How to present online information to older cancer patients

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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.

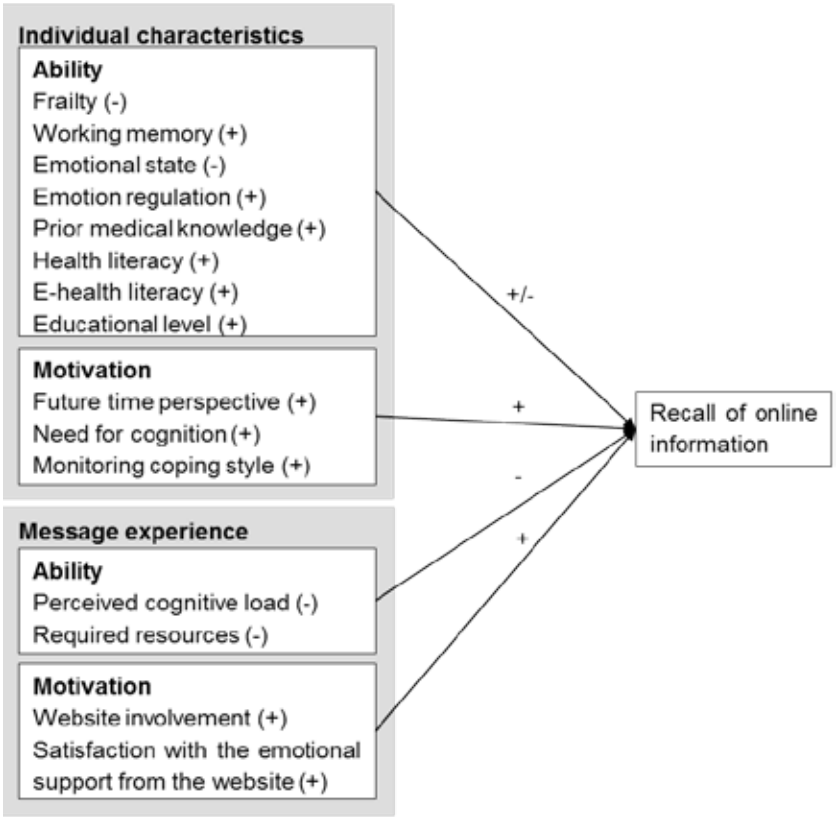

Figure 8.1. Conceptual model of ability and motivation factors to recall online cancer information categorized as individual and message experience characteristics.

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).

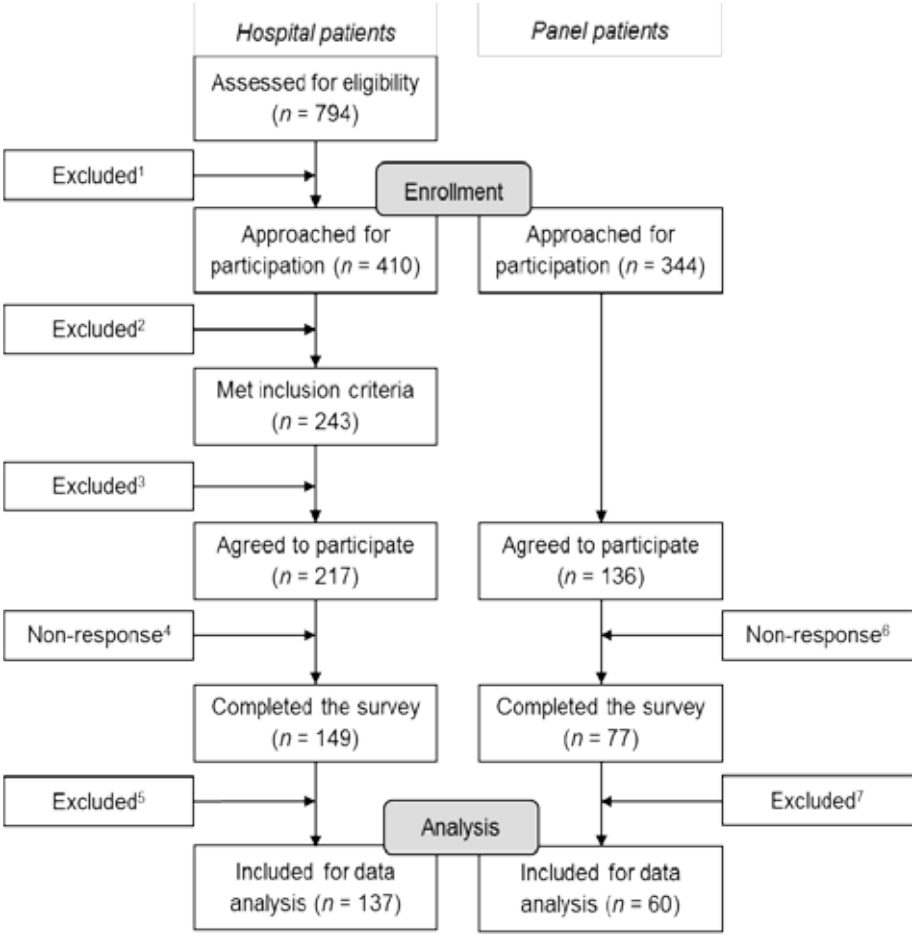

Figure 8.3. Flowchart of participant recruitment

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.