Improving online health information provision for older cancer patients

Online health information usage and its influence on patient outcomes

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Publication date
2021

Chapter 4

Information presentation styles in cancer decision aids: effects of illustrations and narration style in cancer decision aids on cognitive load, satisfaction, and information recall

Abstract

The effectiveness of decision aids, or online tools that support patients in decision making regarding treatment options, is often evaluated based on their content (i.e. *what* information is presented), but less on *how* information should be presented. Prior research on online health information has suggested that patient outcomes (e.g., satisfaction with the information and information recall) may be enhanced when information is presented via multiple media presentation modes, such as verbally (i.e. text) and visually (i.e. illustrations) and when information is presented in narrative rather than in factual form (i.e. narration style). Possibly these two information provision strategies affect satisfaction with the information and information recall by decreasing the receiver's perceived cognitive load. The current study tested the potential benefits of these information presentation styles in the context of decision aids specifically with regards to cognitive load, satisfaction with the information and recall. Further, it was tested whether a match between the type of illustration and the type of narration style (i.e. cognitive illustration and factual text or affective illustration and narrative text) was more effective than no match (i.e. affective illustration and factual text or cognitive illustration and narrative text), and whether age and decision making style moderated effects of information presentation styles. (Former) cancer patients (n = 432; M_{age} = 58.19, SD_{age} = 18.53; 49.3% male; 32.6% low, 33.8% middle, 33.6% high level of education) participated in an online experiment with a 3 (modality: text only vs. text + affective illustration vs. text + cognitive illustration) x 2 (narration style: narrative versus factual information) between-subjects factorial design. In contrast to our expectations, no significant effects of modality and/or narration style on cognitive load and subsequently satisfaction and recall were found. Furthermore, a match between the type of illustration and type of narration style was not found to enhance outcomes compared to no match. Moreover, age and decision making style did not influence the effects of information presentation styles on cognitive load. However, independent of information presentation styles, however, a decrease in cognitive load resulted in increased satisfaction and in turn increased recall. Besides, patients with a more intuitive decision making style perceived more cognitive load, resulting in worse satisfaction and recall, than patients with a more rational decision making style, regardless of the information presentation style. The results suggest that multimedia information and narrative information might not be effective in decreasing cognitive load within the context of online decision aids.

Introduction

Nowadays, cancer patients have become more involved in decisions regarding their medical situation and treatment options (Hawley & Jagsi, 2015). To support patients in making deliberate choices among treatment options, patient decision aids have been developed in which information on treatment options and consequences is presented (Stacey et al., 2017). Decision aids are effective in improving knowledge regarding treatment options (Stacey et al., 2017). If this knowledge can later on be recalled correctly, this can help patients make a more informed decision about their treatment (Bopp & Verhaegen, 2005; Gaston & Mitchell, 2005; Marteau, Dormandy & Michie, 2001).

The quality of online decision aids is mainly evaluated by focusing on the content of information, such as information about options, side-effects, and effectiveness of treatments (Elwyn et al., 2009; International Patient Decision Aid Standards Collaboration, 2005). Even though guidelines such as the International Patient Decision Aids Standards (2005) include some information about *how* to present information in decision aids, for example presenting information in graphs, the majority of these guidelines describe *what* information should be presented. However, previous research suggests that presenting multimedia information, in the form of an audiovisual format, seems a promising way of increasing the effectiveness of decision aids (de Looper et al., 2020). In a similar way, other types of multimedia information, such as text combined with static illustrations might enhance the effectiveness of decision aids as well.

Adding static illustrations to textual information in decision aids might be an affordable and effective strategy to improve outcomes as satisfaction and information recall, instead of animations that ask for a more expensive and complex development process. The combination of textual and visual information already showed to be effective in terms of improving satisfaction with the information and information recall in more general forms of online health information, aside from decision aids (Bol et al., 2015; Meppelink et al., 2015). Surprisingly, a recent review study found that only half of decision aids presented information not only textually but also visually (Vromans et al., 2019).

In addition, the illustrations that were included in the decision aids were mostly cognitive illustrations (Vromans et al., 2019), or illustrations that further explain the textual information or provide additions information such as graphs or icon arrays (Levie & Lentz, 1982; Bol et al., 2015). Even though combining text with cognitive illustrations can be effective, affective illustrations might be considered as well since both cogntive and affective illustrations are expected to positively affect information processing, however via different mechanisms (Huk & Ludwigs, 2009). Based on these findings it seems plausible that information provision in cancer decision aids could be further improved by adding illustrations, either cognitive or affective.

Combining textual information with cognitive illustrations is expected to be effecive, because individuals learn better from information presented via text and illustrations than from text only (Mayer, 2002). According to the cognitive theory of multimedia learning (CTML; Mayer, 2005), using multimedia information, for example verbal information, such as text, combined with visual information, such as illustrations, decreases the risk of cognitive overload (Mayer, 2002; Mayer, 2005; Sparks et al., 2013; Sweller, 2011). However, affective illustrations, or illustrations that add a certain emotional experience by depicting situations or feelings (Levie & Lentz, 1982; Bol et al., 2015), could also improve information processing (Huk & Ludwigs, 2009). Traditional multimedia learning theories, such as the CTML, have been extended by considering affective factors resulting in the cognitive-affective theory of learning with multimedia (CATLM; Moreno & Mayer, 2007). The CATLM, states that affective factors can increase interest and motivation to process the information and thereby improve cognitive learning (Moreno & Mayer, 2007). Especially when information is visually appealing, cognitive processes are enhanced (Mayer & Estrella, 2014), which can result in decreased cognitive load (Um et al., 2012). As both the addition of cognitive illustrations and the addition of affective illustrations to textual information are expexted to be effective, we will investigate the effects of using text combined with different types of illustrations on cognitive load and patient outcomes.

In a similar manner, different types of textual health information can affect information processing (Bol et al., 2015; Bol et al., 2016; Levie & Lentz, 1982). While most traditional health information texts provide cognitive information by presenting facts or professional opinions (Reinard, 1988; Vromans et al., 2019), affective information, which is focused on emotions and experiences is believed to be easier to process (Shaffer et al., 2012; Winterbottom, Bekker, Conner & Mooney, 2008) and could therefore decrease cognitive load (Koenig Kellas, 2015). A narrative, or personal story including emotional experiences, is an example of an affective text (Winterbottom et al., 2008). Therefore, narratives possibly also lead to a decrease in cognitive load and could therefore increase the effectiveness of decision aids.

Since the combination of textual information and illustrations is most successful in increasing comprehensibility when both their functions complement each other (Rosen & Purington, 2004), the effectiveness of narratives in decision aids could possibly be further improved by adding illustrations that match the affective function of the narration style. To the best of our knowledge, it has not yet been studied how narration style and illustrations could best be combined in decision aids. Therefore, the second aim of this study is to investigate the effect of a narrative text (as compared to a factual text) in decision aids and how this effect is influenced by adding either affective or cognitive illustrations

Finally, patients can differ in their processing style. The effectiveness of combining narration style with illustrations might increase further if both fit the processing style of the patient. Especially older patients experience difficulties with understanding factual information due to age-related decreased cognitive functioning (Hibbard et al., 2001). This worsened cognitive functioning can also negatively affect information processing and hinder informed decision making (Bopp & Verhaeghen, 2005; Gaston & Mitchell, 2005; Marteau et al., 2001; McGuire, 1996). Since older patients become less successful in processing cognitive information and probably rely more on emotional information, they might benefit more from a narrative combined with an affective illustration than younger patients.

Aside from age differences, patients could differ in their decision-making style by having a predisposed preference for a certain type of information. Some patients have a more intuitive decision-making style and tend to rely more on emotional information while others have a more rational decision-making style and prioritize facts and numbers while asked to make a decision (Hamilton, 2016). Thus, the last aim of the current study is to investigate whether patients who value emotional information more than factual information, because of either age-related declines or predisposed preference, will benefit more from a narrative text and affective illustrations than patients who prefer facts and numbers.

To sum up, the aim of the current study is to test if information presentation mode (text only vs. text and illustrations) and narration style (narrative vs. factual) in a decision aid aimed at cancer patients influence patient outcomes (i.e. satisfaction with the information and information recall) via cognitive load. Besides, we aim to investigate which combination of information presentation mode and narration style is most effective for different individuals based on differences in age and decision-making style.

Theoretical framework

Modality

Combining textual information with illustrations can be effective in improving information processing. According to the dual coding theory (Pavio, 1986) and the multimedia principle described in the CTML (Cognitive theory of multimedia learning, Mayer, 2014; Sweller, 2011), individuals learn better from information that is presented in multiple modalities (such as textual and illustrations), as compared to information presented in one modality (e.g. textual information only). According to the CTML, especially information that will be processed verbally, such as text, combined with information that will be processed visually, such as illustrations, can positively affect information processing (Mayer, 2002). It

is described in the CTML that both the verbal and visual processing channels are limited in their processing capacity (Mayer, 2014). This means that the amount of information that can be processed via each channel is limited by this capacity. Therefore, receiving too much information via one channel can result in cognitive overload (Pavio, 1986). Illustrations are received and processed via the visual/pictorial channel. Written text is initially received visually as well, but later on processed via the verbal/auditory channel (Mayer, 2005). Thus, by presenting information via text and illustrations, both the verbal and the visual processing channels of the receiver will be addressed, making cognitive overload in one of these channels less likely (Mayer, 2002; Mayer, 2005; Sparks et al., 2013; Sweller, 2011). Previous research studying medical information on an informative website found that textual information combined with cognitive illustrations resulted in better comprehension and information recall than textual information only (van Weert et al., 2011). These findings support the CTML and support the notion that cognitive illustrations can be valuable in medical decision aids as well.

Even though this seems mostly the case for cognitive illustrations in which part of the textual information is depicted, affective illustrations can decrease cognitive load by increasing interest and motivation to process the information (Moreno & Mayer, 2007). According to the CATLM (Moreno & Mayer, 2007), affective features can increase the engagement of the receiver and thereby enhance cognitive processing and decrease cognitive load (Mayer, 2014). Illustrations that evoke emotional responses, for example illustrations that show faces or social situations are found to improve comprehension (Plass et al., 2014), decrease cognitive load (Um et al., 2012), and improve learning (Mayer & Estrella, 2014; Um et al., 2012). These previous findings are in line with the CATLM and point to the potential of including affective illustrations in decision aids.

As both of these presentation styles could lead to decreased cognitive load (Mayer, 2002; Sparks, Chang, & Chung, 2013; Sweller, 2011) adding illustrations is expected to facilitate information processing (Mayer, 2002; Sparks et al., 2013) because it makes processing more simple and pleasant for the receiver (Mayer, 2009). Therefore, it can be expected that combining textual information with cognitive or affective illustrations leads to lower levels of cognitive load, which subsequently leads to higher levels of satisfaction with the information. In turn, higher satisfaction with the information could increase the receivers' motivation to process the information, thus possibly improving recall of the information (Bol et al., 2014; Bol et al., 2018; Petty & Cacioppo, 1986).

Accordingly, previous studies on general information health websites have shown promising results of adding visual information to textual information in terms of satisfaction (Bol et al., 2015; van Weert et al., 2011) and information recall (Bol et al., 2013; Bol et al., 2015; Meppelink et al., 2015; van Weert et al., 2011). In line with previous findings, the following hypotheses are proposed:

H1: Providing textual information combined with *cognitive* illustrations in a decision aid leads to a) less cognitive load and b) subsequently more satisfaction with the information and, in turn, c) better information recall as compared to textual information without illustrations.

H2: Providing textual information combined with *affective* illustrations in a decision aid leads to a) less cognitive load and b) subsequently more satisfaction with the information and, in turn, c) better information recall as compared to textual information without illustrations.

Narration style

Traditionally, health information is generally factual in nature (Reinard, 1988) and this is still mostly the case in online decision aids (Vromans et al., 2019). However, narrative texts including more affective information, can help patients understand the impact of an illness and treatment (Butow, Fowler & Ziebland, 2005; Khangura et al., 2008; Winterbottom et al., 2008). Besides, this communication style is a basic mode of human communication. Because of individual's familiarity with this communication style, information including narrative elements is generally easier to process than information without narrative elements (Shaffer et al., 2012). Furthermore, narrative text can reduce cognitive load by enabling patients to store the information based on how the information is already coherently and causally linked together in the narrative (Koenig Kellas, 2015). Previous research has shown that for other types of online health information, such as informative health websites, a narrative text indeed increased satisfaction with the information (Bol et al., 2013) and information recall (Bol et al., 2015), compared to a factual text. However, the results on the effectiveness of narratives in online decision aids are inconclusive. In one previous study it was found that narratives did not influence perceived cognitive load or satisfaction as compared to factual information (Yilmaz et al., 2020), whereas in another study narratives were found to increase satisfaction with the information (de Looper et al., 2020). For better insight into the effectiveness of narrative information in online decision aids, the following hypothesis will be tested in the current study:

H3: Providing information in a decision aid via a narrative text leads to a) less cognitive load and b) subsequently more satisfaction with the information and, in turn, c) better information recall as compared to providing information via a factual text.

Combination of modality and narration style

Both adding illustrations and a narrative text are expected to increase satisfaction with the information and subsequently improve information recall via a reduction in cognitive load because both strategies are possibly easier to process than verbal information and factual text. Results of previous studies showed that narrative online health information presented in both verbal and visual mode was the most optimal strategy in terms of satisfaction and information recall (when compared to other modality and narration style combinations (Bol et al., 2013; Bol et al., 2015). Therefore we expect that the combination of narrative text and illustrations will perform best in terms of reduced cognitive load, increased satisfaction and improved information recall:

H4: Providing information in a decision aid via a narrative text combined with illustrations leads to a) less cognitive load and b) subsequently more satisfaction with the information and, in turn, better information recall as compared to narrative text without illustrations, factual text with illustrations and factual text without illustrations.

Match between narration style and type of illustration

Adding illustrations to textual information can serve different goals. Illustrations can fulfil cognitive functions, for example by providing additional information or explaining information by means of graphs, or affective functions, for example adding a certain emotional experience by showing situations (Bol et al., 2015; Levie & Lentz, 1982). Previous research showed that adding illustrations to textual information is especially effective in increasing comprehensibility when the illustrations match the content of text (Rosen & Purington, 2004).

Regarding cognitive illustrations, cognitive load can be reduced by dividing the information into verbally processed information and visually processed information (Mayer, 2002; Mayer, 2005; Sparks et al., 2013; Sweller, 2011). Therefore, components that are featured in the text should also be presented in the cognitive illustrations, so that the same information is processed via both the verbal and the visual channel and reduce cognitive load as much as possible (Mayer, 2005). Therefore, the combination of factual texts, in which facts and numbers are presented, are probably best matched with cognitive illustrations, such as graphs that show the same factual information as provided in the text instead of affective illustrations.

Adding affective illustrations to textual information could potentially decrease cognitive load by evoking emotional responses and increasing motivation. Previous research showed that adding affective illustrations is most effective in improving learning when the illustrations are strongly connected to the textual information (Schneider

et al., 2018). Therefore, narrative texts in which in which emotional and experiential information is presented by describing emotions and experiences are probably best matched with affective illustrations that depict the same emotional information instead of factual illustrations. Therefore, it is expected that a match between narration style and type of illustration results in less cognitive load and more satisfaction and information recall, resulting in the following hypothesis:

H5: A match between narration style and type of illustration (narrative text + affective illustrations / factual text + cognitive illustrations) in a decision aid leads to a) less cognitive load and b) subsequently more satisfaction, and in turn c) better information recall as compared to a mismatch between text and type of illustration (narrative text + cognitive illustrations / factual text + affective illustrations).

Patient characteristics: Age and decision-making style

Incorporating illustrations and using a narrative text could be especially effective for certain individuals, since it can be expected that some individual characteristics influence information provision preferences and processing abilities.

Age. First of all, with aging cognitive function decreases, resulting in difficulties with processing, understanding, and recalling information (Sparks & Nussbaum, 2008; van Gerven et al., 2002). Older patients are therefore more at risk of experiencing cognitive overload, making it even more important to employ information provision strategies that reduce cognitive load, such as by adding illustrations or narrative information. Second, according to the socioemotional selectivity theory, older individuals tend to rely more on emotional focused outcomes instead of knowledge related outcomes (Carstensen et al., 2003; van der Goot et al., 2019). This could mean that when older individuals are asked to make decisions, emotional information is more important to them as compared to factual information (Becker, 2004; McInnes & Haglund, 2011). In line with this, older individuals are better able to recall narrative information than factual information as compared to younger individuals (Sparks & Nussbaum, 2008). Therefore, narrative text and affective illustrations, both providing emotional information, are expected to be more effective as age increases. These expectations translate into the following hypothesis:

H6: The effects hypothesized in H1 (the effect of illustrations), H2 (the effect of a narrative text), H3 (the effect of a narrative text combined with an affective illustration or a factual text combined with a cognitive illustrations), and H4 (the effect of a match between narration style and type of illustration) on cognitive load are expected to be stronger when the patient's age increases.

Decision-making style. Individuals of all ages vary in their decision-making style, which refers to the way of responding to situations that ask for a decision (Hamilton, Shih & Mohammed, 2016; Scott & Bruce, 1995). Decision making styles can range from more rational decision-making, mostly relying on a systematic and extensive search for available information in support of a task at hand, to a more intuitive decision-making style characterized by a tendency to make decisions based on affective information such as feelings, intuitions, and past experiences (Hamilton, Shih & Mohammed, 2016).

Since individuals with a more rational decisional making style prefer to acquire a great body of information and rely less on affective information than individuals with a more intuitive decision making style, providing them with factual information might support them best. For individuals with a more intuitive decisional style, affective information that evokes an emotional response can be most effective since these individuals prefer to make decisions based on emotions and have a lower need for obtaining factual information. Therefore, while narratives combined with affective illustrations are expected to be generally effective, this information provision strategy is expected to be the most beneficial for patients with an intuitive decision making style, as this strategy would better fit their needs for affective information. Therefore, it is expected that the positive effects of narratives combined with affective illustrations are stronger in individuals scoring higher on an intuitive decision making style.

H7: The effects hypothesized in H1 (the effect of illustrations), (the effect of a narrative text), H3 (the effect of a narrative style combined with illustrations), and H4 (the effect of a match between narration style and type of illustration) on cognitive load are expected to be stronger for patients with a more intuitive decision-making style, as compared to patients with a more rational decision-making style.

Method

Design

An online experiment was conducted with a 3 (modality: textual information vs. textual information + affective illustration vs. textual information + cognitive illustration) x 2 (narration style: narrative text vs. factual text) between-subjects factorial design (see Figure 4.1). The study was approved by the Ethics Committee of ASCoR (2017-PC-7979) and informed consent was obtained from all participants at the beginning of the experiment.

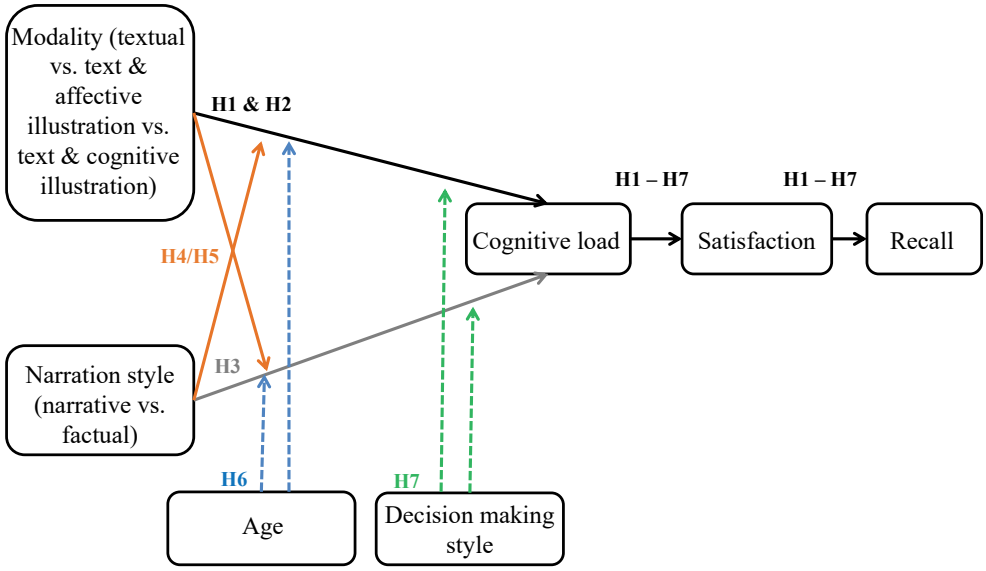

Figure 4.1. Conceptual model.

Participants and procedure

Participants were recruited via an online panel (Panelclix, ISO certified) and were analogue cancer patients, or patients who have experienced being diagnosed with cancer, which is a validated method (Van Vliet et al., 2012). Participants who were willing to participate in the study first completed a short questionnaire on background variables (age, gender, educational level, medical knowledge, and internet usage). Subsequently, the sample was stratified to ensure age (18–44, 45–64, 65–74, 75+), gender (male, female) and educational level (low, middle, high education) were equally represented in the sample. Subsequently, participants were randomized into one of the six conditions. Before starting with the questionnaire, participants were asked to imagine being diagnosed with colorectal cancer, and having to choose between two treatment options. They were instructed to open an online decision aid and carefully read the information presented in that decision aid, i.e. on the advantages and disadvantages of each of the treatment options, presented on a website. After visiting the website, participants completed a questionnaire assessing perceived cognitive load, satisfaction with the information, information recall, and a manipulation check. Participants were then thanked for their participation.

Stimulus materials

Textual information. The stimuli were developed with an advisory team consisting of healthcare providers, patients, representatives of gastrointestinal patient organizations,

and decision aid developers. As a starting point pages from an existing colorectal cancer decision aid were used. On these pages, two treatment options (CAP and CAPOX) for colorectal cancer were presented, with information about the effect of the treatment on the tumor, side-effects and administration of the treatment. The advisory team recommended on the core information to be included in the stimuli and ensured that all information was correct. Subsequently, this core information was carefully transformed into both a factual and a narrative version ensuring that the same core information was presented in both versions. In the narrative version elements were added that focused on emotions, social situations and personal experiences with the treatments. This resulted in the narrative version consisting of exactly the same core information, but comprising more words than the textual version (see Appendix B). For a more detailed description of the development of the narrative version, see de Looper et al. (2020).

Illustrations. In the conditions with illustrations, two illustrations were displayed: one alongside the textual information on the first treatment option, and one alongside the textual information presenting the second treatment option. The cognitive illustrations presented information on side-effects of the treatment options by means of bar graphs, as previous research showed that bar graphs are appreciated well and understood by both younger and older individuals (van Weert et al., 2021). The affective illustrations where photographs of a doctor interacting with a patient. Four photographs representing patients with various demographics were selected: a younger male, a younger female, an older male, and an older female. Within the conditions with affective illustrations, there was always one picture of a male patient and one picture of a female patient, with the order counterbalanced. This means that in half of the conditions, the female patient was presented next to the first treatment option and the male next to the second treatment option, and this was reversed for the other half of the conditions. Similarly, half of the conditions presented pictures of younger patients, while the other half of the conditions displayed older patients. This was done to prevent differences in identification with the characters depicted in the illustrations.

The affective pictures were selected based on pre-testing. A first pre-test was conducted among 64 participants (age: M = 54.64, SD = 9.85; gender: 64.1% female; educational level: 14.1% low, 15.6% middle, 70.3% high). Participants rated 13 pictures on the extent to which the pictures were fitting to a text presenting information on treatment options for colorectal cancer, the likability of the patient shown in the picture, and were asked to estimate the age of the patient shown in the picture. Several participants indicated that the selected pictures of the younger patients were not fitting to the information on the website, as the doctor was central to the pictures instead of the patient, and the patient appeared too happy for the context of the text. A second pre-test was therefore conducted with other pictures (using the same characters, but with the patient central to the picture,

and the patient not smiling) for the selection of the pictures representing the younger patients (N = 18, age: M = 25.78, SD = 7.76; gender: 72.2% female; educational level: 44.4% middle, 55.6% high). The pre-tests showed that all selected pictures were found to be fitting to the text presenting colorectal cancer treatment options, that the characters were liked, and the older patients were estimated to be older than the younger patients. See Appendix B.2 for an overview of the final stimulus materials.

Measures

Perceived cognitive load. The perceived cognitive load of the information in the decision aid was measured with two items addressing the amount of cognitive resources it cost to process the webpage (Eveland & Dunwoody, 2001), for example 'viewing the webpage cost me a lot of effort'. These items could be answered on a scale from 1 (*totally disagree*) to 7 (*totally agree*) (r = .786, p < .001). Higher scores translate to higher perceived cognitive load

Satisfaction with information. Satisfaction with the information was measured with 10 items belonging to the Website Satisfaction Scale (WSS; Bol et al., 2015). This scale addressed satisfaction with the attractiveness of the decision aid, satisfaction with comprehensibility of the information in the decision aid, and satisfaction with emotional support provided by the decision aid (α =.927). Respondents could answer on a 7-point Likert scale, ranging from 1 (*totally disagree*) to 7 (*totally agree*).

Information recall. Recall of information presented on the webpages was measured following the Patient Information Recall Questionnaire (NPIRQ) (Jansen et al., 2008). Seventeen open-ended questions were composed, to capture participants' recall of the core information presented on the webpages. Participants answered the questions after viewing the decision aid and could not reopen the decision aid once they started with answering the recall questions.

A codebook was developed beforehand which was used by two independent coders to code the answers. Per question, participants could obtain 0 (wrong answer), 1 (partially correct answer) or 2 (completely correct answer) points, resulting in a maximum sum score of all questions ranging from zero to 34 points. Participants scored from 0 to 28 points in total (M = 9.38). To assess intercoder-reliability, a random 10% (N = 50) of the dataset was double coded by both coders. Intercoder-reliability ranged from .55 to 1.00 depending on the question, with an average score of .82 which is considered satisfactory (Hayes & Krippendorff, 2007).

Background and control variables. Questions regarding socio-demographic information (age, gender, education level, level of medical knowledge, and internet usage) of the respondents were included in the questionnaire. Age was measured in years and

education level was measured according to pre-defined answer options, and later divided into three categories (low, middle and high). Besides, health literacy and numeracy were measured to control for in the analyses, as well as identification with the characters in the narrative conditions. Knowledge about one or both treatments discussed in the decision aid was assessed by means of one question: "Did you have any knowledge about the treatments CAP and/or CAPOX before participating in this study?" and used as exclusion variable. Participants who scored 1 (*no knowledge at all*) or 2 (*very little knowledge*) were included for further analyses, while participants who scored 3 (*quite a lot of knowledge*) or 4 (*a lot of knowledge*) were excluded for further analyses.

Manipulation check

A manipulation check was carried out to check whether the narrative text was perceived as more narrative than the factual text and vice versa. Three items measuring amount of narrativity of the information (α = .915) were included in the questionnaire as well as three items measured the amount of factuality (α = .787), both used a Likert scale ranging from 1 (*totally disagree*) to 7 (*totally agree*). The narrative text scored significantly higher on narrativity F (1, 398) = 203.80, $p < .001$ (M = 5.81, SD = 1.22), than the factual text (M = 3.95, SD = 1.37) and the factual text scored significantly higher on factuality F (1, 398) = 58.79, $p < .001$, (M = 5.26, SD = 1.05) than the narrative text (M = 4.49, SD = 1.25). It can therefore be concluded that the manipulation of narration styles was successful.

Statistical analyses

First, the distribution of demographic variables (i.e. age, gender, education level) and control variables (i.e. internet usage and level of medical knowledge) over the conditions was checked by conducting Chi-square tests and ANOVA's. Second, the first hypothesis was tested using an ANOVA. The indirect effects hypothesized in H2–H7 were tested using structural equation modelling (SEM) in AMOS version 23. The two-step approach of Kline (2016) was followed for the SEM analyses, first testing the measurement model which was subsequently used as input for testing the structural model. Model fit was assessed based on values of Chi-square, root mean squared error of approximation (*RMSEA*) and comparative fit index (*CFI*). In the final model, modality and narration style were included as independent variables, information recall as dependent variable, cognitive load and satisfaction with the information as mediating variables, and age and decision-making style as moderating variables.

Results

Sample characteristics

In total, 442 panel members completed the questionnaire. Ten participants who indicated to be familiar with one or both of the treatments discussed on the webpages of the decision aid were excluded for further participation resulting in a final sample of 432 participants (M_{age} = 58.19, SD_{age} = 18.53, range 18–95, 49.3% male, 32.6% low, 33.8% middle, 33.6% high level of education). See Table 4.1 for sample characteristics.

Table 4.1. Sample characteristics

Background variables	Sample	*N*
Demographic information		432
Age (years), mean (*SD*)**	58.19 (18.53)	
Gender		
Male, *n* (%)	213 (49.3%)	
Female, *n* (%)	219 (50.7%)	
Education level		
Low, *n* (%)	141 (32.6%)	
Medium, *n* (%)	146 (33.8%)	
High, *n* (%)	145 (33.6%)	
Average time spent on internet (hours per week)		421
In hours, mean (*SD*)	20.66 (18.06)	
Outcomes		432
Cognitive load, mean (*SD*)	3.35 (1.67)	
Satisfaction with information, mean (*SD*)	4.65 (1.09)	
Information recall, mean (*SD*)	9.06 (7.78)	

Randomization

Because of the stratification process, participants were equally divided over the six experimental conditions regarding age F (411) = .46, p = .805; gender F (411) = .47, p = .798; educational level F (411) = .88, p = .492; having some level of medical knowledge F (431) = .40, p = .851; and amount of internet use F (420) = 50.80, p = .979. There were no differences between conditions regarding identification with the character talking about CAP χ^2 (34) = 28.37, p = .740 and the character talking about CAPOX χ^2 (38) = 33.90, p = .660.

Model testing

To test the hypotheses, structural equation modelling was carried out in AMOS. Following Kline (2011), the measurement model was tested first using confirmatory factor analysis

(CFA) in AMOS before using the measurement structure in the structural model. As cognitive load and satisfaction were measured with multiple items, these variables were included in the model as latent structures, for which an item-based approach was handled (Little et al., 2002). Since information recall was measured with a sum score, this variable was considered as a unidimensional construct and was therefore eligible to be included in the measurement model as a parcelled structure (Little et al., 2002). The CFA analyses showed that all items used to measure the latent constructs cognitive load and satisfaction, significantly load on these constructs. This is also indicated by the acceptable model fit of the measurement model, χ^2 (15) = 65.395, p = .000, *CFI* = .99, *GFI* = .87, *TLI* = .99, *RMSEA* = .08 (Hooper, Coughlan, & Mullen, 2008). Even though the Chi-square is significant and the *RMSEA* value is not optimal, the *CFI*, *GFI* and *TLI* values indicate good fit. Thus, this measurement model was accepted and used as input for the structural model.

The hypothesis testing was done in two phases. First, H1, H2, H3, H5(a–c) and H6(a–c) were tested by adding the independent variables 'modality' and 'narration style' and the moderators 'age' and 'decisional style' to the measurement model, resulting in the first structural model. Although the structural model showed a significant chi-square, χ^2 (169) = 438.318, p < .001, the other model fit indices suggest good model fit *CFI* = .98, *GFI* = .92, *TLI* = .98, *RMSEA* = .06 (Hooper, Coughlan, & Mullen, 2008). Thus, the structural model was accepted and used to test H1, H2, H3, H5(a–c) and H6(a–c). In the second phase, H4, H5(d) and H6(d) were tested by adding the independent variable 'match between narration style and type of illustration' and the moderators 'age' and 'decisional style' to the measurement model, resulting in the second structural model. Model fit was again acceptable with a significant chi-square, χ^2 (91) = 212.284, p < .001, but the other model fit indices suggest good model fit *CFI* = .98, *GFI* = .93, *TLI* = .96, *RMSEA* = .07 (Hooper, Coughlan, & Mullen, 2008).

Hypotheses testing

Direct effects of modality and narration style (H1, H2, H3 & H4). The results showed no effect of modality on cognitive load (F (2, 431) = 2.62, p = .769). Combining text with affective illustrations (M = 2.99) or with cognitive illustrations (M = 3.02) did not result in significantly less cognitive load than text only (M = 2.92). Modality also did not have an effect on satisfaction with the information F (2, 431) = 2.20, p = .112). Text combined with affective illustrations (M = 4.79) or text with cognitive illustrations (M = 4.60) did not lead to significantly more satisfaction than text only (M = 4.54). Lastly, no effect of modality on information recall was found F (2, 431) = 1.95, p = .143). Thus, text and affective illustrations (M = 8.49) and text and cognitive illustrations (M = 10.14) did not

result in significantly better information recall than text only (M = 8.65). Therefore, H1 and H2 had to be rejected.

Narration style did not have a significant effect on cognitive load F (1, 431) = 1.26, p = .263), thus narrative text did not result in significantly less cognitive load (M = 2.90) than factual text (M = 3.04). In addition, narration style did not significantly affect satisfaction with the information F (1, 431) = 2.41, p = .121), i.e. narrative text did not lead to significantly more satisfaction (M = 4.73) than a factual text (M = 4.57). Besides, narration style did not influence information recall F (1, 431) = .00, p = .954), meaning that recall scores did not significantly differ for participants who received a narrative text (M = 9.09) and factual text (M = 9.05). Based on these results, H3 had to be rejected.

There was no significant interaction effect of modality and narration style on cognitive load F (2, 431) = .83, p = .435), satisfaction F (2 431) = .73, p = .481) or information recall F (2, 431) = .65, p = .524). This means that narrative text combined with visuals did not lead to the least cognitive load, the highest satisfaction and the best information recall, as compared to the other conditions. Meaning H4 was not supported.

Indirect effects of modality and narration style (H1, H2, H3 & H4). The sequential indirect effects of modality on information recall (β = 1.27, 95% CI [-6.62, 4.00], p = .578) and of narration style on information recall (β = 1.73, 95% CI [-6.24, 9.35], p = .618) were not significant, meaning there was no indirect effect of modality or narration style on information recall via cognitive load and satisfaction. Therefore, H3 and H4 must be rejected. Lastly, the sequential indirect interaction effect of modality and narration style on recall via cognitive load and satisfaction was not significant (β = -3.73, 95% CI [-8.89, 8.50], p = .927).

Regardless of the conditions, it was found that an increase in cognitive load resulted in a significant decrease in satisfaction (β = -.25, SE = .03, p < .001), which in turn was positively related to recall (β = 1.72, SE = .32, p < .001). The sequential indirect effect of cognitive load on recall was significant as well (β = -.43, 95% CI [-.77, -.25], p = .005). This means that an increase in perceived cognitive load results in a decrease in satisfaction with the information, which in turn worsens information recall.

Effects of match between narration style and type of illustration (H5). The results show no effect of match between narration style and type of illustration as compared to a no match between narration style and type of illustration (β = -.57, SE = .96, p = .556) on cognitive load. The sequential indirect effect of match between narration style and type of illustration on information recall was also not significant (β = 1.68, 95% CI [-2.37, 7.23], p = .436), meaning the match between narration style and type of illustration did not results in better information recall via a decrease in cognitive load and subsequently an increase in satisfaction. Therefore, H5 was not supported.

Moderation effects of age and decisional style (H6 & H7). Analyses showed no significant interaction effect of modality and age (β = .01, *SE* = .01, *p* = .655) and of narration style and age on cognitive load (β = .03, *SE* = .02, *p* = .073). Also, no three-way interaction effect of modality, narration style and age on cognitive load was found (β = -.02, *SE* = .02, *p* = .300). Furthermore, the sequential indirect interaction effects of modality and age (β = -0.27, 95% CI [-.088, .018], *p* = .361), narration style and age (β = -.086, 95% CI [-.15, -.012], *p* = .064), and modality, narration style and age (β = .066, 95% CI [-.02, .16], *p* = .182) on recall via cognitive load and satisfaction with the information were not significant.

Regarding decisional style, no interaction effect was found for modality and decisional style (β = -.42, *SE* = .31, *p* = .178) or for narration style and decisional style (β = -.38, *SE* = .32, *p* = .239) on cognitive load. Besides, no three-way interaction effect was found of modality, narration style and decisional style (β = .47, *SE* = .40, *p* = .243). The sequential indirect interaction effects of modality and decisional style (β = .81, 95% CI [-.14, 2.37], *p* = .171), narration style and decisional style (β = 1.21, 95% CI [-.29, 2.70], *p* = .180), and modality, narration style and decisional style (β = -1.11, 95% CI [-2.99, .58], *p* = .284) on recall via cognitive load and satisfaction were not significant.

Moderation effects of age and decisional style (H6 & H7). Analyses showed no significant interaction effect of the match between narration style and type of illustration and age on cognitive load (β = .002, *SE* = .01, *p* = .834). Besides, no significant interaction effect was found of match between narration style and type of illustration and decisional style on cognitive load (β = .16, *SE* = .23, *p* = .485). Therefore, H6d and H7d were not supported.

Additional analyses. As all hypotheses were rejected, additional analyses were carried out with SEM to get more insight into the data. First, the effects of the independent variables on satisfaction with the information and information recall were tested. Modality had no effect on satisfaction (β = -.42, *SE* = .55, *p* = .447) and recall (β = .87, *SE* = 1.27, *p* = .746). In addition, narration style did not have an effect on satisfaction (β = -1.21, *SE* = .63, *p* = .056) and recall (β = -.31, *SE* = 1.04, *p* p = .766). Looking into the effects of age and decisional style on cognitive load, satisfaction and recall, age did not have a significant relationship with cognitive load (β = .01, *SE* = .01, *p* = .960), satisfaction (β = -.001, *SE* = .004, *p* = .749), and recall (β = -.02, *SE* = .03, *p* = .494). However, decisional style had a significant effect on cognitive load (β = .72, *SE* = .25, *p* = .005), satisfaction (β = -.51, *SE* = .12, *p* < .001), and recall (β = -2.76, *SE* = .80, *p* < .001), in such a way that a more intuitive decisional style was related to more cognitive load, less satisfaction and worse recall.

With regards to the interaction effects of modality combined with age and decisional style, analyses showed no significant effect of modality and age on satisfaction (β = -.01, *SE* = .01, *p* = .235) and recall (β = -.01, *SE* = .04, *p* = .843). Besides, there was

no effect of modality and decisional style on satisfaction (β = .24, *SE* = .13, *p* = .072) and no significant effect on recall (β = .10, *SE* = .78, *p* = .893). With regards to the interaction effects narration style combined with age and decisional style, no significant interaction effect of narration style and age was found on satisfaction (β = -.01, *SE* = .01, *p* = .351) and recall (β = .01, *SE* = .03, *p* = .811). However, analyses showed a significant interaction effect of narration style and decisional style on satisfaction (β = .54, *SE* = .15, *p* < .001), but not on recall (β = 1.27, *SE* = .77, *p* = .100). This means that narrative narration style increases satisfaction with the information, as compared to factual narration style, for individuals with a more intuitive decision making style instead of a rational decision making style.

Conclusion & discussion

The aim of this study was to test two information presentation strategies, multimedia information (combining text and illustrations) and narratives, in a decision aid for cancer patients. It was hypothesized that both strategies would decrease cognitive load and in turn lead to more satisfaction and subsequently better information recall. In addition, it was expected that a match between the narration style and the type of illustration would result in better outcomes as compared to no match in terms of satisfaction and recall. These effects were expected to be stronger for older (vs. younger) patients, and patients with an intuitive (vs. rational) decision-making style.

In line with our expectations, a decrease in cognitive load resulted in an increase in satisfaction and subsequently in better information recall. However, cognitive load was not decreased by adding illustrations to textual information and providing the information in a narrative style (vs. a factual style). Furthermore, a match between narration style and type of illustration (narrative text combined with affective illustrations, or factual text combined with cognitive illustrations) was not more effective as compared to a no match (narrative text combined with cognitive illustrations, or factual text combined with affective illustrations). Also no interaction effects between modality, match, age and decisional style on cognitive load were found. Nevertheless, there was a significant interaction effect of decision making style and narration style on satisfaction with the information. Patients that had an intuitive decision making style benefitted more from narrative information than from factual information as compared to patients with a rational decision making style. Besides, additional analyses showed that patients with an intuitive decision making style perceived more cognitive load from the decision aid as compared to patients with a rational decision making style, regardless of the modality or the narration style. Subsequently, the higher perceived cognitive load of these patients

resulted in lower satisfaction and worse information recall as compared to patients with a rational decision making style. It can be concluded that patients with an intuitive decision making style are more at risk to perceive higher levels of cognitive load and could therefore benefit more from certain information presentation style, such as narrative information.

The results of the current study support the notion that lowering cognitive load can positively influence satisfaction with and recall of information within the context of medical decision aids. This means that lowering cognitive load is an effective strategy to aim for when optimizing decision aids. However, in contrast to our expectations, adding illustrations to textual information presented in decision aids, or presenting information in a narrative narration style were not found to be effective strategies to lower cognitive load, and subsequently increase satisfaction and information recall). Additionally, a patient's age or decisional style did not influence the relation between modality or narration style and the outcome measures.

With regard to the addition of illustrations, the results of the current study do therefore not support the CTML, stating that information presented in multiple modalities can decrease cognitive load and improves learning (Mayer, 2014; Sweller, 2011). Results of previous research with regards to the effect of combing text with static illustrations are mixed. While one study showed that adding static illustrations increased satisfaction with the information (Bol et al., 2014) another study showed that text combined with illustrations was perceived as more comprehensible than textual information only, albeit without being perceived as more attractive and not improving information recall (van Weert et al., 2011). Previous research within the context of online health information provision did find multimodal information to positively influence satisfaction with the information (Bol et al., 2015; de Looper et al., 2020) and information recall (Bol et al., 2013; Bol et al., 2015; de Looper et al., 2020; Meppelink et al., 2015). However, in these studies the multimedia information consisted of videos or animations. Possibly adding illustrations to textual information is not substantial enough to reduce cognitive load, as compared to animations or videos. Even though, according to Mayer (2005), illustrations are processed via the visual/pictorial channel and text is processed via the verbal/auditory channel, both text and static illustrations are initially received via the visual/pictorial processing channel. This could explain the absence of a multimedia effect in the current study as compared to the effects found regarding animations (de Looper et al., 2020).

Besides, previous studies that found positive effects of static illustrations focused on information presentation in informative health websites instead of in online decision aids (Bol et al., 2014; van Weert et al., 2011). It could be argued that patients engage in more elaborate information processing when receiving a decision aid, since the purpose is to make an informed decision about a serious issue, choosing the best treatment option, as compared to processing information presented at a more general informative

health website. If patients engage in more elaborate information processing when using a decision aid, the way in which the information is presented might be less of influence with regards to outcomes such as satisfaction and information recall.

Adding affective illustrations to text in a decision aid was expected to reduce cognitive load because it could evoke emotions, increase motivation and interest and thereby enhance information processing and decrease cognitive load (Mayer, 2014). According to previous research, illustrations in which faces or social situations are depicted prompt emotions and result in better comprehension (Plass et al., 2014). However, affective illustrations in which not only faces or social situations are portrayed, but also cognitive information is explained showed to decrease cognitive load (Um et al., 2012). Even though the affective illustrations used in the current study showed faces of the patients and the healthcare providers engaging in a social interaction, no cognitive information was represented in these illustrations. Possibly adding illustrations to textual information is most effective when the illustrations contain both an affective component as well as a cognitive component.

Taking results from the current study together with prior research, animations seem to be more effective in reducing cognitive load, and improving satisfaction and recall within the context of decision aids than static, soundless illustrations (i.e. pictures). Future research could investigate the effectiveness of other types of static, soundless illustrations, for example illustrations that comprise both an affective element as well as a cognitive element. Besides, it could be studied whether such static, soundless illustrations are effective in situations where patients are already less motivated to process the information, for example within the context of more general informative health websites.

Furthermore, narrative narration style did not decrease cognitive load (and subsequently did not increase satisfaction or improve information recall). This is noteworthy since exactly the same narrative stimulus was used as in a previous experiment in which narrative information resulted in more satisfaction with the information as compared to factual information, but not better information recall (de Looper et al., 2020). It has to be noted that in the current experiment cognitive load was taken into account in the analyses as underlying mechanism, whereas this was not the case in the previous experiment. Possibly another underlying mechanism, instead of decreased cognitive load, was responsible for the positive effect of narratives on satisfaction found previously. Even though narratives in online health information have showed to increase satisfaction (de Looper et al., 2020), it is unknown whether a decrease in cognitive load explains this effect.

Since the narratives in the current study provided factual as well as contextual information, the narrative conditions consisted of more information than the factual conditions. Previous research suggested that the amount of information may negatively

influence recall, especially for older patients (Jansen, Butow, et al., 2008). Therefore, the amount of information provided in the narratives could complicate information processing, thereby diminishing the potential positive effect of the narrative regarding cognitive load. For older patients who already struggle with processing complex medical information, it can be particularly difficult if the total amount of information increases. Thus a relatively long narrative text may be more difficult to process for older patients as compared to younger patients. This could explain why no age interaction effects of the narration style and age were found in the current study.

It has to be noted that the results of previous research do not convincingly indicate narratives being effective in improving patient outcomes. For example in the previous experiment of the authors of the current study, narratives have shown to improve satisfaction with the information, but not information recall (de Looper et al., 2020). This same pattern regarding recall was found in another study (Bol et al., 2016). These findings combined with the findings of the current study ask for careful conclusions regarding the positive effects of narratives in online health information or online decision aids. However, different types of narratives possibly yield different results. Within the field of medical decision making, Shaffer and Zikmund-Fisher (2013) divided narratives into three categories: outcome narratives, or narratives including the discussion of the consequences of the treatment decision, process narratives, or narratives in which the decision making process of the character is described, and experience narratives, or narratives in which personal experiences of the character are described with regards to the illness. The narratives used in the current study were a combination of process narratives and experience narratives. A previous study did not find an effect of process narratives and experience narratives on satisfaction with the information in general, but only for older patients (Yilmaz, 2020). Future research could investigate whether certain types, or combinations of types, of narratives yield more compelling results for specific patient populations, such as older patients or patients with a more intuitive decision-making style.

Lastly, the results showed that patients with a more intuitive decisional style experienced more cognitive load, were less satisfied and recalled less information than patients with a less intuitive decisional style. Unexpectedly, patients with an intuitive decisional style were more satisfied with a narrative text than with a factual text as compared to patients with a less intuitive decisional style. Based on these results it can be concluded that narrative information is especially important to support patients with an intuitive decision making style. As these patients do not prefer to review an extensive amount of information to base their decision on, information only consisting of facts and numbers might not be appreciated. However, since patients with an intuitive decision making style prefer to rely on emotions and feelings when making decisions, narrative

information might help them to experience certain emotions that would come with the decision through the character and thereby decreasing cognitive load. It should be noted that our results also suggest that patients with an intuitive decision making style are more vulnerable for worse information recall as they experience higher cognitive load than patients with a ration decision making style. This could eventually negatively influence their informed decision making. Therefore, future research should look into information presentation styles to support these patients in decreasing cognitive load and making informed treatment decisions, for example testing other forms of affective information. For example, patient testimonials, short experiences from real patients instead of more elaborate narratives could be effective in decreasing cognitive load.

Strength & limitations

A major strength of this study is that the stimulus material is identical to the materials used in a previous study conducted by the authors (de Looper et al., 2020), allowing for direct comparison between the two experiments. As a consequence, the differences found between the studies to can be attributed to the difference in modalities rather than differences in the stimuli. Hence, our conclusions are based on the results of both studies, providing us with a broader understanding of the effects of multimodal and narrative information.

A limitation of this study is that some design elements influenced the external validity of the results. First, the participants included in this study were (former) cancer patients who had registered themselves for participation in online studies. Therefore, the results might not be generalizable to patients in a clinical setting. Patients in the current study were asked to imagine a scenario in which they were just diagnosed with colorectal cancer, but patients in a clinical setting that are actually just diagnosed might differ in several ways that could influence their information processing and their experience with the information. Even though (former) patients should be able to imagine just being diagnosed as they al went through this at some point, and this is a validated method (Van Vliet et al., 2012), these patients could still differ from patients that are recently diagnosed with regards to their emotional state such as anxiety (Bronner et al., 2019). Future research could look into the effects of illustrations in a real-world clinical setting to get better insights into the effects of illustrations among patient populations that experience higher levels of cognitive load.

Second, multimodal, multimedia, and narrative information where tested in a decision aid only aimed at one type of colorectal cancer and offered patients only two treatment options. Therefore, the results of this study might not be generalizable to other types of cancer that ask for a more complicated treatment decision, for example a

decision between more than two treatment options. Future research should investigate whether illustrations and narrative information are effective in the case of more complex medical decision making.

Lastly, this study was carried out as an online experiment and patients were asked to make the decision entirely on their own. Normally, in a clinical setting, patients would get the chance to discuss their options with their healthcare provider, whereas patients in this experiment only had the information available in the decision aid to base their decision on.

Final conclusion

To conclude, in the current study no effect was found of modality, narrativity, match between narration style and illustration on cognitive load, satisfaction with the information and information recall. Besides, no interaction effects of age and decisional style were found. We were not able to replicate the effects of multimodal information in the form of animations, found in a previous study, to multimedia information in the form of static illustrations. Therefore, it can be carefully concluded that animations might be more effective in improving patient outcomes than static illustrations. Regarding narrative information, previous positive findings on satisfaction and information recall of a previous study could not be replicated. Therefore, taking into account the results of the current study and the high costs that come with developing narrative information, narratives are not necessarily advised to be included in online decision aids. However, the results of the current study indicate that patients with an intuitive decision making style were more satisfied with narrative information than with factual information. These patients are more at risk to experience higher cognitive load and, subsequently, less satisfaction with the information and worse information recall. Therefore, patients with an intuitive decision making style should be considered when developing decision aids. More research should be done to find information provision strategies to support these patients.

Lastly, we did find that a decrease in cognitive load increases satisfaction with the information and subsequently information recall. For future research it is advised to look into other strategies in online decision aids aimed at cancer patients, to decrease cognitive load and subsequently increase satisfaction and improve information recall, for example testing different forms of audiovisual information.