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Published in:

Journal of Health Communication

DOI:

[10.1080/10810730.2017.1394400](https://doi.org/10.1080/10810730.2017.1394400)

[Link to publication](#)

Citation for published version (APA):

Bol, N., Smets, E. M. A., Burgers, J. A., Samii, S. M., de Haes, H. C. J. M., & van Weert, J. C. M. (2018). Older patients' recall of online cancer information: Do ability and motivation matter more than chronological age? *Journal of Health Communication*, 23(1), 9-19. DOI: 10.1080/10810730.2017.1394400

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Older Patients' Recall of Online Cancer Information: Do Ability and Motivation Matter More than Chronological Age?

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This study proposes and tests a model to provide a more comprehensive understanding of the contribution of chronological age versus age-related ability and motivation factors in explaining recall of online cancer information among older patients ($n = 197$). Results revealed that recall is not a matter of chronological age per se, but rather a matter of ability and motivation. Age-related ability and motivation factors explained 37.9% of the variance in recall. Health literacy, involvement with the webpage, and satisfaction with the emotional support were positively associated with recall. Furthermore, recall was negatively related to frailty, anger, future time perspective, and perceived cognitive load. The findings pose relevant opportunities for tailoring interventions to improve online information provision for older cancer patients.

Keywords: ability, motivation, age-related factors, online cancer information, recall

Providing information to patients suffering from a severe disease such as cancer is crucial for optimal care. Patients need information to prepare for their treatment, to cope with their illness, and to manage their disease in daily life (De Haes & Bensing, 2009). Recall of information, the ability to reproduce and remember information, is a prerequisite to follow up on medical 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 for older patients, because they often deal with multiple diseases at the same time, such as cancer, diabetes, and, heart

problems (World Health Organization, 2014), and thus need to memorize more complex medical information about treatment and disease. However, older age is often associated with poorer recall performance (Jansen et al., 2008), also when it concerns recall of online information (Bol et al., 2015).

Patients increasingly turn to the Internet to find disease-relevant information (Fiksdal et al., 2014). However, using online technologies for medical information might not be clearly understood by all individuals, such as older adults. Research has shown that older people often see themselves as less able and are often less motivated to utilize the Internet for medical information (Bodie & Dutta, 2008). This may hamper accurate uptake and recall of information. At the same time, older individuals differ in how much they recall from, for example, online medical sources. This might be explained by the fact that individual differences increase when people get older (Dannefer, 1988). It has therefore been suggested that “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 understand systematic differences in older adults recall performances. In recognizing the heterogeneity of the older aged, this paper aims to explore to what extent chronological age versus age-related factors predict recall of online information in older adults. To this end, we will (1) present an overview of factors that, according to previous studies, may be predictive of (online) information recall in older adults, and (2) empirically test which of these factors relate to recall of online information among an

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older cancer patient population. Understanding these relationships can inform interventions to tailor online information to older patients.

Recall of Online Cancer Information in Older Patients

According to the elaboration likelihood model (ELM: Petty & Cacioppo, 1986) and the limited capacity model of motivated mediated messages (LC4MP: A. Lang, 2000), information processing is influenced by two overarching 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). Since the current literature lacks a unifying framework aiming at understanding older adults' *ability* and *motivation* to recall information in a cancer communication context, we used the ELM and LC4MP as a guiding framework to identify age-related factors that are expected to predict recall of information. In doing so, we conducted a scoping review to identify *ability*-related and *motivation*-related factors relevant for older patients' recall of online cancer information (scoping review details are available upon request). We distinguished between personal characteristics and message experience characteristics relevant for patients' *ability* and *motivation* to recall information.

Personal Characteristics

Ability

Our review revealed numerous personal characteristics in *ability* that explain one's ability to recall information. Given the heterogeneous nature of the older aged, it is expected that older individuals highly differ on personal characteristics relevant for *ability*, which consequently explains the variance in recall of online cancer information. We expect that some characteristics negatively influence recall of information due to age-related decline, while others positively influence recall due to age-related compensatory mechanisms.

Negative age-related factors as identified by our scoping review are *educational level*, *health literacy*, *e-health literacy*, *working memory*, *frailty*, and *emotional state*. Earlier research has suggested that older adults often have completed lower levels of *education* (Bostock & Steptoe, 2012), which has been found to influence recall of information (Wagner, Wuensch, Friess, & Berberat, 2014). Furthermore, *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 low *e-health literacy* skills, 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, 2006a, e9)," might also explain why older patients poorly recall information from online sources.

In addition, the negative association between age and recall has also been explained by cognitive and emotional factors, such as working memory, frailty, and emotional state. Age-related

decline in *working-memory* capacity has been widely associated with poor recall of information (Brown & Park, 2003). Moreover, older persons often experience simultaneous loss of resources in several domains of functioning, which is referred to as *frailty*. As frailty is associated with cognitive decline (Buchman, Boyle, Wilson, Tang, & Bennett, 2007), it is expected to also negatively influence one's ability to recall information. Being diagnosed with cancer may elicit *emotional states*, such as feelings of anxiety, stress, depression, and anger, which might 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 treatment information (Christianson & Loftus, 1991; Kessels, 2003).

On the other hand, some age-related factors positively influence recall of information. These are *emotion regulation* and *prior knowledge*. Older people are generally better able to *regulate their emotions* (Carstensen, Fung, & Charles, 2003), which has been found to 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 information processing (Brown & Park, 2003).

Motivation

Secondly, *motivation* influences older patients' recall of information in three ways. First, socioemotional selectivity theory suggests that older people generally *perceive less time left in life*, causing older adults to shift from having knowledge-related goals, i.e., acquisitive behavior geared toward learning, to having more emotional-related goals, i.e., behavior related to emotion regulation (Carstensen, Isaacowitz, & Charles, 1999). This implies that they might be less willing to process information, and thus recall information. Second, some older people are more motivated to process 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). Third, a *monitoring coping style*, i.e., the extent to which individuals are approaching potentially negative information to cope with their illness, 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 recall of online cancer information among older patients.

Message Experience Characteristics

Ability

Regardless of what a message looks like, individuals can vary in their experience with a message, which may influence the *ability* to 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). Older adults' 'total cognitive capacity' is generally smaller (Van Gerven, Paas, Van Merriënboer, & Schmidt, 2000), but expected to vary across individuals. Factors such as *required cognitive resources* to process information and *perceived cognitive load* might thus affect their 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 older patients' recall of online cancer information.

Motivation

Message experience can also contribute to a person's *motivation* to engage in effortful information processing (A. Lang, 2006), and consequently recall of information. For instance, *involving* and *emotionally satisfying* messages are known to increase patients' motivation to put cognitive effort into the processing of online information (Bol et al., 2014; Petty & Cacioppo, 1986). It has been argued that information is more deeply processed, and thus better recalled, when people are involved with the information (Petty & Cacioppo, 1986), and when they are emotionally satisfied with the information (Bol et al., 2014). We thus expect that increased website involvement and satisfaction with the emotional support from the website are

positively related to recall of online cancer information among older cancer patients.

The Current Study

To summarize, we discussed personal and message experience characteristics that the literature suggested to be relevant for older adults' ability and motivation to recall information. To address our first goal, an overview of the aforementioned age-related factors is presented in a conceptual model (see Figure 1). To address our second goal, we will empirically test which of these age-related factors contribute to recall of information among an older cancer patient population.

Methods

Participants

A heterogeneous group of cancer patients was recruited between April and May 2015 from 2 hospitals, a large online panel of cancer patients, and a panel from the research institute. 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

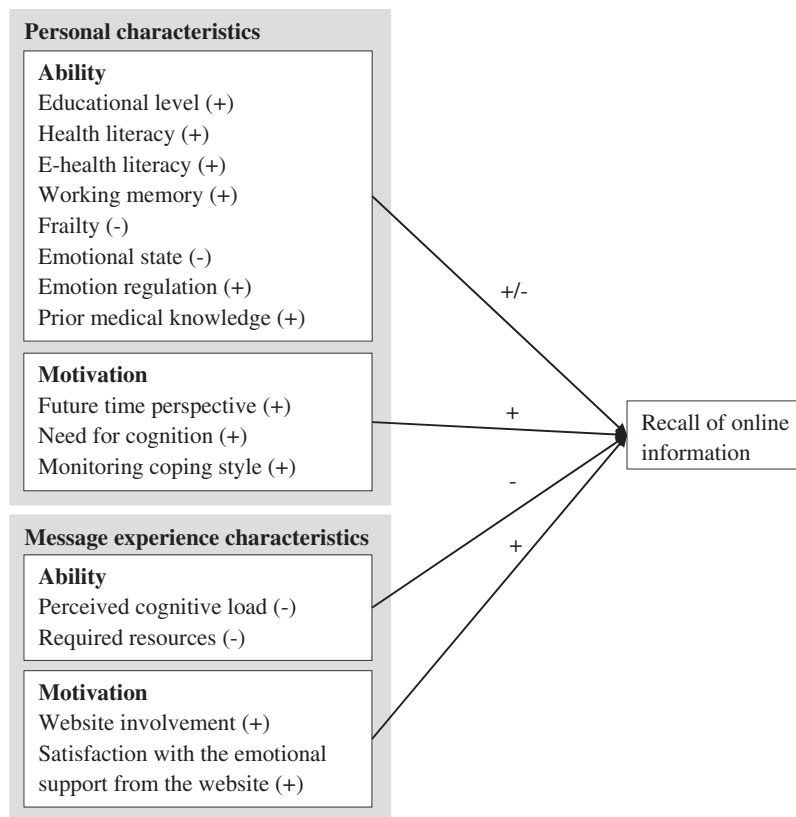


Fig. 1. Conceptual model of ability and motivation factors to recall online cancer information categorized as personal and message experience characteristics.

study related to this study's research line, and had had at least one consultation with their oncologist. 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 an 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. The study was approved by the institutional review board of the research institute, as well as the medical ethics committee and local feasibility advisory committee of the two participating hospitals

Procedure

To mimic natural searching behavior and information processing online, we provided patients within the online questionnaire with various webpage designs for patients to actively look for their preferred online information. Hence, five different webpage designs containing the same information, but differing in design (i.e., text, illustrations, video), were presented in a random order on a storyboard within the online questionnaire (see Figure 2). Participants were asked to choose the version they would have chosen if they were searching information online. This way, we were able to unravel associations between age-related factors and recall of information,

which would reflect patients' natural behavior when visiting a website. The informational text addressed a relatively unknown treatment, radio frequency ablation (RFA), which is a minimally invasive method to treat metastases in the lung. The webpages' presentation mode differed as follows: (1) text-only information; (2) text and medical illustrations (i.e., illustrations that explain text); (3) text and non-medical illustrations (i.e., illustrations that are text irrelevant but aim to enhance enjoyment); (4) text and a video in which a doctor explained the RFA treatment; and (5) text and a video in which a patient explained the RFA treatment. The videos in the latter two versions 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, minimal stylistic changes were made (i.e., information was presented from a first-person perspective) (for video scripts, see Bol et al., 2013). Besides clicking on videos, the webpages were not interactive. Patients were exposed to the online information of their choice as long as they wanted. However, after turning to the next page with the recall questions, patients were unable to return to the previous page to consult the webpage again. The online questionnaire continued with assessing age-related personal and message experience characteristics deemed relevant for ability and motivation as introduced in our conceptual model.

Dependent Variable

Recall of information was assessed by eleven open-ended questions reflecting the content of the webpage (Authors, 2014), based

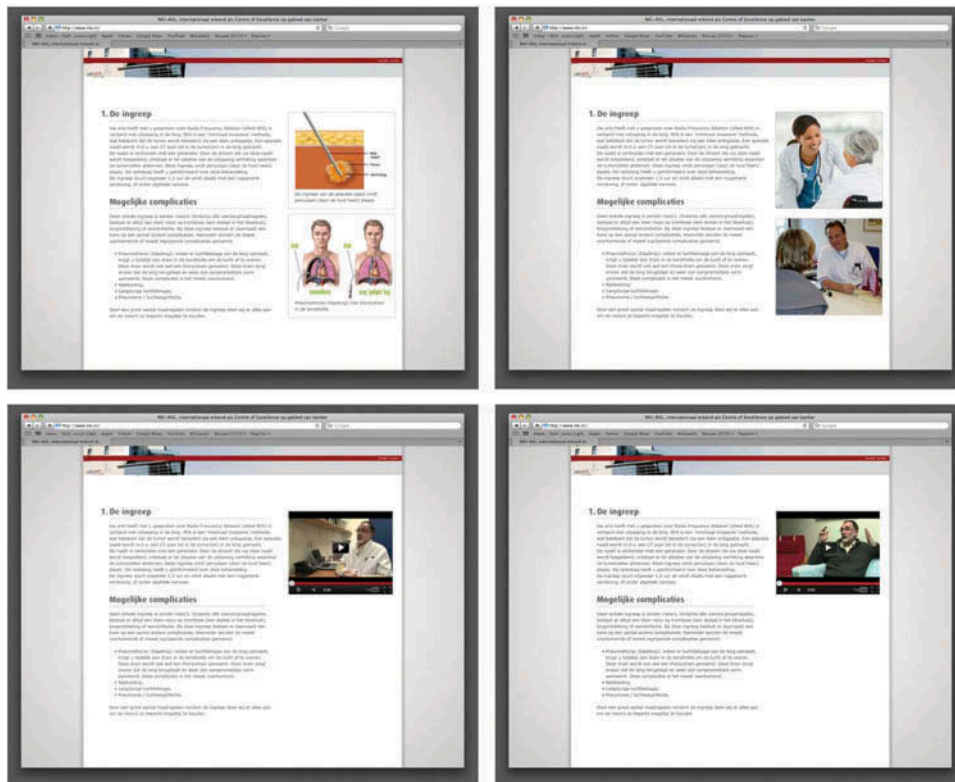


Fig. 2. Webpages containing RFA treatment information presented in text and medical illustrations (top left), text and non-medical illustrations (top right), text and a video with a doctor (bottom left), and text and a video with a patient (bottom right). Webpage with text-only information is not displayed, since it is equal to the webpages shown in this figure without the illustrations or videos.

on the Netherlands Patient Information Recall Questionnaire (NPIRQ: Jansen et al., 2008). Questions included “How much time does RFA treatment take?” and “Can you name the types of sedations that are possible during RFA treatment?”. Answers were to be reported in a text box below each question. They were manually scored based on a codebook. Each answer received a score of 0 (not recalled), 1 (partially recalled), or 2 (completely recalled). A second coder coded the recall scores of 38 patients (19.3%) to establish 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).

Personal Characteristics

Ability

Education was divided into the lower educational level (0 = primary, lower vocational, preparatory secondary vocational, intermediate secondary vocational education, senior secondary vocational and university preparatory vocational education) and the higher educational level (1 = higher vocational education and university). *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 do not 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, 2006b), 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,” Cronbach’s $\alpha = .94$). *Working memory* was measured with eleven 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.” (Cronbach’s $\alpha = .83$) Higher scores represent lower levels of working memory. Patients’ *frailty* in the physical, cognitive, social, and psychosocial domain was assessed using the Groningen Frailty Indicator (Schuurmans, Steverink, Lindenberg, Frieswijk, & Slaets, 2004). Scores range between 0 and 15. Higher scores indicate higher levels of frailty. *Emotional state* was measured using the six-item short-form of the STAI (STAI-6: Marteau & Bekker, 1992), including items such as “I feel calm” and “I feel tense,” measured on a 4-point scale (1 = “not at all,” 2 = “somewhat,” 3 = “moderately,” 4 = “very much,” $\alpha = .85$). Additionally, the Emotion Thermometers Tool (Mitchell, Baker-Glenn, Granger, & Symonds, 2010) assessed current emotional states using three 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?” (range 0 = ‘none’ to 10 = ‘an extreme amount’). *Emotional regulation* was measured with 10 items of the BRIEF-SR (adapted version: Guy et al., 2004). Items included “I get upset by minor things” (1 = “never,” 2 = “sometimes,” 3 = “always,” Cronbach’s $\alpha = .81$). Higher scores indicate lower levels of emotion regulation. 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,” Cronbach’s $\alpha = .79$).

Motivation

Future time perspective was measured by ten items, such as “There are only limited possibilities in my future” (7-point Likert scale ranging from “not at all true” to “very much true,” Cronbach’s $\alpha = .90$) (F. R. Lang & Carstensen, 2002). Higher scores indicate more perceived time left in life. 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” (Cronbach’s $\alpha = .78$). *Monitoring coping style* was measured with an adapted version of the Threatening Medical Situation Inventory (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,” Cronbach’s $\alpha = .73$).

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 two items of Keller and Block (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, asking whether the information “included no medical jargon/much medical jargon,” and “required no prior knowledge/much prior knowledge” (Cronbach’s $\alpha = .87$).

Motivation

Four items, such as “I was highly involved in evaluating the site,” reflected *website involvement* (Dutta-Bergman, 2004) (7-point scale, ranging from “strongly disagree” to “strongly agree,” Cronbach’s $\alpha = .89$). *Satisfaction with the emotional support from the website* was assessed with a subscale of the Website Satisfaction Scale (Authors, 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” (Cronbach’s $\alpha = .96$).

Statistical Analysis

Analyses were performed using SPSS version 22 (SPSS, Inc., Chicago, IL). Results were considered significant at a p -value of $< .05$. Descriptive statistics were used to describe the older cancer patient population. To examine predictors of recall of information, we conducted a multiple linear regression

analysis. Five blocks were entered as separate blocks: (1) chronological age, (2) “personal characteristics relevant for ability” variables, (3) “personal 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, 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 the final model. The analysis showed only a slight difference between the

two models, i.e., when only considering patients from hospitals, website involvement did no longer significantly predict recall.

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. Afterwards, 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.

Results

Patient Recruitment and Characteristics

Figure 3 shows the recruitment flow and reasons for exclusion and non-response. Of the 794 patients from the two hospitals, 410 patients (51.6%) were approached to participate in the

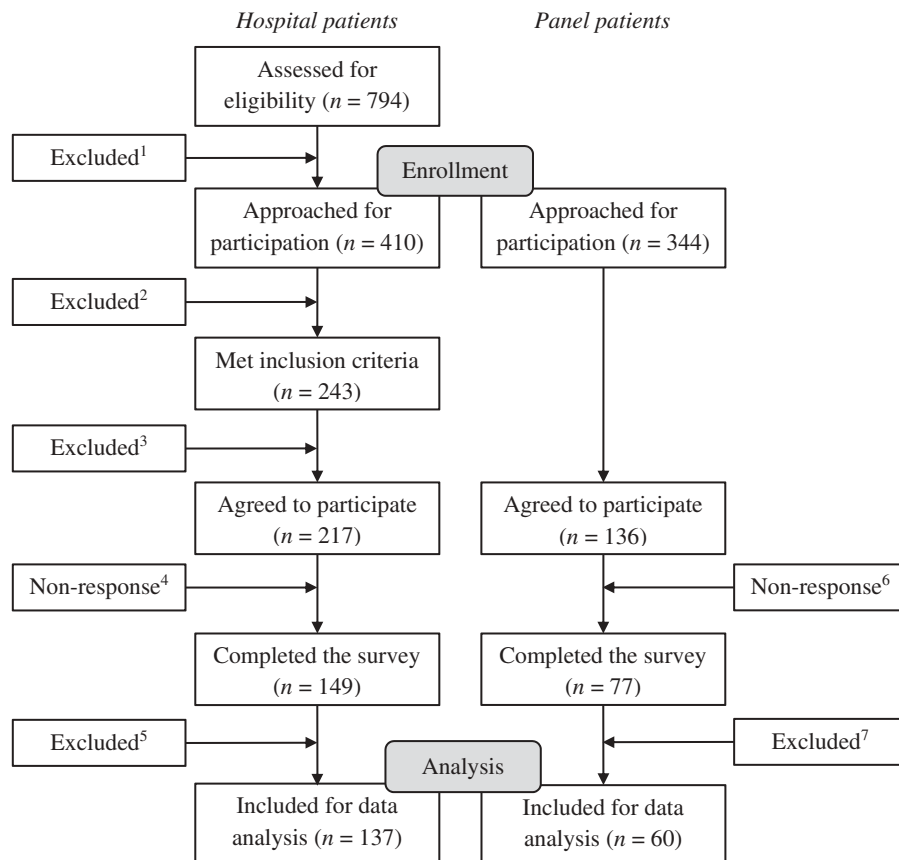


Fig. 3. Flowchart of participant recruitment. ¹Newly diagnosed with cancer ($n = 238$), deceased ($n = 110$), participated in previous study ($n = 27$), cognitive impairment according to medical status ($n = 9$). ²Deceased ($n = 57$), no access to Internet or computer ($n = 56$), could not be reached through telephone ($n = 52$), did not speak Dutch ($n = 2$). ³Struggles with Internet use ($n = 13$), felt too sick or too tired ($n = 6$), had no time ($n = 5$), unknown ($n = 2$). ⁴Started 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 ($n = 1$). ⁵Questionnaire filled out by someone else ($n = 7$), not exposed to webpage material due to technical issues ($n = 2$), used other source to answer recall questions ($n = 1$), did not meet age criterion (< 65 yrs.; $n = 2$). ⁶Started but did not finish for unknown reasons ($n = 48$), did not meet age criterion (< 65 yrs.; $n = 11$). ⁷Did not meet age criterion (< 65 yrs.; $n = 14$), used other source to answer recall questions ($n = 2$), duplicate entry ($n = 1$).

Table 1. Sociodemographic and medical background characteristics and personal and message experience characteristics of older cancer patients (n = 197)

Variable	Older cancer patients n = 197 Mean (SD), range
Background/control variables	
Gender	
Male, n (%)	128 (65.0)
Female, n (%)	69 (35.0)
Age	71.03 (4.42), 65 – 86
Web choice	
Text-only information, n (%)	11 (5.6)
Text and medical illustrations, n (%)	98 (49.7)
Text and non-medical illustrations, n (%)	20 (10.2)
Text and video with doctor, n (%)	60 (30.5)
Text and video with patient, n (%)	8 (4.1)
Medical characteristics	
Time since diagnosis ^a	42.97 (62.14), 0 – 544
Treatment goal	
Curative	121 (63.0)
Palliative	71 (37.0)
Type of cancer	
Lung	129 (65.5)
Urological	38 (19.3)
Gastroenterological	27 (13.7)
Breast	13 (6.6)
Skin	8 (4.1)
Lymphoma	4 (2.0)
Gynaecological	2 (1.0)
Type of treatment	
None	11 (5.6)
Chemotherapy	95 (48.2)
Surgery	86 (43.7)
Radiotherapy	80 (40.6)
Hormone therapy	13 (6.6)
Immunotherapy	8 (4.1)
RFA	4 (2.0)
Personal characteristics – Ability	
Education**	
Low, n (%)	110 (55.8)
High, n (%)	87 (44.2)
Health literacy	15.90 (5.03), 0 – 22
E-health literacy	3.23 (0.87), 1 – 5
Working memory ^b	1.52 (0.34), 1 – 2.27
Frailty	3.26 (2.58), 0 – 12
Anxiety (STAI-6)	37.33 (12.71), 20 – 73
Stress	2.68 (2.58), 0 – 10
Depression	1.56 (2.38), 0 – 10
Anger	1.77 (2.65), 0 – 10
Emotion regulation ^c	1.37 (0.33), 1 – 2.56
Prior medical knowledge	2.32 (1.27), 1 – 7
Personal characteristics – Motivation	
Future time perspective	3.40 (1.26), 1 – 7
Need for cognition	4.53 (1.07), 1.75 – 7
Monitoring coping style	3.63 (1.03), 1 – 5

(Continued)

Table 1. (Continued)

Variable	Older cancer patients n = 197 Mean (SD), range
Message experience characteristics – Ability	
Perceived cognitive load	2.80 (1.13), 1 – 6
Resources required	1.80 (0.90), 1 – 5
Message experience characteristics – Motivation	
Website involvement	4.05 (1.55), 1 – 7
Satisfaction with emotional support	3.85 (1.73), 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 Time since diagnosis in months. Abbreviations: *SD* = standard deviation. ^b Higher scores indicate poorer working memory. ^c Higher scores indicate poorer emotion regulation.

survey. 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 which 137 (91.9%) were eligible for analysis. 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, 60 (77.9%) were eligible for analysis.

The majority of the included patients were male (65.0%), and the mean age was 71 years old ($M = 71.03$, $SD = 4.42$). Patients were on average diagnosed 3.5 years ago ($M = 42.97$ [months], $SD = 62.14$), and most patients received treatment with curative intent (63.0%). The majority of patients were diagnosed with lung cancer (65.5%), followed by urological cancers (19.3%), and gastroenterological cancers (13.7%). Common treatments among this group of older cancer patients were chemotherapy (48.2%), surgery (43.7%), and radiotherapy (40.6%). Patient characteristics are shown in Table 1.

Recall of Information

Overall, patients recalled 33.6% of the information on average ($M = 7.38$, $SD = 4.78$, range = 0 – 20). Patients from online panels on average recalled 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

Chronological 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. “Personal characteristics relevant for ability” accounted for 28.9% of the variance in recall ($\Delta R^2 = .289$, $p < .001$), suggesting a large contribution to recall of online information. “Personal characteristics relevant for motivation” did not predict information recall ($\Delta R^2 = .020$, $p = .174$). “Message experience characteristics relevant for ability” accounted for 7.6% of the variance in recall ($\Delta R^2 = .076$,

Table 2. Final linear model of personal and message experience predictors of 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: Personal characteristics – Ability $\Delta R^2 = .289, p < .001$				
Education (1 = high, 0 = low)	0.55	.66	.06	.402
Health literacy	0.17	.07	.18	.016
E-health literacy	-0.29	.38	-.05	.449
Working memory	0.69	.96	.05	.475
Frailty	-0.31	.16	-.17	.049
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
Prior medical knowledge ^a	1.93	2.01	.06	.340
Block 3: Personal 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	-1.13	2.79	-.03	.686
Block 5: Message experience characteristics – Motivation $\Delta R^2 = .055, p < .001$				
Website involvement	0.37	.19	.12	.046
Satisfaction with emotional support	0.52	.17	.19	.003

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

$p < .001$). “Message experience characteristics relevant for motivation” accounted for 5.5% of the variance in recall ($\Delta R^2 = .055, p < .001$).

The final linear model (see Table 2) including all potential predictors of information recall accounted for 37.9% of the variance in recall of online information ($p < .001$). Chronological age did not predict recall of information ($\beta = .01, p = .876$). Instead, age-related personal and message experience factors relevant for ability and motivation predicted recall. Among personal characteristics influencing ability were lower levels of frailty ($\beta = -.17, p = .049$) and anger ($\beta = -.20, p = .022$), as well as higher levels of health literacy ($\beta = .18, p = .016$). Among personal characteristics influencing motivation were future time perspective ($\beta = -.16, p = .020$): the less perceived future time, the more patients recalled. Of the experienced message variables that influenced ability, the less perceived cognitive load perceived was associated with better recall ($\beta = -.28, p = .001$). Of the message experience variables influencing motivation, website involvement ($\beta = .12, p = .046$) and satisfaction with the emotional support from the website

($\beta = .19, p = .003$) positively predicted recall, i.e., high levels of website involvement and satisfaction were related to better recall.

Discussion

We aimed to provide a more comprehensive understanding of the contribution of chronological age versus age-related factors in explaining recall of online cancer information among older patients. Potential recall predicting factors were categorized in terms of personal and message experience characteristics as relevant for older patients’ *ability* and *motivation* to recall online cancer information. Our main finding is that, among 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*, both constituting of personal and message experience characteristics. These age-related *ability* and *motivation* factors explained 37.9% of the variance in recall of online information. Personal characteristics relevant for ability contributed most to explaining recall of information, followed by message experience characteristics relevant for ability, and message experience characteristics relevant for motivation. Chronological age and personal characteristics relevant for motivation did not contribute to recall of information. These results indicate that in older age recall of online cancer information is related to a wide variety of age-related factors but not to chronological age.

Of the personal characteristics relevant for *ability*, frailty, and anger were negatively associated recall of information. At the same time, higher levels of health literacy were positively associated. This was in line with our expectations. Yet, contrary to our expectation was the finding that of the personal characteristics relevant for *motivation*, future time perspective was negatively related to recall of information. We had argued that older adults experiencing little time left in life might be less willing to process information. We based this expectation on the theoretical assumptions of the socioemotional selectivity theory. Now, we tentatively argue that information might be 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 can render information more important and enhance their willingness to process, and consequently recall information.

In terms of message experience characteristics relevant for *ability*, experiencing higher levels of perceived cognitive load to process the information was related to less recall. Perceived cognitive load was the strongest recall predictor in our model. In addition, message experience characteristics relevant for *motivation* positively related to accurate recall of information. As expected, we found that website 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.

Other personal 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 correlate with recall of information in the final model. Nevertheless, our results revealed the most important age-related processes in recall of online cancer information.

Implications for Theory and Practice

Our findings relate to the ELM and LC4MP, which explicate that information processing is influenced by ability and motivation (A. Lang, 2000; Petty & Cacioppo, 1986). In line with the LC4MP, our study underlines the importance of considering ability and, to some extent, motivation from both a personal and message experience perspective. Importantly, we made a first attempt to specify age-related personal 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.

By identifying ability and motivation factors that predict 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. Our findings suggest that we should consider age-related factors such as frailty, anger, health literacy, future time perspective, perceived cognitive load, website involvement, and satisfaction with the emotional support from the website. This poses opportunities for tailoring interventions. Chronological age cannot be changed, but addressing relevant age-related factors may help to improve information provision for older cancer patients. Further research is needed to explore how these factors can be translated into practical tools that support the individual older patient.

Limitations

This study also has limitations. First, the design was cross-sectional, rather than longitudinal or experimental, meaning that a causal relationship between age-related factors and recall of information cannot be assumed. We were able to confirm the model for our patient sample and the subsample of patients recruited from hospitals, but further research is desirable to test the generalizability and robustness of our results in a heterogeneous group of cancer patients. Our model should therefore be tested among other subsets of cancer patients.

Furthermore, our theoretical model is limited by message characteristics that are experienced by the message recipient. We wanted to keep the information on the webpage as constant as possible to ensure that recall was a function of the age-related factors introduced rather than a function of various message-related factors that would interfere with age-related factors. For instance, if this study would have aimed to determine the role of text complexity, length, or type, we would have had to create different types of information, which calls for different research designs, such as experiments (Bol et al., 2014; Van Weert et al., 2011).

Further research might also invite patients to browse on a website rather than viewing one webpage only. For example, e-health literacy might have played a larger role when patients had to visit a full website rather than one webpage. This suggests that some age-related factors only predict recall under certain conditions, but it can also mean that some do not predict recall at all. We therefore suggest to test the proposed model in different settings.

Conclusions

Our study aimed at gaining a more comprehensive understanding of online cancer information recall among older cancer patients. Our proposed model indeed explained a substantial amount of variance in online information recall by introducing age-related factors in *ability* and *motivation* rather than chronological age. Yet, further research should explore other factors, such as message-related factors, to optimize the model in explaining 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.

Acknowledgments

We wish to thank the participating hospitals (Netherlands Cancer Institute and Deventer hospital) and, in particular, the oncology assistants Daphne Robert and Annette Hemels for their assistance during data collection. We also thank Melanie de Looper, Stephanie Immerzeel, Kirsten Hamelink, Maartje Hendriks, and Ashley den Toom for helping to recruit participants. Furthermore, we would like to thank kanker.nl for their help with recruiting patients online. We thank Remco Sanders, Remao Tummers, Melanie de Looper, Kirsten Hamelink, Joost Daams, and Stefano Giani for their assistance in reviewing the literature for recall predictors. Moreover, we like to thank Renske van Bronswijk for translating the English need for cognition items into Dutch, and Melanie de Looper for partly coding the recall scores and assessing the intercoder reliability. Last but not least, we would like to show our gratitude to all patients willing to participate in this study.

Funding

This study was funded by the Dutch Cancer Society (KWF, grant no. UVA 2014-7288). KWF management was not involved in the study design, data collection, data analysis and interpretation, and manuscript preparation

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