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Should we be afraid of simple messages? The effects of text difficulty and illustrations in people with limited or adequate health literacy

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ABSTRACT

It is often recommended that health information should be simplified for people with limited health literacy. However, little is known about whether messages adapted to limited health literacy audiences are also effective for people with adequate health literacy, or whether simple messages are counterproductive in this group. Using a two (illustrated vs. text-only) by two (non-difficult vs. difficult text) between-subjects design, we test whether older adults with limited (*n* = 279) versus adequate health literacy (*n* = 280) respond differently to colorectal cancer screening messages. Results showed that both health literacy groups recalled information best when the text was non-difficult. Reduced text difficulty did not lead to negative attitudes or less intention to have screening among people with adequate health literacy. Benefits of illustrations, in terms of improved recall and attitudes, were only found in people with limited health literacy who were exposed to difficult texts. This was not found for people with adequate health literacy. In terms of informed decisions, non-difficult and illustrated messages resulted in the best informed decisions in the limited health literacy group, whereas the adequate health literacy group benefited from non-difficult text in general, regardless of illustrations. Our findings imply that materials adapted to lower health literacy groups can also be used for a more general audience, as they do not deter people with adequate health literacy.

INTRODUCTION

Colorectal cancer is the third leading cause of cancer-related deaths in the United States (American Cancer Society, 2011). In 2011, colorectal cancer caused nearly 50,000 deaths in the United States (American Cancer Society, 2011). In the Netherlands, 4,800 people die from colorectal cancer every year, and many of these people are older than 55 years. A significant number of these deaths can be prevented by colorectal cancer screening (Health Council of the Netherlands, 2009). Therefore, as in many other countries, a national screening program has recently started in the Netherlands, testing people between 55 and 75 years. Despite the potential benefits for public health, participation rates for colorectal cancer screening rarely exceed 60% (Von Euler-Chelpin, Brasso, & Lynge, 2010). It is a real communication challenge to encourage screening participation based on informed decisions. To achieve this, people have to not only obtain accurate knowledge but also develop attitudes that are in line with the screening behavior (Marteau, Dormandy, & Michie, 2001).

An important determinant of how people process health information is health literacy. Health literacy is defined by Berkman, Davis, and McCormack (2010, p. 16) as "the degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make informed health decisions." Although the current literature shows little agreement upon the precise definition and conceptualization of health literacy (for recent conceptual models, see Sørensen et al., 2012; Squiers, Peinado, Berkman, Boudewyns, & McCormack, 2012), people's understanding of health information is usually a key component. In the frameworks, health literacy is positively associated with people's ability to understand information about health.

To improve understanding of health-related information among people with limited health literacy, messages should be non-complex (Wilson & Wolf, 2009) or illustrated (Houts, Doak, Doak, & Loscalzo, 2006). Although guidelines are available to make health information understandable for people with limited health literacy, it has been shown that currently available information rarely meets these standards (McInnes & Haglund, 2011). This is surprising, as there is a clear need for simplified materials for limited health literacy audiences. One explanation could be that writers of health materials are afraid that plain messages are not appreciated by the health literate part of the audience. Until now, little has been known about how people with adequate health literacy respond to plain materials, such as those that were originally designed

for lower health literacy groups. Are the effects similar? Or do these messages induce negative responses in this group? There is some evidence that people with adequate literacy or health literacy are satisfied with low-literacy materials (Davis et al., 1996; Hill-Briggs et al., 2008; Otal et al., 2012). Mackert, Whitten, and Garcia (2008), for example, found that people with adequate health literacy appreciated health websites that had been designed for a limited health literacy audience, indicating that information presented in a simpler fashion also works for a more general audience.

The aim of our study is to investigate whether colorectal cancer screening messages that match the receiver's health literacy level are more persuasive and result in better informed screening decisions compared to messages that do not match. To do this, people of limited and adequate health literacy levels are included in our study. If non-difficult messages result in positive effects in both groups, this means that messages designed for limited health literacy people are effective for the entire target population, and that there is no need to consider the audience's health literacy level beforehand.

The effect of text difficulty and health literacy

An important factor in health communication is the message's level of complexity, especially when the audience is characterized by limited health literacy. According to Wilson and Wolf (2009), people with limited health literacy often experience cognitive overload when they try to read and process health messages. By reducing the complexity of a message, the needed cognitive capacity decreases, which positively influences information processing. As a result, the information will be better recalled (Lang, 2000). However, recall is not the only relevant outcome in health communication. For informed participation in screening programs, attitudes toward the screening and screening behavior are equally important (Marteau et al., 2001). The question is how informed decisions can be achieved using health communication, and by taking into account message complexity and health literacy level. Based on the resource matching hypothesis (Anand & Sternthal, 1989), we expect different persuasion effects between people with limited and adequate health literacy. This hypothesis states that persuasion effects are optimal when people's cognitive capacity matches the capacity that is required for message processing. If too much processing capacity is available, people are likely to devote the unused resources to thoughts that are irrelevant or even to question the message, and therefore the message's persuasiveness decreases (Meyers-Levy & Malaviya, 1999). Keller and Block (1997) confirmed the resource matching hypothesis in a series of experiments on vividness effects. They found that messages are most persuasive if the amount of cognitive capacity allocated to the

information processing matches the amount of resources that is demanded. If the message is too easy or hard to process, it becomes less persuasive. With respect to message complexity and health literacy, it can be argued that people with adequate health literacy quite easily process non-complex health messages without requiring much of their cognitive capacity. If many cognitive resources are allocated to the message, but not many are required, there is no match. In sum, we hypothesize: Non-difficult messages (compared to difficult messages) have more added value (i.e., cause larger effects) in terms of recall improvement (H1a), positive attitudes toward the screening (H1b) and intention to have screening (H1c) among people with limited health literacy (i.e., match) than among people with adequate health literacy (i.e., no match).

The added value of illustrations

Another way to adapt messages to limited health literacy audiences is to add explanatory illustrations to the text. The added value of illustrations in health communication has been shown in several studies (Houts et al., 2006). Nevertheless, in line with Houts and colleagues (2006), we argue that more research is needed on which type of information benefits most from illustrations. According to Mayer's (2002) cognitive theory of multimedia learning, illustrations facilitate the creation of mental representations, which facilitates learning. However, if text difficulty is reduced so that people are well able to understand a message on the basis of the text alone, illustrations probably do not improve information processing. Therefore, the presence of illustrations will particularly support information processing in the case of difficult messages and among people with limited health literacy. Also, when exposed to illustrated messages, people are less likely to experience cognitive overload compared to text-only messages, as both processing channels can be used (i.e., visual and verbal; Mayer, 2002). Consequently, there could be a better match in cognitive demand and resource allocation in people with limited health literacy that positively affects informed decisions, as these are based on recall, attitudes toward the behavior, and intention. It is therefore hypothesized: In the case of difficult texts, illustrated messages (vs. text only messages) have more added value (i.e., cause larger effects) in terms of recall improvement (H2a), positive attitudes toward the screening (H2b), and intention to have screening (H2c) among people with limited health literacy compared to people with adequate health literacy.

The importance of informed decisions

Ideally, health communication should result in informed decisions. Informed decisions

are defined as a decision that is based on sufficient knowledge combined with consistent attitudes and intentions (Marteau et al., 2001). Smith et al. (2010) evaluated the effects of a decision aid for colorectal cancer screening for low educated adults. The study showed that people who received the decision aid made more often an informed decision to have cancer screening compared to the people in the control group, who received the standard brochure. The participants in this study were mainly of low education, leaving unclear how people with higher levels of education or health literacy would have responded to the materials. Because reduced text difficulty is expected to positively affect recall, and illustrations help to understand difficult messages, the following is hypothesized in line with hypotheses 1 and 2: Non-difficult illustrated messages lead to most informed decisions, followed by non-difficult text-only and difficult illustrated messages. Difficult text-only messages will result in least informed decisions (H3a). The pattern of informed decisions as described in H3a will only exist among people with limited health literacy; no differences between conditions in informed decisions are expected in the adequate health literacy group (H3b).

METHODS

Design, participants, and procedure

A two (illustrated vs. text only) by two (non-difficult vs. difficult text) between-subjects design was used to investigate the effects of message design on information recall, attitudes, and intention to have screening. Participants were members of the online panel of the ISO certified market research company PanelClix. People were randomly selected and invited by e-mail to participate. At the start of the questionnaire, participants were informed about the topic of the study, colorectal cancer screening, and anonymity was ensured. People gave informed consent, which was a prerequisite for participation. Ethical approval was provided by the research institute (number 2013-CW-5). All information was brief and in plain language (including the informed consent and instructions) to make sure that all participants would understand our study materials.

The questionnaire first asked for the participant's education level, age, and sex. Based on this information, a stratified sample was created in which sex, different age groups (55–64, 65–74, ≥75 years), and people having higher versus lower education levels were equally represented in each condition (see the flow chart of the sampling procedure Appendix A). Because PanelClix had no information on its members' health literacy level but it had information on education level (which is associated with health literacy),

we used a stratified sample in which we only included people with either low or high education levels.[2.1]

Five hundred fifty-nine participants completed the questionnaire. The mean age was 67.2 years (*SD* = 7.86, range 55–87), and 56% of the participants were male. Because we used an online panel, our participants were probably used to taking part in online research and to reading and completing questionnaires. Therefore, it is unlikely that our sample consisted of many completely illiterate participants. The first part of the questionnaire assessed professional medical background, general medical knowledge, and knowledge of colorectal cancer and colorectal cancer screening. Then, within each stratum, participants randomly saw one of the four experimental messages. Each message consisted of 15 separate webpages, and exposure to the message was self-paced. The second part of the questionnaire measured recall, attitude toward screening, intention, and health literacy. As a reward, participants received credit points from the research company. As forced response settings were used, our data did not include missing values.

Experimental stimuli

As a basis for the stimuli, we used information materials from the Dutch government about the national colorectal cancer screening program, starting about a year after data collection. At the moment of data collection this information had not been communicated to the public yet. Therefore, we expected that colorectal cancer screening was relevant but relatively unknown to our participants. The experimental messages addressed the risks of colorectal cancer, how the disease usually develops, the benefits of early detection, the test procedure (fecal occult blood test), and the possible test outcomes. Two pretests, among 51 and 69 participants respectively, were conducted to develop messages that differed in text difficulty but were equal in terms of content and number of words (449 words for the non-difficult text and 450 words for the difficult text). To make the paragraphs more difficult or easy, we used the following steps that are similar to the guidelines for writing presented by Doak, Doak, and Root (1996):

[2.1.] An exception was made for the stratum of high-education women over the age of 75 years. A higher education degree or university degree is quite rare among women of this age. Therefore, we included women who had a middle-level education in this stratum as well (n = 23).

1. The paragraphs differed by sentence construction (short vs. long sentences).
2. The use of active or passive voice.
3. The use of concrete, clear words vs. abstract jargon.
4. Whether or not uncommon words (such as polyp) were explained.

For an extensive description of the pretest see Appendix B.

Non-difficultparagraph:
(36 words in Dutch translation)

Bowel cancer usually develops from a polyp. A polyp is a lump of cells at the lining of the bowel. People aged over 55 usually have polyps in their bowel. Most polyps are not dangerous.

Difficult paragraph:
(38 words in Dutch translation)

Bowel cancer often originates from benign bowel polyps, which are not extraordinary among people older than 55. It often concerns polyps that stem from the intestinal membrane, of which the hyperplastic polyp is most prevalent. This type of polyp hardly constitutes a health risk.

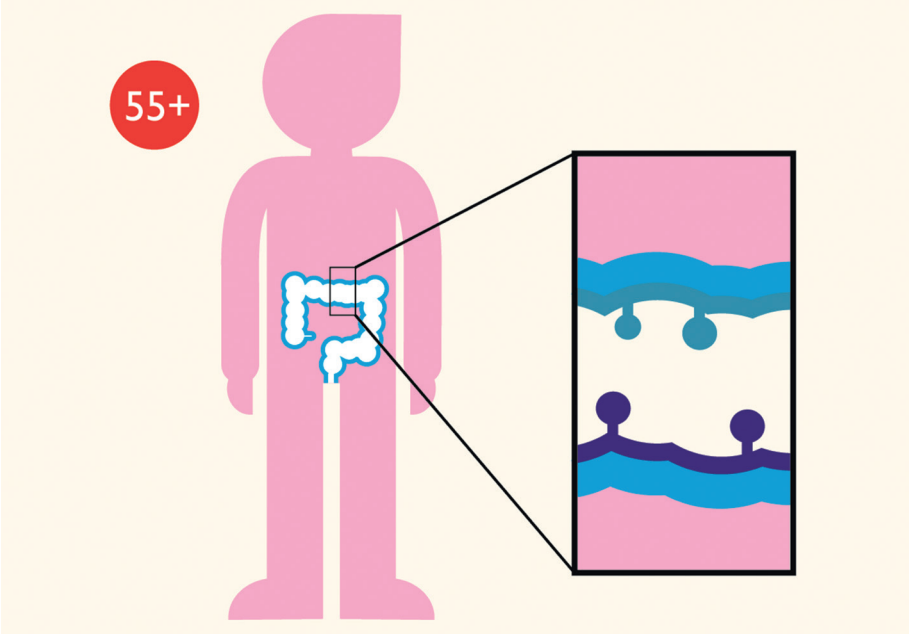


Figure 2.1 Example of the non-difficult and the difficult paragraph and the illustration used to explain the development of colorectal cancer.

In the illustrated conditions, both messages were supported by the same illustrations. Simple, non-detailed drawings were created for the purpose of this study and clearly depicted the content of the text without any additional, possibly distracting content. Research showed that simple drawings are comprehended better than more naturalistic drawings or photographs (Houts et al., 2006). Before developing the final illustrations, different drawing styles and color formats were presented to the target group to assess attractiveness and clarity of the images. Figure 2.1 presents an example of the experimental messages.

Measures

Health literacy

Health literacy was measured using the Short Assessment of Adult Literacy in Dutch (SAHL-D comprehension: Pander Maat, Essink-Bot, Leenaars, & Fransen, 2014). This measure is based on the Rapid Estimate of Adult Literacy in Medicine in Dutch (REALM-D: Fransen, Van Schaik, Twickler, & Essink-Bot, 2011) and the Short Assessment for Health Literacy for Spanish and English (Lee, Bender, Ruiz, & Cho, 2006). The SAHL-D consists of 33 health-related words, such as obesity, ventricle, and palliative. For each word, people had to select the correct meaning out of three multiple-choice options. The answer option "I don't know" was available to prevent guessing. To calculate health literacy scores, 1 point was awarded to every correct answer. If the wrong answer was selected or people indicated that they did not know the answer, no points were given. Consequently, health literacy scores ranged from 0 to 33 (M = 24.2, SD = 6.60). This mean is somewhat lower than the mean reported in the validation study of the SAHL-D in which, on average, 80% of the items were answered correctly (M = 26.4). The people in our sample were on average 11 years older than the participants in the validation study (67.2 years compared to 56.2 years respectively), which could explain the difference.

Recall of information

Information recall was measured with an adapted version of the Netherlands Patient Information Recall Questionnaire (NPIQR: Jansen et al., 2008). Fourteen open-ended recall questions asked participants about the content of the messages; the responses were typed into a text box. All responses were scored afterward based on a codebook, which had been created prior to data collection. Each answer could be marked with 0 (false), 1 (partly good), or 2 points (good). Consequently, total recall scores could range between 0 and 28 (M = 12.97, SD = 6.11). Intercoder reliability was calculated for 12% (n = 80) of the responses, coded by the first author and a second coder not being one

of the authors, and appeared to be good: Cohen's kappa = .90 (range .65–1.00).

Attitude toward screening

Seven items were used to measure attitude, based on word pairs used by Keer, Van den Putte, and Neijens (2010). Participants evaluated colorectal cancer screening on a 5-point semantic differential using the following anchor points: positive/negative, good/bad, desirable/ undesirable, useful/useless, important/unimportant, pleasant/ unpleasant, reassuring/not reassuring (α = .90, *M* = 4.39, *SD* = .65).

Behavioral intention

Intention to participate in colorectal cancer screening was measured with one item on a 5-point scale. Bergkvist and Rossiter (2007) recommend the use of single-item measures in case of concrete attributes such as intentions. People responded to the following statement: "If I am invited to participate in colorectal cancer screening I will . . . ." Answer options ranged from 1 = definitely not participate to 5 = definitely participate (*M* = 4.39, *SD* = 1.08).

Informed decisions

We used the procedure followed by Smith et al. (2010) to indicate whether intention to participate in cancer screening was informed. Adequate knowledge was indicated by recall scores of 50% or higher, which corresponds to the median split (*Mdn* = 14). Positive attitudes were indicated by scores on attitudes toward the screening that were above the median (*Mdn* = 4.57); positive intentions were indicated by value 5 (definitely screen). Informed decisions are made by people having adequate recall and attitudes and intentions that are consistent (either both positive or both negative) (Smith et al., 2010). Partly informed decisions are characterized by inadequate recall with consistent attitudes and intentions or adequate recall with inconsistent attitudes and intentions. Finally, uninformed decisions are based on inadequate recall and inconsistent attitudes and intentions.

Control variables

Knowledge was measured using three items on a 5-point Likert scale (1 = no knowledge, 5 = much knowledge) by asking people how much knowledge they had with respect to medicine (*M* = 2.37, *SD* = .99), colorectal cancer (*M* = 1.96, *SD* = .99), and colorectal cancer screening (*M* = 1.83, *SD* = 1.01). In addition, participants were asked to indicate whether or not they had a professional medical background (i.e., medical, nursing, or paramedical). Chi-squared tests showed that none of the variables differed between

conditions: general medical knowledge, $\chi^2(12) = 15.15$, $p = .233$; knowledge about colorectal cancer, $\chi^2(12) = 5.71$, $p = .930$; and knowledge about colorectal cancer screening, $\chi^2(12) = 20.45$, $p = .059$. Also, the groups were found to be similar with respect to the participant's professional background in medicine, $\chi^2(3) = 3.41$, $p = .303$. The variables were therefore not included in the analysis.

Statistical analysis

To test the influence of health literacy, text difficulty, and illustrations on recall, attitudes, and intention, a multivariate analysis of variance (MANOVA) was conducted using SPSS 20. Health literacy was split in two groups using median split. SAHL-D comprehension scores of 25 and below were labeled "limited health literacy" and scores of 26 or higher were considered "adequate health literacy." This is comparable with the norm scores for this health literacy measure indicating limited and adequate health literacy (Pander Maat et al., 2014). We used a chi-squared test to test whether the proportion of informed decisions differed across conditions.

RESULTS

Effects of text difficulty and illustrations in both health literacy levels

Our first hypothesis predicted an interaction between Health Literacy and Text Difficulty on information recall, attitudes, and intention. Results show that this interaction was found for none of the dependent variables. Table 2.1 shows that, in both health literacy groups, non-difficult texts were significantly better recalled than difficult texts. This effect was not bigger in the limited health literacy group, $F(1, 550) = .01$, $p = .92$, rejecting H1a. Also, people with limited and adequate health literacy did not have different attitudes toward cancer screening, $F(1, 550) = .09$, $p = .61$, nor intentions $F(1, 550) = .25$, $p = .62$ as a result of the message they were exposed to. This was not in line with our expectations and therefore H1 was rejected.

Subsequently, we tested whether combinations of text difficulty and illustrations cause different effects in people with limited and adequate health literacy. The simple effect analysis presented in Table 2.2 showed that illustrations added to difficult texts improved recall and resulted in more positive attitudes among people with limited health literacy. This was not found for people with adequate health literacy, which means that H2a and H2b were supported. Intention to have cancer screening did not vary as a result of illustrations added to difficult texts, in none of the groups, rejecting H2c.

Table 2.1 Interaction effects of text difficulty and health literacy on information recall, attitude to screening, and screening intention.

		Information recall		Attitude to screening		Intention	
	n	*M*	*(SE)*	*M*	*(SE)*	*M*	*(SE)*
		[95% CI]		[95% CI]		[95% CI]	
Text Difficulty x HL							
non-difficult – limited	140	11.94 [a]***	(.47)	4.44	(.06)	4.35	(.09)
		[11.04, 12.90]		[4.33, 4.54]		[4.18, 4.52]	
non-difficult – adequate	144	16.20	(.47)	4.43	(.05)	4.52	(.08)
		[15.29, 17.12]		[4.32, 4.45]		[4.35, 4.68]	
difficult – limited	139	9.68 [b]***	(.47)	4.36	(.06)	4.32	(.09)
		[8.75, 10.62]		[4.25, 4.47]		[4.15, 4.49]	
difficult – adequate	136	14.01	(.48)	4.31	(.06)	4.37	(.09)
		[13.07, 14.95]		[4.20, 4.42]		[4.19, 4.54]	

Note. *M* = mean, *SE* = standard error, CI = confidence interval. Scales for attitude and intention range from 1 to 5, recall scale ranges from 0 to 28. Higher scores indicate more recall, positive attitudes, and intention.

[a] Mean differs significantly compared to adequate health literates in non-difficult texts,

[b] Mean differs significantly compared to adequate health literates in difficult texts.

* $p < .01$, ** $p < .01$, *** $p < .05$.

Table 2.2 Interaction effects of text difficulty and illustrations on information recall, attitude to screening, and screening intention in people with limited and adequate health literacy.

		Information recall		Attitude to screening		Intention	
	n	*M* [95% CI]	*(SE)*	*M* [95% CI]	*(SE)*	*M* [95% CI]	*(SE)*
HL x Text Difficulty x Illustrations							
limited - non-difficult – illustrated	73	12.19 [10.91, 13.47]	(.65)	4.48 [4.33, 4.63]	(.08)	4.48 [4.25, 4.71]	(.12)
limited - non-difficult – text-only	67	11.75 [10.41, 13.09]	(.68)	4.39 [4.23, 4.54]	(.08)	4.22 [3.98, 4.47]	(.12)
limited - difficult – illustrated	67	10.88[a]* [9.54, 12.22]	(.68)	4.47[a]* [4.32, 4.68]	(.08)	4.43 [4.19, 4.68]	(.12)
limited - difficult – text-only	72	8.49 [7.19, 9.78]	(.66)	4.25 [4.10, 4.40]	(.08)	4.21 [3.97. 4.44]	(.12)
adequate – non-difficult – illustrated	65	16.80 [15.44, 18.16]	(.69)	4.40 [4.24, 4.55]	(.08)	4.54 [4.29, 4.79]	(.13)
adequate – non-difficult – text-only	79	15.61 [14.37, 16.84]	(.63)	4.46 [4.32, 4.61]	(.07)	4.49 [4.27, 4.72]	(.11)
adequate - difficult – illustrated	69	14.77 [13.45, 16.09]	(.67)	4.33 [4.18, 4.49]	(.08)	4.49 [4.25, 4.73]	(.12)
adequate - difficult – text-only	67	13.25 [11.91, 14.59]	(.68)	4.29 [4.14, 4.45]	(.08)	4.24 [4.00, 4.48]	(.12)

Note. *M* = mean, *SE* = standard error, CI = confidence interval. Scales for attitude and intention range from 1 to 5, recall scale ranges from 0 to 28. Higher scores indicate more recall, positive attitudes, and intention.

[a] Mean differs significantly compared to limited health literate group in difficult texts without illustrations.

* $p < .01$, ** $p < .01$, *** $p < .05$.

Table 2.3 Distribution of informed, partly informed, or uninformed choices for conditions and health literacy groups.

	Informed choice %			Partly informed choice %			Uninformed choice %		
	Limited HL	Adequate HL	Total	Limited HL	Adequate HL	Total	Limited HL	Adequate HL	Total
non-difficult illustrated	35.6[a]	58.5[a]	46.4[a]	49.3[a]	38.5[ab]	44.2[ab]	15.1[ab]	3.1[a]	9.4[b]
non-difficult text-only	28.4[ab]	60.8[a]	45.9[a]	52.2[a]	32.9[b]	41.8[b]	19.4[ab]	6.3[a]	12.3[ab]
difficult illustrated	28.4[ab]	47.8[ab]	38.2[a]	62.7[a]	46.4[ab]	54.4[a]	9.0[b]	5.8[a]	7.4[b]
difficult text-only	16.7[b]	35.8[b]	25.9[b]	56.9[a]	53.8[a]	55.4[a]	26.4[a]	10.4[a]	18.7[a]

Note. Values are percentages. HL = health literacy.
Proportions with different superscripts within a column indicate significant difference (p <.05).

To test our third hypothesis, we looked at the proportion of participants that made an informed decision about screening. As expected, the proportion of participants making an informed decision was the highest in the non-difficult illustrated group (46.4%) and the lowest in the difficult text-only group (25.9%) ($p < .001$). People receiving the non-difficult text without illustrations and the difficult illustrated text also made more informed decisions than participants receiving the difficult text only (45.9% and 38.2% vs. 25.9%, $p = .001$ and $p = .039$, respectively). H3a was partly supported because we also expected a difference between the groups exposed to the non-difficult illustrated text, the non-difficult text only, and the difficult illustrated text. As shown in Table 2.3, these differences were not found.

Hypothesis H3b predicted that the expected pattern of informed decisions in H3a would only exist among people with limited health literacy. As shown in Table 2.3, participants in both health literacy groups made significantly more informed choices in the non-difficult illustrated condition compared to the difficult text-only condition, rejecting H3b. In the adequate health literacy group, the proportion informed decisions in the non-difficult text-only condition was also significantly higher than in the difficult text-only condition.

DISCUSSION

The aim of this study was to investigate whether messages designed for people with limited health literacy have similar effects on people with adequate health literacy or whether simple messages might be counterproductive in this group. Although reduced text difficulty was shown to improve recall in both health literacy groups, our study showed no differences between health literacy groups regarding people's attitudes toward cancer screening and intention to have screening in the case of non-difficult messages. This was not in line with our expectations based on the resources matching hypothesis (Anand & Sternthal, 1989), and we therefore found no support for the first hypothesis. In addition, our study showed that illustrations improve recall and attitudes among limited health literacy people in case of difficult texts, but no effects were found for intention. The second hypothesis was therefore partly supported. Finally, non-difficult illustrated messages led to better informed decisions compared to difficult text-only information, partly supporting H3a. H3b was rejected because both health literacy groups, and not just the people with limited health literacy, benefit from non-difficult illustrated messages for making informed decisions. People with

limited health literacy need plain text combined with illustrations to come to the best informed screening choice. For people with adequate health literacy, adding illustrations is not particularly needed, as long as the text is non-difficult: Non-difficult text both with and without illustrations resulted in better informed decisions compared to the difficult text-only message.

Our results add to the findings of Mackert and colleagues (2008) by showing that messages designed for limited health literacy audiences are also persuasive and lead to informed decisions among people with adequate health literacy. The finding that additional illustrations improve information recall in the case of difficult texts is in line with Mayer's (2002) cognitive theory of multimedia learning. The fact that the multimedia effect was only found in the case of difficult texts could imply that the non-difficult text was sufficiently clear and concrete in itself and that illustrations did not therefore enhance message processing. This result adds to the literature as discussed by Houts et al. (2006) by showing that illustrations do improve information recall, but only in difficult texts and limited health literacy audiences. The findings of this study are important because they show that plain health materials are also effective for people with adequate health literacy and do not induce negative reactions. This adds to the guidelines for developing low-literacy materials of the National Cancer Institute (NCI, 2003), which state that it is unclear whether low-literacy materials also suit a general audience. It must be noted that we used high-quality illustrations that were created by a professional illustrator for the purpose of this study. The simple drawings clearly depicted the text without distracting details and were adult appropriate, which is in line with both the NCI guidelines and the suitability assessment of materials (SAM) by Doak et al. (1996).

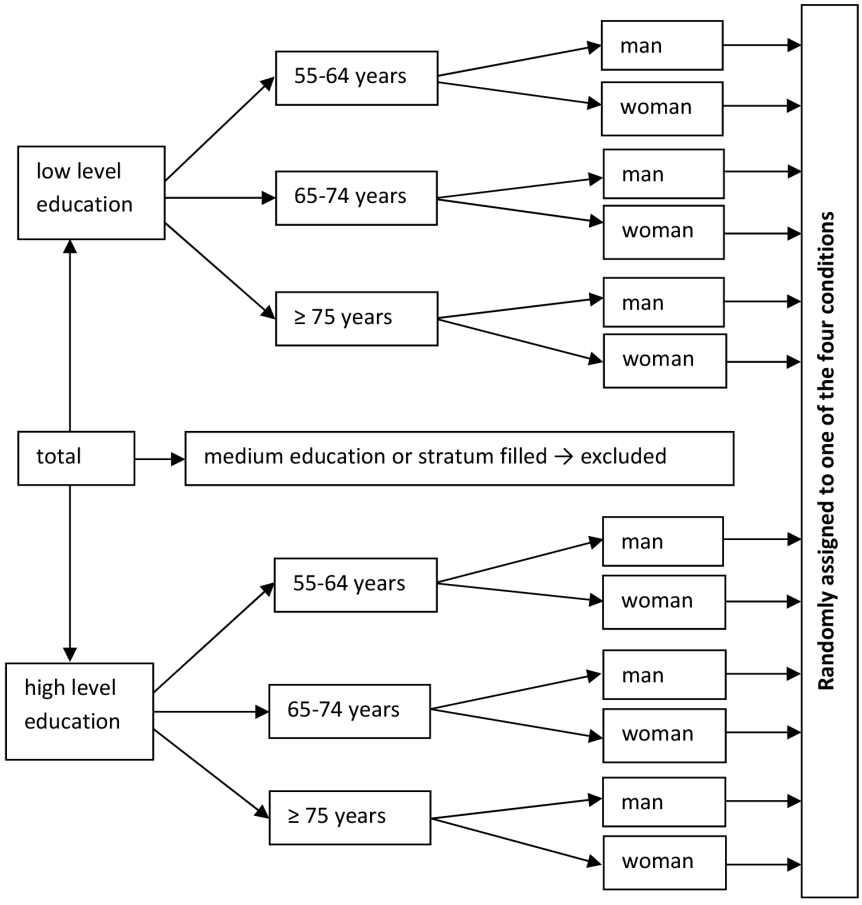
Our experimental texts were carefully developed, resulting in a non-difficult message that was easy to understand but definitely not infantile. Although the use of readability levels to test for comprehensibility is often recommended in limited health literacy interventions (Hill-Briggs, Schumann, & Dike, 2012), research has shown that in cancer communication, readability and comprehensibility are not always related (Friedman & Hoffman-Goetz, 2007). Therefore we primarily chose to pretest the messages extensively for difficulty. In addition, we checked the readability levels of our messages, showing level B1 for the non-difficult text and level C1 for the difficult text (Common European Framework of Reference for Languages: Council of Europe, 2014).

Another message feature that is recommended to use in limited health literacy materials is interactivity (Doak et al., 1996; National Cancer Institute, 2003). Although we did not include interactivity in this study, it would be useful to focus on this message characteristic in future research. Our study revealed that plain texts are beneficial to all audiences and illustrations improve message effectiveness among people with limited health literacy. Nevertheless, there is room for improvement. Especially in today's society, with the rise of e-health applications, it should be easier than ever before to incorporate interactivity in health education materials in order to improve people's understanding of health information (Kreps & Neuhauser, 2010). In line with Mackert, Champlin, Holton, Muños, and Damásio (2014), we therefore recommend future studies to focus on the theory-driven development and evaluation of e-health interventions appropriate for people with lower levels of health literacy.

Our study has some limitations. In our study, we used the SAHL-D as an indicator of health literacy. The SAHL-D measures only part of the entire health literacy skills spectrum, just like other objective measures that have been widely used to assess health literacy (e.g., REALM or TOFHLA, Sørensen et al., 2012). Future research should include multiple measures (McCormack, Haun, Sørensen, & Valerio, 2013) to assess the different facets of health literacy. Furthermore, we used recall to indicate adequate knowledge and intention as a proxy of behavior to assess informed decisions. Although intention and behavior are related (Ajzen, 1991), it is recommended to assess actual screening behavior in future research. In colorectal cancer screening there could be different reasons why people who intend to have the screening eventually do not participate.

Our study showed that all people benefit from non-difficult health messages. The remaining question is, why is most of the online health information still written at a level that many people find difficult to understand? Are developers of health communication afraid to use simple text because they believe that materials written at a low reading level may reflect poorly on their organization's expertise (National Cancer Institute, 2003)? Or are they just unaware of the health literacy problem and unfamiliar with low-literacy techniques? This latter explanation would be in line with the findings of a study conducted by Mackert, Ball, and Lopez (2011) showing that different kinds of health care workers tend to overestimate their own knowledge of health literacy. This points us to the possible challenge ahead: making health care workers and health communicators aware of the health literacy problem and the serious need for plain language and use of illustrations in all health communications.

APPENDICES



Appendix 2A Flow chart of the sampling procedure

Appendix 2B Description of the pre-tests for the non-difficult and difficult messages.

The first pre-test tested five versions of each paragraph of the experimental message. All versions covered the same content, but differed in terms of difficulty. Using an online questionnaire, 51 participants (M_{age} = 25.1, age range: 21-50 years, 78.4% female) were randomly exposed to one of the five versions of the first paragraph, followed by one of the five versions of the second paragraph, and so on. Combined, the paragraphs represented the entire message. Participants evaluated text difficulty for each of the paragraphs separately, by responding to five statements on a seven-point semantic differential (i.e., *easy to read/difficult to read*, *easy to understand/difficult to understand*, *easy to follow/difficult to follow, no jargon included/much jargon included*, *required no prior knowledge/much prior knowledge)*. Based on the participants' responses, an average text difficulty score was calculated for each paragraph.

We used the results of the first pre-test to select the paragraphs that significantly differed in text difficulty. For each paragraph, three alternatives were included in the second pre-test: the least difficult one and the two most difficult paragraphs. The 69 participants in the second pre-test were much older than the participants of the first pre-test, which made this sample comparable to the people participating in the main study (M_{age} = 57.1, age range: 43-83 years, 55% female). The procedure of the second pre-test was similar to the first. The paragraphs that were evaluated as least difficult were combined as the non-difficult text (449 words). Similarly, paragraphs that were evaluated as most difficult were taken together as the difficult text (450 words).

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