How to present online information to older cancer patients

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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 (≥ 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 (≥ 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.