How to present online information to older cancer patients

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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.

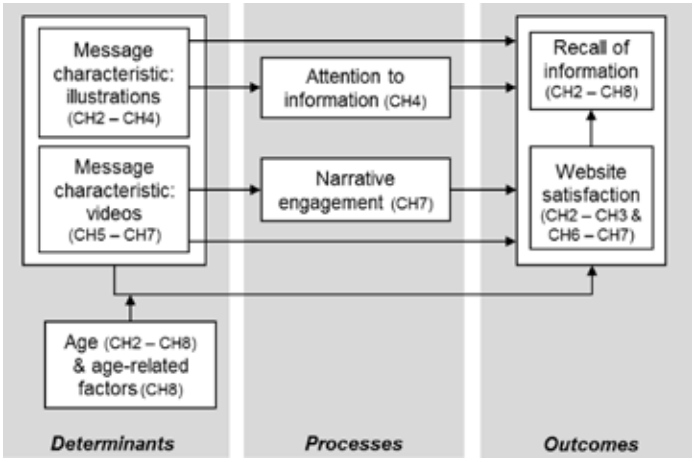

Figure 1.1. Visualization of the dissertation outline.

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.