deze resultaten laten zien dat zowel cognitieve als affectieve illustraties gebruikt kunnen worden om de tevredenheid met een website te verhogen. De belangrijkste conclusie is dat naarmate ouderen meer tevreden zijn met de emotionele steun van de webpagina, zij ook meer onthouden van de online informatie*.

In **Hoofdstuk 3** wordt het onderzoek beschreven in Hoofdstuk 2 herhaald, alleen dit keer onder patiënten. In een online experiment wordt onder 62 jongere ($<$ 65 jaar) en 112 oudere ($\geq$ 65 jaar) patiënten met darmkanker wederom het effect van illustraties op de tevredenheid met en het onthouden van online informatie onderzocht. De patiënten ontvingen een webpagina over een behandeling voor darmkanker, waarop zij ofwel alleen tekst, tekst met cognitieve illustraties, of tekst met affectieve illustraties te zien kregen. Met de toevoeging van cognitieve illustraties blijken zowel jongere als oudere patiënten meer tevreden te zijn met de aantrekkelijkheid van de webpagina. Tevens faciliteren deze illustraties het onthouden van informatie bij ouderen: ouderen onthouden over het algemeen minder informatie dan jongeren (39% vs. 50%), maar wanneer cognitieve illustraties worden toegevoegd aan de online informatie zijn er geen leeftijdsverschillen meer in de hoeveelheid informatie die onthouden wordt. Daarnaast zijn ouderen meer tevreden met de emotionele steun van de webpagina dan jongeren, vooral als deze affectieve illustraties bevat. *Deze resultaten laten zien dat effectieve online informatie over kanker voor ouderen bij*

voorkeur zowel cognitieve als affectieve illustraties bevat om de tevredenheid met en het onthouden van online informatie te verbeteren.

Hoofdstuk 4 heeft als doel te verklaren hoe tekst en illustraties op een website precies gebruikt worden door jongeren en ouderen. Hoewel veel studies de effecten van het gebruik van illustraties in online gezondheidsboodschappen (bijvoorbeeld op hoe informatie onthouden wordt) onderzoeken, richt weinig onderzoek zich op het mechanisme dat aan deze uitkomsten ten grondslag ligt. Illustraties zullen geen effect hebben op uitkomsten zoals het onthouden van informatie als deze niet worden opgemerkt. Het is daarom belangrijk dat de mate van aandacht ook onderzocht wordt wanneer gekeken wordt naar het effect van illustraties op het onthouden van informatie. Daarnaast is ook weinig bekend over de rol die leeftijd speelt in het verband tussen aandacht en het onthouden van informatie. Middels een eye-tracking onderzoek onder 55 jongeren ($<$ 65 jaar) en 42 ouderen ($\geq$ 65 jaar) wordt de relatie tussen aandacht en het onthouden van informatie onderzocht. Eye-tracking is een onderzoeksmethode waarbij met een speciale computer nauwkeurig gezien kan worden hoe iemand naar een website kijkt. Deelnemers werden blootgesteld aan een webpagina met daarop alleen tekst, tekst met cognitieve illustraties of tekst met affectieve illustraties. Meer aandacht voor tekstuele informatie zorgt er bij ouderen voor dat informatie beter wordt onthouden, terwijl dit bij jongeren niet het geval is. Voor jongeren blijkt juist dat zij meer aandacht aan de cognitieve illustraties besteden dan ouderen en ook meer van de informatie met cognitieve illustraties onthouden. *We kunnen daarmee concluderen dat online informatie over kanker aantrekkelijk aangeboden informatie zou moeten bevatten die ervoor zorgt dat ouderen de tijd nemen om websiteteksten te lezen*.

Hoe kunnen video's gebruikt worden om de tevredenheid met en het onthouden van online informatie over kanker bij ouderen te verhogen?

Naast illustraties worden video's ook gezien als effectieve visuele communicatietools. Video's zouden vooral effectief kunnen zijn voor ouderen, omdat ze een beroep doen op zowel het visuele als auditieve werkgeheugen. Hierdoor wordt het werkgeheugen optimaal benut. Hoewel video's daarom effectief lijken voor ouderen, is nog niet onderzocht *of* en *hoe* video's van invloed zijn op de tevredenheid met en het onthouden van online informatie over kanker. Daarom wordt dit nader bestudeerd in drie empirische hoofdstukken.

Het onderzoek in **Hoofdstuk 5** heeft tot doel de effectiviteit van video's in online informatie over kanker te onderzoeken. Daartoe werden in een online experiment onder 236 jongeren en 204 ouderen de modaliteit en stijl waarop de informatie werd aangeboden gevarieerd. De modaliteit varieerde tussen video en tekst en de stijl kon formeel (in derde persoon gepresenteerd door een arts) of informeel (in eerste persoon gepresenteerd door een patiënt) zijn. Deelnemers kregen één van de vier mogelijke webpagina's te zien waarop informatie over een longbehandeling gepresenteerd werd: tekst in formele informatiestijl, tekst in informele informatiestijl, video in formele informatiestijl of video in informele informatiestijl. Dit experiment laat zien dat wanneer informatie gegeven wordt door middel van een video deze beter onthouden wordt door zowel jongeren als ouderen dan wanneer de informatie gegeven wordt door

middel van een tekst. Daarnaast blijkt dat de combinatie van video presentatie en informele informatiestijl ervoor zorgt dat het meeste onthouden wordt vergeleken met alle andere combinaties van modaliteit en stijl. *Dit onderzoek laat zien dat de combinatie van het gebruik van video en een informele manier van presenteren ertoe leidt dat zowel jongeren als ouderen meer online informatie over kanker onthouden*.

In **Hoofdstuk 6** wordt de studie uit Hoofdstuk 5 herhaald, wederom om te onderzoeken of de bevindingen van dit eerdere hoofdstuk ook gelden voor patiënten. Hoofdstuk 6 rapporteert over de effecten van video's op de tevredenheid met en het onthouden van online informatie bij ouderen met longkanker. In totaal werden 95 jongere en 74 oudere patiënten gevraagd een webpagina met alleen tekst, tekst met video in formele informatiestijl of tekst met video in informele informatiestijl te bekijken. Uit de resultaten blijkt dat patiënten meer tevreden waren met de aantrekkelijkheid, begrijpelijkheid en emotionele steun van de webpagina wanneer informatie gepresenteerd wordt door middel van een video in informele informatiestijl in vergelijking met alleen tekst. Daarnaast is de tevredenheid met de emotionele steun ook hoger in vergelijking met de video in formele informatiestijl. Voor het onthouden van informatie maakt het niet uit welk type video wordt getoond: beide video's zorgen voor het beter onthouden van informatie in vergelijking met alleen tekst. Oudere patiënten onthouden minder informatie van zowel de tekst als de video dan jongere patiënten, maar wanneer rekening wordt gehouden met hoe vaak jongeren en ouderen het internet gebruiken verdwijnt dit leeftijdsverschil. Dit betekent dat ouderen, die over het algemeen minder vaak het internet gebruiken dan jongeren, net zoveel onthouden als jongeren wanneer zij even vaak gebruik maken van het internet als jongeren. *Deze bevindingen laten zien dat het gebruik van een video in informele informatiestijl op een webpagina het meest effectief is in het verhogen van de tevredenheid met en het onthouden van online informatie over kanker. Daarnaast blijkt internetgebruik een betere verklaring voor de mate waarin ouderen informatie van een webpagina onthouden dan hun kalenderleeftijd*.

Om inzicht te krijgen in waarom informele video's effectief zijn, wordt in **Hoofdstuk 7** de rol van narratieve betrokkenheid onderzocht. Eerder onderzoek liet zien dat narratieve betrokkenheid een belangrijke voorwaarde is voor de effectiviteit van narratieve boodschappen. Een narratieve boodschap wordt ook wel een verhalende boodschap genoemd waarin in een samenhangend verhaal – met een duidelijk begin, midden en einde – personages en hun levensverhaal worden besproken. Narratieve betrokkenheid is zowel de betrokkenheid bij het verhaal (de mate waarin je opgaat in het verhaal) als betrokkenheid bij het videopersonage (de mate waarin je het personage leuk vindt, als gelijke ziet en je ermee kan identificeren). Gebruikmakend van de onderzoeksgegevens uit het online experiment zoals beschreven in Hoofdstuk 5, wordt onderzocht of narratieve betrokkenheid een verklaring kan bieden voor de bevinding dat informatiestijl (formele vs. informele informatiestijl) van invloed is op de tevredenheid met en het onthouden van online informatie over kanker. Daarbij wordt ook rekening gehouden met gelijkheid van leeftijd tussen de leeftijd van de deelnemer en de leeftijd van het videopersonage die de deelnemer te zien kreeg ('leeftijdscongruentie'). De bevindingen van deze studie uit Hoofdstuk 7 laten wederom zien dat de stijl waarop de video-informatie aangeboden wordt van invloed is op het onthouden van informatie; video's in informele informatiestijl worden beter

onthouden door zowel jongeren als ouderen dan video's in formele informatiestijl. Daarnaast blijkt leeftijdscongruentie een interessante rol te spelen voor ouderen. Wanneer oudere participanten een ouder videopersonage zien, zijn zij meer tevreden met de emotionele steun van de website dan wanneer zij een jonger videopersonage zien. Leeftijdscongruentie blijkt dus belangrijker voor ouderen dan voor jongeren. *Aan de hand van deze resultaten kunnen we concluderen dat narratieve betrokkenheid kan bepalen in hoeverre mensen tevreden zijn met online informatie en in hoeverre zij deze informatie onthouden. Bovendien zijn ouderen meer tevreden met de emotionele steun van een webpagina wanneer video's op een webpagina personages bevatten die dezelfde leeftijd hebben*.

Welke invloed heeft leeftijd op de tevredenheid met en het onthouden van online informatie over kanker bij ouderen?

Voorgaande hoofdstukken bieden veel inzicht in de effectiviteit van het gebruik van illustraties en video's in online gepresenteerde informatie over kanker. Er bleken echter maar weinig verschillen te zijn tussen jongeren en ouderen met betrekking tot de tevredenheid met en het onthouden van online informatie over kanker. Daaruit blijkt dat leeftijd maar een bescheiden rol speelt. De verklaring hiervoor ligt waarschijnlijk in het feit dat een groot aantal leeftijdsgerelateerde factoren, zoals de het *kunnen* ('bekwaamheid') en *willen* ('motivatie') verwerken van informatie, een belangrijkere rol spelen dan kalenderleeftijd.

In **Hoofdstuk 8** wordt daarom gekeken naar de invloed van kalenderleeftijd en leeftijdsgerelateerde factoren op het onthouden van informatie. Het is bekend dat ouderen vaak weinig informatie onthouden, maar we weten minder in hoeverre dit gerelateerd is aan het *kunnen* en *willen* onthouden van online informatie over kanker. Bij 197 patiënten van 65 jaar en ouder werd een online vragenlijst afgenomen waarin zij een webpagina met informatie over een behandeling voor longkanker te zien kregen. Daarna werden vragen over de inhoud van deze webpagina gesteld. De resultaten tonen aan dat het onthouden van informatie niet zozeer beïnvloed wordt door kalenderleeftijd, maar door het *kunnen* en *willen* onthouden van online informatie over kanker. Het *kunnen* onthouden van informatie wordt bepaald door de kwetsbaarheid, boosheid en gezondheidsvaardigheden ('health literacy') van de patiënt en de cognitieve inspanning die het de patiënt kost om de informatie te verwerken, en het *willen* onthouden van informatie wordt bepaald door het toekomstperspectief van de patiënt, de betrokkenheid bij de informatie en de tevredenheid met de emotionele steun van de website. Deze factoren beïnvloeden het onthouden van online informatie over kanker. Zo blijkt dat wanneer een patiënt erg kwetsbaar en boos is, deze minder informatie onthoudt. Ook wanneer informatieverwerking veel cognitieve inspanning kost wordt er minder onthouden. Patiënten die veel gezondheidsvaardigheden hebben en weinig toekomstperspectief ervaren onthouden juist veel informatie. Ook patiënten die betrokken zijn bij het evalueren van online informatie en tevreden zijn met de emotionele steun van die informatie onthouden over het algemeen veel informatie. *Dit onderzoek laat zien dat het onthouden van online informatie over kanker niet zozeer afhankelijk is van kalenderleeftijd, maar beïnvloed wordt door andere leeftijdsgerelateerde factoren*. Dit geeft interessante inzichten om informatie

voor ouderen op maat aan te kunnen bieden door rekening te houden met de mate waarin zij informatie *kunnen* en *willen* verwerken.

Algemene conclusie: Hoe kan online informatie het best gepresenteerd worden aan ouderen met kanker?

Dit proefschrift draagt bij aan kennisvergroting over de effectiviteit van het gebruik van illustraties en video's in online informatie voor ouderen met kanker. Schaars eerder onderzoek toonde geen eenduidige bevindingen in studies onder ouderen. Daarom wordt in dit proefschrift onderzocht op welke de manier online informatie over kanker specifiek aan ouderen met kanker aangeboden kan worden. Daartoe werd onder zowel jongeren als ouderen bestudeerd hoe illustraties en video's gebruikt kunnen worden om de tevredenheid met en het onthouden van online informatie over kanker te verbeteren. Gegeven de resultaten van dit onderzoek, kan geconcludeerd worden dat video's gepresenteerd in een informele informatiestijl aanbevolen kunnen worden om informatie aan ouderen te presenteren. Vergeleken met andere manieren van informatiepresentatie, leiden deze video's tot hogere tevredenheid met en het beter onthouden van online informatie. Het zorgvuldig uitzoeken van een goed videopersonage lijkt ook van groot belang. Met name het selecteren van een aardig en ouder personage leidt bij ouderen tot verhoogde tevredenheid met en het beter onthouden van informatie. Daarnaast is een goed script ook belangrijk, omdat dit zorgt voor een hoge betrokkenheid bij het verhaal, wat vervolgens weer leidt tot hogere tevredenheid met en het beter onthouden van informatie. Samenvattend kunnen we zeggen dat een video waarin een goed script gepresenteerd wordt door een ouder, aardig personage die informatie in een informele presentatiestijl overbrengt alle ingrediënten bevat voor een effectieve informatieboodschap over kanker. Dit type video zal bij ouderen bijdragen aan het *kunnen* en *willen* gebruiken van online informatie over kanker.

Tevens kan ook het gebruik van illustraties aanbevolen worden om de tevredenheid met en het onthouden van online informatie over kanker te verbeteren. Hoewel cognitieve en affectieve illustraties meestal niet direct bijdragen aan het beter onthouden van informatie, zijn deze wel belangrijk om de tevredenheid met de informatie te verhogen, waardoor ouderen meer gemotiveerd raken om online informatie over kanker te gebruiken en te onthouden. Daarnaast zijn cognitieve illustraties belangrijk voor ouderen die weinig gezondheidsvaardigheden ('health literacy') hebben en kunnen deze illustraties daarom wel belangrijk zijn voor een deel van de oudere patiënten. Net zoals bij video's is het van groot belang dat illustraties van tevoren getest worden onder de doelgroep om te bepalen of cognitieve en affectieve illustraties passend, duidelijk en genoeg gedetailleerd zijn. Illustraties werken alleen als deze aansluiten op de behoeften en voorkeuren van ouderen met betrekking tot cognitieve en affectieve illustraties. Op deze manier kunnen illustraties eraan bijdragen dat ouderen online informatie over kanker *willen* verwerken, wat vervolgens kan bijdragen aan het beter *kunnen* verwerken van informatie.

Samenvattend kan worden geconcludeerd dat effectieve online informatie over kanker voor ouderen video's bevat die in een informele informatiestijl gepresenteerd zijn. Daarnaast kunnen cognitieve en affectieve illustraties ook aangeraden worden.

Omdat met name ouderen erg verschillen in hoe zij informatie *kunnen* en *willen* verwerken, moet ook gekeken worden naar individuele behoefte en voorkeur voor informatiepresentatie. De laatste studie uit dit proefschrift toont aan dat verscheidene leeftijdsgerelateerde factoren zoals de kwetsbaarheid en toekomstperspectief van de patiënt een belangrijke rol spelen in hoe online informatie over kanker onthouden wordt. Het lijkt daarom relevant om deze leeftijdsgerelateerde problemen van ouderen te identificeren, zodat ouderen informatie ontvangen die het best aansluit bij hun niveau van *kunnen* en *willen* gebruiken en verwerken van online informatie over kanker.

Kortom: de resultaten van dit proefschrift laten zien dat voor de verbetering van online informatie over kanker voor ouderen gebruik kan worden gemaakt van zowel video's die gepresenteerd zijn in een informele presentatiestijl als illustraties, mits van tevoren goed getest onder de doelgroep. Omdat de mate van informatie onthouden niet zozeer bepaald wordt door kalenderleeftijd, maar juist door het *kunnen* (bepaald door bijvoorbeeld de kwetsbaarheid van de patiënt) en *willen* (bepaald door bijvoorbeeld het toekomstperspectief van de patiënt) onthouden van informatie, is het belangrijk dat online informatie over kanker aangepast wordt voor de oudere doelgroep en zorgvuldig getest wordt onder de doelgroep. Wanneer de aanbevelingen in dit proefschrift in acht genomen worden, kunnen webdesigners online informatie over kanker op zodanige manier presenteren dat ouderen optimaal gebruik *kunnen* en *willen* maken van informatie die zij op het internet vinden.

Author contributions

CHAPTER 2

Using cognitive and affective illustrations to enhance older adults' website satisfaction and recall of online cancer-related information

Bol, N., Van Weert, J. C. M., De Haes, J. C. J. M., Loos, E. F., De Heer, S., Sikkel, D., & Smets, E. M. A.

Study concept and design: NB, JvW, JdH, EL, SdH, and ES. Acquisition of data: NB, SdH, and DS. Data analysis and interpretation: NB. Manuscript preparation: NB. Critical review: JvW, JdH, EL, SdH, DS, and ES.

CHAPTER 3

Illustrations enhance older colorectal cancer patients' website satisfaction and recall of online cancer information

Bol, N., Smets, E. M. A., Eddes, E. H., De Haes, J. C. J. M., Loos, E. F., & Van Weert, J. C. M.

Study concept and design: NB, ES, JdH, EL, and JvW. Acquisition of data: NB and EE. Data analysis and interpretation: NB. Manuscript preparation: NB. Critical review: ES, EE, JdH, EL, and JvW.

CHAPTER 4

How are online health messages processed? Using eye tracking to predict recall of information in younger and older adults

Bol, N., Van Weert, J. C. M., Loos, E. F., Romano Bergstrom, J. C., Bolle, S., & Smets, E. M. A.

Study concept and design: NB, JvW, EL, JRB, ES. Acquisition of data: NB and SB. Data analysis and interpretation: NB and JRB. Manuscript preparation: NB. Critical review: JvW, EL, JRB, SB, and ES.

CHAPTER 5

The effect of modality and narration style on recall of online health information: Results from a web-based experiment

Bol, N., Van Weert, J. C. M., De Haes, J. C. J. M., Loos, E. F., & Smets, E. M. A.

Study concept and design: NB, JvW, JdH, EL, and ES. Acquisition of data: NB. Data analysis and interpretation: NB. Manuscript preparation: NB. Critical review: JvW, JdH, EL, and ES.

CHAPTER 6

Do videos improve website satisfaction and recall of online cancer-related information in older lung cancer patients?

Bol, N., Smets, E. M. A., Rutgers, M. M., Burgers, J. A., De Haes, J. C. J. M., Loos, E. F., & Van Weert, J. C. M.

Study concept and design: NB, ES, JdH, EL, and JvW. Acquisition of data: NB, MR, and JB. Data analysis and interpretation: NB. Manuscript preparation: NB. Critical review: ES, MR, JB, JdH, EL, and JvW.

CHAPTER 7

The effect of narration style and age congruency in narrative communication on website satisfaction and recall of online health information

Bol, N., Van Weert, J. C. M., De Haes, J. C. J. M., Loos, E. F., & Smets, E. M. A.

Study concept and design: NB, JvW, JdH, EL, and ES. Acquisition of data: NB. Data analysis and interpretation: NB. Manuscript preparation: NB. Critical review: JvW, JdH, EL, and ES.

CHAPTER 8

Older cancer patients' recall of online cancer information: Do ability and motivation matter more than chronological age?

Bol, N., Smets, E. M. A., Burgers, J. A., Samii, S. M., De Haes, J. C. J. M., Loos, E. F., Jansen, J., & Van Weert, J. C. M.

Study concept and design: NB, ES, and JvW. Acquisition of data: NB, JB, and SS. Data analysis and interpretation: NB. Manuscript preparation: NB. Critical review: ES, JB, SS, JdH, EL, JJ, JvW.

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Curriculum Vitae

Nadine Bol was born on the 9th of January 1988 in Alkemade, the Netherlands. In 2006, she started the bachelor's degree Communication Science at the University of Amsterdam and focused on health communication. In 2011, Nadine completed the Research Master Communication Science 'cum laude' (with distinction) at the same university. Her master thesis about online and offline social support sources for cancer patients received the Unilever Research Prize and was nominated for the UvA thesis award. After graduation, she continued specializing in health communication with her PhD project on effective ways of presenting online information to older patients. During her PhD, she applied for two travel grants to visit universities abroad and wrote a postdoctoral research proposal to study effective online and offline personalized communication for older cancer patients and their healthcare providers. All three grants were awarded. Furthermore, she received three best paper awards at national and international conferences. After finishing her dissertation, Nadine will remain working at the Amsterdam School of Communication Research / ASCoR, University of Amsterdam as a postdoctoral researcher. In her future research, she aims to further explore when and how online technologies are effective by examining novel ways of personalizing information to improve and optimize health outcomes for a wide variety of individuals.

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Providing information to cancer patients is crucial within cancer care. As the Internet is becoming an increasingly valuable source of cancer information, it is important to consider the rapidly aging population when designing online cancer materials. Yet, the lack of studies and inconsistent findings with regard to how online information can be optimally presented to older populations call for theory-based research. This dissertation provides insight into (1) the effects of illustrations and videos on older adults' website satisfaction and recall of online cancer information, (2) the underlying processes explaining those relationships, and (3) the role of age and age-related factors in this regard. The studies discussed in this dissertation deepen our understanding of how to present online cancer materials in such a way that older patients can effectively process cancer information from the Internet.