Enhancing patient participation among older and migrant cancer patients through eHealth

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CHAPTER 3

Testing the effects of modality and narration style on patients' information use in a lung cancer treatment decision aid

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ABSTRACT

Background Risk information in patient decision aids (PDAs) is often difficult to process for older patients. Providing audiovisual and narrative information may enhance understanding and use of health-related information. We studied the effects on patients' information processing and use of including audiovisual and narrative information in an early stage non-small cell lung cancer treatment decision aid explaining surgery and stereotactic ablative radiotherapy. We further investigated differences between older and younger patients.

Methods We conducted a 2 (Modality: textual vs audiovisual) x 2 (Narration style: factual vs narrative) online experiment among cancer patients and survivors (N=305; M_{age}=62.42, SD=11.68). Age was included as a potential modifier: younger (<65 years) versus older (≥65 years) age. We assessed: (1) perceived cognitive load, (2) satisfaction with information, (3) comprehension, (4) information recall, and (5) decisional conflict. ANOVAs were used for data analysis.

Results Irrespective of patient age, audiovisual information (compared to textual information) led to lower perceived cognitive load, higher satisfaction with information and lower decisional conflict (subscale Effective Decision). Narrative information (compared to factual information) led to reduced decisional conflict (subscale Uncertainty), but only in younger patients. Combining audiovisual information with factual information also resulted in lower perceived cognitive load in younger patients compared to older patients.

Limitations Patients who actually face the decision, especially older patients, might be more motivated to process our decision aid information than the present study participants who responded to a hypothetical situation online.

Conclusions Providing participants with audiovisual information, irrespective of their age, improved their processing and use of information in a decision aid. Narratives did not clearly benefit information processing.

INTRODUCTION

Older cancer patients are increasingly expected to make informed and preference-sensitive decisions about their treatment after being provided with evidence-based risk information. Such information relates to the benefits and harms of treatment options, which a patient considers in the light of personal values and preferences (Bekker, 2010; Lewis & Pignone, 2009). To prepare patients, many patient decision aids (PDAs) have been developed which provide evidence-based risk information and value clarification exercises (Bekker et al., 2013; Cardona-Morrell et al., 2017; McAlpine et al., 2018; Stacey et al., 2017; Zdenkowski et al., 2016). In older patients, the use of PDAs can foster better quality decisions by reducing decisional conflict and enhancing satisfaction with the decision-making process (Cardona-Morrell et al., 2017). However, the risk information provided may be difficult to process and use (Gaissmaier & Gigerenzer, 2008; Rakow et al., 2015), and this problem is likely exacerbated with older age. Prior research has indicated that a beneficial effect of using PDAs is less in older patients as compared to younger patients (van Weert et al., 2016). This finding may be a consequence of the needs and information processing characteristics in older adults being neglected in PDA designs (van Weert et al., 2016).

Recent studies indicate that processing and use of health-related information can be enhanced by presenting information in an audiovisual modality (instead of text) (Bol et al., 2013; Bol et al., 2015; Leahy & Sweller, 2011; Meppelink et al., 2015; Shaffer, Owens, et al., 2013) and in a narrative narration style (instead of factual) (Bekker et al., 2013; Bol et al., 2013; Bol et al., 2015; Khangura et al., 2008; Kreuter et al., 2007; Osaka & Nakayama, 2017; Shaffer et al., 2018; Shaffer, Hulsey, et al., 2013; Shaffer & Zikmund-Fisher, 2013). Such a comprehensive, multimedia approach (i.e. combining audiovisual and narrative information) is often used in health communication and might be beneficial for older patients who use PDAs (Bol et al., 2013). For example, narratives can provide patients with emotional and social information that is often lacking in factual information (Greenhalgh & Hurwitz, 1999). Additionally, older adults weigh information differently than younger patients in health-related decision-making (Baker et al., 2000; Mayer, 2002; Sparks et al., 2013); specifically, older patients rely more on emotional, intuitive reasoning (Peters, 2011). However, it remains little studied whether the emotional aspect of narratives may lead to more optimal processing and use of information compared to factual information in older patients processing risk information in PDAs. Although multimedia presentations are increasingly used and studied in PDAs (Shaffer, Owens, et al., 2013), experimental studies comparing such approaches to textual and factual information have remained scarce. Therefore, this study aimed to assess the effects of audiovisual information and narrative information in a PDA on information processing and use in older patients compared to younger patients.

Risk information in PDAs is typically presented textually (i.e. written) and often with visual displays, rather than presented in an audiovisual modality. The Cognitive Theory of Multimedia Learning (CTML; (Mayer, 1999)) predicts a modality effect when information is presented in auditory format combined with visuals, for instance in an animation (i.e. audiovisual information), compared to information in written format only (Dunn et al., 2004; Ginns, 2005; Sparks et al., 2013). In particular, information can be divided over different processing channels and, consequently, more information can be processed before cognitive overload occurs (Leahy & Sweller, 2011; Mayer, 2002). Recent studies in health communication provided support for CTML by showing that audiovisual information (compared to textual information) results in better recall (i.e. ability to remember and reproduce information) (Bol et al., 2013; Bol et al., 2015; Meppelink et al., 2015) and higher satisfaction with the provided information (Bol et al., 2013). Older patients are expected to benefit more from audiovisual information as they face age-related declines in working memory capacity (Baker et al., 2000; Bopp & Verhaeghen, 2005; Brown & Park, 2003; Crome & Lally, 2011; Delgado-Guay et al., 2013; Jansen, van Weert, et al., 2008; Posma et al., 2009; Sparks & Nussbaum, 2008). As a result, older patients may experience greater cognitive overload than younger patients (Brown & Park, 2003), likely leading to dissatisfaction with information and decisional conflict (Parrott et al., 2008). Such dissatisfaction, in turn, might lead to lower information comprehension (i.e. ability to understand the meaning of words, pictures, or their overall meaning) (Brown & Park, 2003) and lower information recall (i.e. ability to remember and reproduce information) (Bol et al., 2014). Altogether, it can be hypothesized that: *being provided with audiovisual information in a PDA, compared to textual information, will have a positive effect on cancer patients' satisfaction with information, information comprehension, and information recall, and a negative effect on perceived cognitive load and decisional conflict (H1a). This effect of audiovisual information will be greater in older patients compared to younger patients (H1b).*

Risk information in PDAs is usually presented in a factual style. However, a narrative style that uses illustrative examples of other patients' experiences relevant to the decision (Winterbottom et al., 2008), combined with the facts, can induce an effective interplay of deliberative and intuitive reasoning, both of which are needed for good quality decision-making. Firstly, narratives can induce elements of deliberative reasoning, mainly by increasing people's motivation to attend to the information, thus making information more memorable and salient, and also by modeling the decision-making process, and by providing a coherent framework for decision-making (Bekker et al., 2013; Wise et al., 2008). This way, narratives can result in higher satisfaction when compared to factual information (Bol et al., 2013), enhanced comprehension (Khangura et al., 2008), better recall (Bekker et al., 2013; Bol et al., 2013), and less decisional conflict (Osaka & Nakayama, 2017). Secondly, the temporal and causal framework in which the narrative links together events, accompanied by the credibility of the narrative's character and affective descriptions, can induce intuitive reasoning (Bekker et al., 2013). Thus, narratives can enhance recall, because people intrinsically try to understand the story of another person (Bol et al., 2015). As older patients are known to have better narrative recall than younger patients (Bol et al., 2015; Sparks & Nussbaum, 2008), providing them with narrative information might be especially beneficial. Hence, we hypothesized that: *being provided with narrative information in a PDA, compared to factual information, will have a positive effect on cancer patients' satisfaction with information, information comprehension, and information recall, and a negative effect on perceived cognitive load and decisional conflict (H2a). The effect of narrative information will be greater in older patients compared to younger patients (H2b).*

Based on the abovementioned theories and evidence, we hypothesized two-way and three-way interactions: *being provided with audiovisual narrative information in a PDA, compared to other combinations of modality and narration style, will have a positive effect on cancer patients' satisfaction with information, information comprehension, and information recall, and a negative effect on perceived cognitive load and decisional conflict (H3a). Furthermore, the effect of audiovisual narrative information will be greater in older patients compared to younger patients (H3b).*

METHODS

Design

This study contained a between-subjects factorial 2 (narration style [factual vs narrative]) x 2 (modality [text vs audiovisual]) experimental design. Age was included as a potential modifier, distinguishing between younger (<65 years) and older (≥65 years) age. Participants were stratified by age first, and then assigned to one of the four conditions through automatic randomization (allocation ratio = 1:1:1:1): 1) textual factual information (*n*=62), 2) textual narrative information (*n*=75), 3) audiovisual factual information (*n*=88), and 4) audiovisual narrative information (*n*=80). The Medical Ethics Committee of Amsterdam UMC, location VUmc, approved the study (2016.587). Written consent was obtained from all participants.

Materials

Prior to data collection, stimulus materials that presented the benefits and harms of two preference-sensitive treatment options (surgery and stereotactic ablative radiotherapy [SABR; radiotherapy whereby focused beams from many angles target the tumor, which leads to the tumor receiving a high dose radiation]) were developed, based on existing information from a Dutch PDA (http://www.keuzehulp-longkanker.nl/). The medical informational content of stimulus materials was evaluated by a surgeon (CD), a radiation oncologist (SS), and a pulmonologist (AB), in order to ensure compliance with current scientific evidence and consensus.

Based on the information from the existing PDA, four scripts were prepared: (1) factual information about surgery, (2) factual information about SABR, (3) narrative information about surgery, and (4) narrative information about SABR. Each participant in each condition received information on the two treatment options, enabling them to make a hypothetical treatment decision in the survey. Both factual and narrative information covered the same information about the two treatment options: (a) details of the procedures (i.e. how does the treatment occur), (b) the outcomes (i.e. 5-year survival rates), and (c) the potential side-effects (i.e. fatigue, pain, and nausea). Hence, in the two conditions, exactly the same benefits and harms were described, exactly the same numerical information was given, and exactly the same number of words was used for basic information content. However, in the narrative condition, this basic content was enriched with contextual information about the main character's experiences (Shaffer & Zikmund-Fisher, 2013). This extended information was based on a previously conducted interview study (unpublished) by the first and last authors (NGY and OCD). For instance, in the narrative about surgery, process information (see Shaffer & Zikmund-Fisher, 2013) was provided as follows: *"For the surgery I was admitted to the hospital. And I received complete anesthetics. I did not mind that. I have been operated before."* Information about treatment outcomes (see Shaffer & Zikmund-Fisher, 2013) was described as: *"Of course the doctor explained exactly what the differences were, but also said that the survival rate after both treatments is approximately equal. I exactly remember the corresponding numbers: 5 years after surgery, 74 out of 100 patients are still alive."* Information about experiences (see Shaffer & Zikmund-Fisher, 2013) was conveyed as: *"I was quite tired after the surgery and also had severe pain in my wound. They did not have to make me laugh at that time. But luckily, I got good painkillers. That helped."* (*Appendix A* presents the complete narratives).

For the audiovisual conditions, six animated videos (i.e. 'a simulated motion picture depicting movement of drawn (or simulated) objects' (Mayer & Moreno, 2002, p. 88)) were developed with the exact same content as the textual conditions: (1) factual information about surgery, (2) factual information about SABR, (3) narrative information about surgery, recorded with a female voice, (4) narrative information about surgery, recorded with a male voice, (5) narrative information about SABR, recorded with a female voice, (6) narrative information about SABR, recorded with a male voice. To make it more likely that participants identified with the animated character, all female participants were exposed to narrative information recorded with a female voice, and all male participants were exposed to narrative information recorded with a male voice. Again, information was structured into procedures, outcomes, and side-effects.

Participants

All participants were either cancer patients (all types) or survivors. We recruited these so-called 'analogue' patients, i.e. persons who imagine the hypothetical health situation of our target population to test the effectiveness of theory-based features (van Vliet et al., 2012). Participants were included if they: (1) were 18 years and older, (2) had a sufficient mastery of the Dutch language (in both reading and speaking), and (3) had already completed their main therapy (to avoid burden to those who might still have to choose a treatment, and to avoid that participants would have prior knowledge about the stimulus material). Participants were recruited through Flycatcher Panel (ISO20252 and 26362 certified), an online research panel. Prior to data collection, Flycatcher sent selection questions to panel members to identify potential participants meeting our inclusion criteria. In total, 6,749 members filled out the selection questions, of which 421 met the inclusion criteria. These 421 members were invited for the study, and 303 members participated (response rate = 72.0%). Eligible panel members were also invited to refer others to the study. This approach, similar to snowball sampling, resulted in an additional two participants, resulting in 305 participants altogether. For this study, an a priori sample size calculation was performed in G*Power for a 2x2 factorial design with a medium effect size of .25 (Cohen's f) and a two-sided significance level of .05. According to this calculation, at least 270 participants needed to be included for sufficient power (.80). Later, a post-hoc power analysis was performed with cognitive load as the primary outcome, yielding sufficient power (up to .99 depending on hypothesis). Data quality was guaranteed by: (1) pre-testing the minimum time needed to read the text; based on this, participants could only move to the next page after 120-155 seconds, and (2) having Flycatcher check data quality and remove data of insufficient quality. Flycatcher checked completed surveys on answers to open-ended questions for information recall, consistency in answers, straight lining (i.e. providing a series of answers in the same column on a rating scale), and time spent to complete the survey, according to their a priori guidelines.

Procedure

Participants received a link to an online survey through Flycatcher. In an opening screen, participants were informed about the study aim, the confidentiality of data, and voluntary participation. Subsequently, participants were asked to tick the box for informed consent. Depending on the condition, they either read textual information or watched audiovisual information. When participants completed their review of provided information, they were directed to the survey.

Measures

The primary outcome was perceived cognitive load. Other dependent variables were: satisfaction with information, information comprehension, information recall, and decisional conflict (see *Appendix B* for outcome measures). Furthermore, socio-demographic variables (age, educational level, health literacy, numeracy, and comorbidity) were assessed. Participants were asked to indicate which health conditions they have, and comorbidity was defined as having more than one condition.

Perceived cognitive load

We used the four item scale developed by Eveland and Dunwoody (2001) (Eveland & Dunwoody, 2001) that measured perceived cognitive load on a 7-point Likert scale (*1=strongly disagree* to *7=strongly agree*; *α*=.78).

Satisfaction with information

We used the Website Satisfaction Scale (Bol et al., 2014; van Weert et al., 2011) containing three subscales. We calculated a total scale (i.e. Satisfaction with information; *α*=.88) and three subscales (i.e. Satisfaction with the attractiveness of the information, *α*=.84; Satisfaction with the comprehensibility of the information, *α*=.90; and Satisfaction with emotional support from the information, *α* =.93). All ten items had a 7-point Likert scale (*1=totally disagree* to *7=totally agree*).

Information comprehension

We posed eight multiple choice questions to assess whether participants comprehended the gist of information. Gist comprehension refers to the 'bottom-line meaning of the information' (Reyna, 2008, p. 2). For each question, only one response option was correct.

Information recall

We posed 15 open questions which were based on the Netherlands Patient Information Recall Questionnaire (Jansen, van Weert, et al., 2008). The questions related to the specific information from the texts or the videos and consisted of three response options. For each question, only one response option was correct.

Decisional conflict

We used the Decisional Conflict Scale (O'Connor, 1995) (*α*=.95). In order to match the aim of the survey, we included only the subscales 'Informed' (*α*=.88), 'Values clarity' (*α*=.91), 'Uncertainty' (*α*=.91), and 'Effective decision' (*α*=.93). All 13 items had a 5-point Likert scale (*1=totally disagree* to *5=totally agree*).

Identification

Identification was measured using the Video Engagement Scale (Visser et al., 2016). In order to match the aim of the survey, we included only three items related to 'Identification' (*α*=.96). All items had a 7-point Likert scale (*1=completely disagree* to *7=completely agree*).

Manipulation Check

A manipulation check was conducted prior to and during actual data collection. Prior to data collection, we asked six items which addressed the extent to which information provided was perceived as factual (e.g. "*The information focused on the facts only*") and narrative (e.g. "*The information described experiences of a patient*"). During data collection, we also assessed the extent to which participants identified with characters in the audiovisual narrative condition. *Appendix C* describes the manipulation check in more detail.

Statistical analyses

Data were analyzed in SPSS, version 26. For information recall, a preliminary codebook was developed by the researchers (NGY and OCD) before data analysis was commenced and was used by them independently to score responses to the seven questions (46.7%). After the first round of independent scoring, the researchers discussed scores and adapted the codebook. The adapted codebook was used by the researcher (NGY) to score the questions again. The two researchers discussed the new scores to ensure their validity. After this iterative process, final codes and scores were decided upon, and the researcher (NGY) went through all codes once more to check the final scores. The maximum score for a correct answer differed by question and ranged from 0 (not recalled) to 1.5 points (completely recalled) (α=.89). Sum scores ranged from zero to 14.5 (IRR = .90). ANOVAs were conducted to test effects of modality (*H1a*) and modality*age (*H1b*), narration style (*H2a*) and narration style*age (*H2b*), and the interaction effect of modality*narration style (*H3a*) and modality*narration style*age (*H3b*) on the outcome variables. For comparisons between younger and older patients, participants younger than 65 years were considered 'young', and participants aged 65 years or older as 'old'. To account for potential effects of multiple hypothesis testing, we applied a Bonferroni correction.

RESULTS

Sample characteristics

Table 5 describes the sample characteristics. The total sample consisted of 305 participants of whom 61.3% were female (*n*=187). Participants in the final sample were aged between 21.4 and 91.9 years. Overall, participants showed a high level of health literacy (*M*=17.27, *SD*=3.93; range=1.00–22.00). The majority (73.6%) answered the numeracy question incorrectly and suffered from comorbidity (90.2%). On average, they rated their quality of life as moderate (*M*=9.94 *SD*=2.52; range=1.00–14.00), and about a third had been diagnosed with breast cancer (31.5%).

Table 5. Sample characteristics.

	Total sample (N=305)	Younger patients (n=162)	Older patients (n=143)
Socio-demographic characteristics			
Age (*M ± SD*)	62.24 ± 11.68	54.00 ± 9.30	71.83 ± 4.93 ***
Gender *(% female)*	61.3	74.1	46.9 ***
Level of education *(%)*			
Low	31.1	25.3	37.8
Moderate	38.4	43.8	32.2 *
High	30.5	30.9	30.1
Health literacy *(M ± SD; range=1–22)*	17.27 ± 3.93	17.59 ± 3.79	16.90 ± 4.07
Numeracy *(% correct)*	26.4	29.9	22.4
Comorbidity *(% yes)*	90.2	87.7	93.0
Quality of life *(M ± SD; range=3–14)*	9.94 ± 2.52	10.01 ± 2.62	9.86 ± 2.40
Diagnosis *(% yes)*			
Lung	5.6	4.3	7.0
Breast	31.5	38.9	23.1 **
Stomach or liver	1.0	1.2	0.7
Colorectal	11.1	6.8	16.1 **
Gynecological	6.9	9.9	3.5 *
Blood of lymphatic	5.9	8.6	2.8 *
Urological	17.0	7.4	28.0 ***
Skin	17.7	18.5	16.8
Other	13.8	13.6	14.0
Outcome measures			
Perceived cognitive load *(M±SD; range=4–22)*	8.93 ± 4.31	8.52 ± 4.38	9.39 ± 4.20
Decisional conflict			
Low (%)	62.6	61.1	64.3
Moderate (%)	22.0	22.2	21.7
High (%)	15.4	16.7	14.0
Comprehension of information *(M±SD; range=0–8)*	6.68 ± 1.15	6.73 ± 1.11	6.61 ± 1.19
Information recall *(M±SD; range=0–12.7)*	5.75 ± 2.93	6.16 ± 2.88	5.28 ± 2.94 *
Satisfaction with information *(M±SD)*			
Attractiveness *(range=3–21)*	13.67 ± 3.79	13.54 ± 4.07	13.81 ± 3.47
Comprehensibility *(range=9–21)*	18.61 ± 2.77	19.01 ± 2.59	18.15 ± 2.90 *
Emotional support *(range=4–28)*	17.87 ± 5.74	17.10 ± 5.84	18.74 ± 5.51 *

*** p < .001 ** $p \leq$ .01 * $p \leq$ .05

The effects of modality (H1a)

Modality had a significant main effect on perceived cognitive load, total satisfaction with information, satisfaction with the attractiveness of the information, and the decisional conflict subscale 'Effective Decision'. Patients who viewed audiovisual information, compared to patients who viewed textual information, perceived significantly less cognitive load (M_{dif} = -2.00, p < .001, 95% CI [-2.95 ; -1.05]), more total satisfaction with the information (M_{dif}=2.46, p=.025, 95% CI [0.31 ; 4.61]) and in particular more satisfaction with the attractiveness of the information (M_{dif}=1.53, p < .001, 95% CI [0.68 ; 2.37]), and less decisional conflict ('Effective Decision') (M_{dif} = -0.79, p=.020, 95% CI [-1.45 ; -0.13]).

Modality had no significant effect on satisfaction with the comprehensibility of the information (M_{dif} =0.43), or satisfaction with emotional support from the information (M_{dif}=0.51); information comprehension (M_{dif}=0.15); information recall (M_{dif}=0.55); total decisional conflict, (M_{dif}= -2.83) and its subscales 'Informed' (M_{dif}= -0.03), 'Values Clarity' (M_{dif} = -0.17), and 'Uncertainty' (M_{dif}= -0.49). Altogether, H1a was partially supported for perceived cognitive load, total satisfaction with information, satisfaction with attractiveness of the information, and decisional conflict concerning effective decision making.

The interaction effects of modality and age (H1b)

Modality and age did not have significant interaction effects on perceived cognitive load (η^2=.004); total satisfaction with information (η^2=.000) or any of its subscales; information comprehension (η^2=.000); information recall (η^2=.001); or total decisional conflict (η^2=.000) or any of its subscales. Thus, H1b was not supported.

The effects of narration style (H2a)

Narration style had no significant effect on perceived cognitive load (M_{dif} = -0.64); total satisfaction with information (M_{dif} =0.57) or any of its subscales; information comprehension (M_{dif} =0.04); information recall (M_{dif} =0.10); or total decisional conflict (M_{dif}=-0.51) or any of its subscales. Hence, H2a was not supported.

The interaction effects of narration style and age (H2b)

Narration style and patient age significantly interacted on the subscale 'Uncertainty' of decisional conflict. Specifically, younger patients who viewed narrative information scored lower on the subscale 'Uncertainty' (i.e. were less uncertain) than younger patients who viewed factual information (M_{dif}= -0.93, p=.030, 95% CI [-1.77 ; -0.09]) whereas narrative style had no significant effect on older adults. Narration style and age did not have significant interaction effects on perceived cognitive load (η^2=.001); total satisfaction with information (η^2=.002) or any of its subscales; information comprehension (η^2=.000); information recall (η^2=.006); or total decisional conflict (η^2=.007) or its subscales 'Informed' (η^2=.000), 'Values Clarity' (η^2=.003), and 'Effective Decision' (η^2=.005). Altogether, H2b was not supported.

The interaction effects of modality and narration style (H3a)

Modality and narration style had no significant interaction effects on perceived cognitive load (η^2=.000); total satisfaction with information (η^2=.002) or any of its subscales; information comprehension (η^2=.003); information recall (η^2=.000); or total decisional conflict (η^2=.001) or any of its subscales. Therefore, H3a was not supported.

The interaction effects of modality, narration style and age (H3b)

The interaction between modality, narration style, and age had a significant interaction effect on perceived cognitive load. Younger patients exposed to audiovisual factual information (M_{dif}= -4.13, p < .001, 95% CI [-6.02 ; -2.24]) or textual narrative information (M_{dif}= -2.08, p=.031, 95% CI [-3.97 ; -0.19]) perceived less cognitive load than younger patients exposed to textual factual information. Older patients provided with audiovisual narrative information perceived less cognitive load than older patients provided with textual narrative information (M_{dif}= -3.09, p=.002, 95% CI [-5.06 ; -1.12]) or audiovisual factual information (M_{dif}= -2.28, p=.014, 95% CI [-4.10 ; -0.46]). Younger patients provided with audiovisual factual information perceived less cognitive load than older patients provided with the same information (M_{dif}= -2.83, p=.001, 95% CI [-4.57 ; -1.10]).

The interaction between modality, narration style and age had no significant effect on total satisfaction with information (η^2=.002) or any of its subscales; information comprehension (η^2=.006); information recall (η^2=.002); or total decisional conflict (η^2=.002) or any of its subscales. As the effect on perceived cognitive load was not in the expected direction, H3b was not supported.

Table 6 shows the F-test statistics per hypothesis. *Table 7* shows the mean scores and standard deviations for all dependent variables per condition, including all significant simple effects. *Figure 4* depicts the significant three-way interaction effect ($p \leq .05$).

Table 6. F-test statistics per hypothesis.

	H1a	H1b	H2a	H2b	H3a	H3b
Perceived cognitive load	$F(1,303)=17.08$, $p < .001$	$F(1,301)=1.16$, $p=.283$	$F(1,303)=1.69$, $p=.195$	$F(1,301)=0.21$, $p=.645$	$F(1,301)=0.01$, $p=.933$	$F(1,297)=9.55$, $p=.002$
Satisfaction with information	$F(1, 303)=5.07$, $p=.025$	$F(1, 301)=0.14$, $p=.705$	$F(1, 303)=0.27$, $p=.602$	$F(1, 301)=0.52$, $p=.470$	$F(1, 301)=0.63$, $p=.430$	$F(1, 297)=0.56$, $p=.455$
Attractiveness	$F(1,303)=12.68$, $p < .001$	*	*	*	*	*
Comprehensibility	$F(1,303)=1.79$, $p=.182$	*	*	*	*	*
Emotional Support	$F(1,303)=0.60$, $p=.441$	*	*	*	*	*
Information comprehension	$F(1, 303)=1.34$, $p=.248$	$F(1, 301)=0.03$, $p=.875$	$F(1, 303)=0.11$, $p=.742$	$F(1, 301)=0.02$, $p=.897$	$F(1, 301)=0.93$, $p=.335$	$F(1, 297)=1.83$, $p=.177$
Information recall	$F(1, 303)=2.67$, $p=.103$	$F(1, 301)=0.23$, $p=.635$	$F(1, 303)=0.09$, $p=.768$	$F(1, 301)=1.92$, $p=.167$	$F(1, 301)=0.04$, $p=.835$	$F(1, 297)=0.47$, $p=.496$
Decisional Conflict	$F(1, 303)=2.19$, $p=.140$	$F(1, 301)=0.02$, $p=.889$	$F(1, 303)=0.07$, $p=.791$	$F(1, 301)=2.19$, $p=.140$	$F(1, 301)=0.30$, $p=.582$	$F(1, 297)=0.57$, $p=.452$
Informed	$F(1,303)=0.02$, $p=.900$	*	*	$F(1, 301)=0.10$, $p=.757$	*	*
Values clarity	$F(1,303)=0.48$, $p=.489$	*	*	$F(1,301)=0.76$, $p=.384$	*	*
Uncertainty	$F(1,303)=2.43$, $p=.120$	*	*	$F(1,301)=6.24$, $p=.013$	*	*
Effective decision	$F(1,303)=5.48$, $p=.020$	*	*	$F(1, 301)=1.50$, $p=.222$	*	*

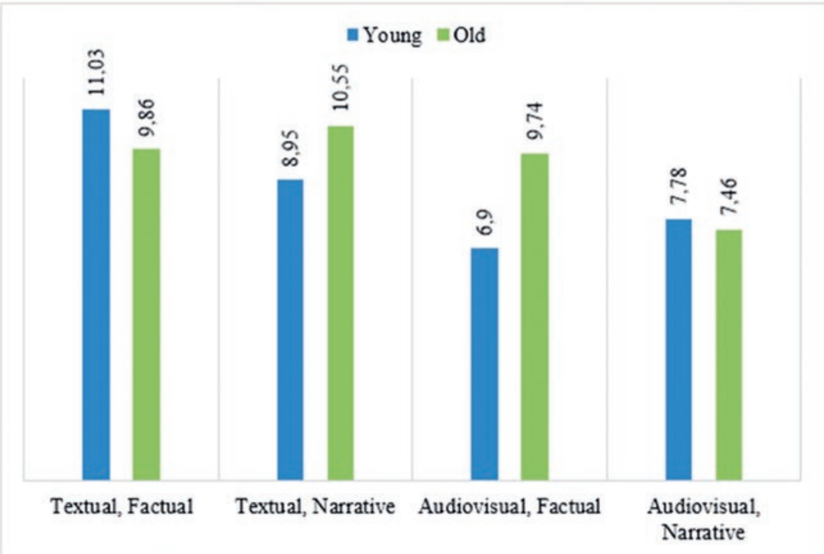
* If no statistically significant effect was found for both the total scale and its subscales, only the F-statistics of the total scale was reported.

Table 7. Mean ± Standard deviation per outcome measure and condition.

	Textual, Factual (n=62)	Textual, Narrative (n=75)	Audiovisual, Factual (n=88)	Audiovisual, Narrative (n=80)
Perceived cognitive load	10.48 ± 4.61 [a,b]	9.65 ± 4.01 [c]	8.39 ± 4.15 [a]	7.64 ± 4.08 [b,c]
Satisfaction with information				
Attractiveness	12.94 ± 3.73 [d]	12.73 ± 4.07 [e]	14.09 ± 3.77	14.64 ± 3.32 [d,e]
Comprehensibility	18.19 ± 2.70	18.52 ± 2.76	18.49 ± 3.00	19.14 ± 2.53
Emotional Support	17.77 ± 5.22	17.44 ± 6.49	17.94 ± 5.92	18.28 ± 5.22
Total	48.90 ± 9.33	48.69 ± 10.28	50.52 ± 10.14	52.05 ± 8.07
Information comprehension	6.48 ± 1.24	6.68 ± 1.26	6.77 ± 1.07	6.71 ± 1.05
Information recall	5.41 ± 3.08	5.47 ± 2.64	5.90 ± 3.17	6.10 ± 2.82
Decisional Conflict				
Informed	1.69 ± 1.92	1.84 ± 2.13	1.81 ± 1.93	1.68 ± 2.19
Values Clarity	2.15 ± 1.87	2.12 ± 2.15	2.03 ± 2.14	1.89 ± 2.19
Uncertainty	3.24 ± 2.91	3.33 ± 2.55	3.03 ± 2.93	2.55 ± 2.50
Effective Decision	3.45 ± 3.30	3.48 ± 2.88	2.73 ± 2.79	2.63 ± 2.85
Total	20.25 ± 16.15	20.72 ± 16.54	18.47 ± 16.76	16.80 ± 17.18

[a] M_{dif} = -2.10, p=.017
[b] M_{dif} = -2.86, p < .001
[c] M_{dif} = -2.02, p=.018
[d] M_{dif} = 1.70, p=.044
[e] M_{dif} = 1.90, p=.010

Figure 4. Interaction effect of modality * narration style * age on perceived cognitive load (range = 4 – 22; *p*=.002).



DISCUSSION

This study assessed the effects of audiovisual information and narrative information on information processing with use of a PDA in both older and younger patients. One main finding was that, irrespective of age, audiovisual information about benefits and harms of treatment options enhanced cancer patients' information processing, when compared to textual information. Specifically, it reduced perceived cognitive load, increased satisfaction with information – in particular with the attractiveness of the information –, and increased perceptions of effective decisions. Our study further showed that narrative information (compared to factual information) reduced perceived uncertainty in only younger patients, that no interaction effect existed between modality and narration style on any of the outcome measures. While the combination of audiovisual and narrative information overall shows a beneficial effect on perceived cognitive load, the combination of audiovisual and factual information (compared to other experimental conditions) reduced perceived cognitive load more in younger patients compared to older patients.

Our study yielded some unexpected results. Firstly, we expected that compared to textual information, audiovisual information would not only result in less perceived cognitive load, more satisfaction with (the attractiveness of the) information, and less decisional conflict concerning the effectiveness of the decision, but also in better comprehension and recall. However, patients in the textual and audiovisual conditions had similar scores for comprehension and recall. A possible explanation for this null result might be that patients in the audiovisual conditions were unable to self-pace the information. When patients can self-pace information and take their time in processing it, they are more likely to recall the information (de Graaf et al., 2016; Meppelink et al., 2015). In our study, patients were able to self-pace information only in the textual conditions. In the audiovisual conditions, patients could not re-watch the animation as we wanted to measure how much of the information was recalled after receiving information once. This difference might explain why audiovisual information did not outperform text with regard to comprehension and recall. Nevertheless, we consider it highly relevant for practice that audiovisual information reduced perceived cognitive load and decisional conflict and increased satisfaction in patients.

We further hypothesized that when compared to a factual style, a narrative style would enhance information processing. However, patients in our narrative conditions did not show significant improvements in information processing compared to patients in factual conditions. This suggests that the influence of narratives might not be as great as has been assumed. Bekker et al. (2013) also concluded that evidence concerning narratives' effectiveness in PDAs was insufficient to claim that narratives help patients to make informed decisions. However, it may be that the narratives used in our study were suboptimal. Firstly, our narratives contained more information than the factual information. This larger amount of information might have led to a lower attention or motivation to process information, resulting in no differences between factual and narrative information in their effects on information processing. Secondly, the literature suggests that the core message of the narrative should not be too implicit, as patients may miss the point of the story (Kreuter et al., 2007). The core message of our narratives (three types of benefits and harms to compare) was strictly aligned with the core message of factual information, because this alignment was thought to be appropriate for the aim of supporting informed decision-making (Shaffer et al., 2018). However, we did not test whether patients actually experienced this message as the core message. In addition, participants may have experienced the core message in the narrative as more factual than not, relative to other more experience-based or emotion-based narratives, thus leading to suboptimal immersion (Shaffer et al., 2018). Consistent with this thinking, identification with the characters in the audiovisual conditions was low to moderate. Thus, the level of immersion in the narrative conditions may have been insufficient to lead to the expected effects. Despite these potential limitations, the narratives did not negatively influence information processing. Combined with an audiovisual modality, narratives even diminished perceived cognitive load in older patients.

We expected that effects of audiovisual and narrative information and their combination would be greater among older patients than younger patients. However, our findings show that older patients did not benefit more than younger patients on any measure whereas younger patients accrued more benefits, such as lower perceived cognitive load and lower uncertainty about the decision (subscale of decisional conflict). These findings might be explained by the fact that we did not include very vulnerable older patients. In our study sample, older patients showed quite high health literacy and quality of life, a possible signal of normal cognitive aging. Normal cognitive aging refers to the fact that older patients' intellectual abilities and skills often remain intact (Sparks & Nussbaum, 2008). Hence, older patients with normal cognitive aging would not necessarily be disadvantaged compared to younger patients in their capacity to process information, perhaps explaining why older patients in our sample did not accrue more benefits than younger patients. Another explanation might be that the type of information provided could have exceeded the working memory capacity of younger patients as well. Nevertheless, the finding that the effects of audiovisual information were quite similar for older and younger patients can be interpreted as a positive result that is of practical relevance. The finding that audiovisual presentations in PDAs are helpful across age ranges, provides useful evidence for the applicability of the CTML to the context of shared decision-making.

Limitations and future research

Some limitations of our study must be kept in mind. Firstly, participants were recruited through an online panel. These participants might be relatively motivated to process stimulus materials. It is unclear whether patients from the actual target population, and especially the more vulnerable ones, will be more or less motivated. However, PDAs are usually provided to patients online, making recruitment through an online panel potentially appropriate. A meta-analysis proved that this common method in experimental communication research is valid and analogue patients can be used as proxies for clinical patients (van Vliet et al., 2012). Secondly, it might be that, due to multiple hypothesis testing, some significant differences were found by chance. To account for this, we applied a Bonferroni correction. It might also be possible that relevant differences were not found because the study was underpowered. A post-hoc power calculation showed that our sample size was sufficient for detecting the effects of modality and narration style on perceived cognitive load, which could be considered the main outcome variable. For other outcome variables, such as decisional conflict, the lack of effects might be explained by insufficient sample size as power to detect effects for these variables was low, ranging from .05 to .31 depending on the specific hypothesis. We should therefore be cautious with concluding that audiovisual and narrative information and their combination are not effective on these outcomes. Additionally, we did not preregister our study protocol. Nevertheless, we conducted the study according to our peer-reviewed and approved grant proposal. Thirdly, no gold standard exists for the use of narratives in PDAs (de Graaf et al., 2016) and we did not counterbalance the order of the information about treatment options provided to participants. Hence, we do not know whether the level of immersion differed between the information about surgery vs SABR. However, it was not an aim of our study to compare surgery with SABR. Instead, we aimed to compare the effects of modality and narration style. In addition, some content in our narrative scripts about surgery and SABR were non-identical due to inherent differences in treatments. Another potential limitation is that the narrative scripts were longer than the factual scripts due to inherent characteristics of narratives which provide contextual information about patients' experiences in addition to the factual information (Winterbottom et al., 2008). However, these differences were inevitable, and although it could have led to different levels of immersion, literature suggests that this contextual information is not (necessarily) cognitively burdensome (Bekker et al., 2013; Moyer-Gusé, 2008). More research on narratives in PDAs seems needed, e.g. to test which type of narratives (i.e. process narratives, experience narratives, or outcome narratives) are most effective in PDAs. Finally, we categorized our participants as younger or older than 65 years. Although this cut-off is generally used in health-related studies that investigate the effects of aging (Jorgensen et al., 2012), such cut-offs are arbitrary. Future studies might focus more on the oldest-old, to analyze the effects in this group of cancer patients.

Practice implications

Our study adds to the growing body of evidence about the benefits of providing information in audiovisual format on patients' information processing. For the use of narratives, more evidence is needed to make clear-cut statements and recommendations about their use in PDAs. Nonetheless, the use of audiovisual information in PDAs seems to offer benefits for both younger and older adults.

Conclusion

Our results support the notion that presenting information in audiovisual modality benefits patients' information processing and use. Age was unrelated to this effect. Furthermore, our results showed little support for the notion that presenting information in a narrative narration style may benefit patients' information processing and use. Further research is needed to understand the effects of narration style on patients' information processing. Research on narrative types that support older patients' information processing would particularly enrich this field.