Designing digital health information in a health literacy context

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Summary

Today, people are increasingly expected to act responsibly with respect to their health and to make informed health decisions. To support this, health information is widely available, for example on the Internet. For many people, however, processing health information is difficult due to limited health literacy. To make health information more accessible to this group, health messages need to be optimally designed. Until now, it was unclear how design features of digital health information could be strategically used to optimize health messages. The aim of this dissertation was therefore to investigate the mechanisms that underlie information processing in different health literacy groups and to identify message design features that optimize health communication in people with limited or adequate health literacy.

First, two experiments were conducted to examine which specific features of digital health communication are most effective in different health literacy groups. Chapter 2 described an online experiment that examined the way in which the level of text difficulty and the presence of illustrations in health communication affect information recall, attitudes, and behavioral intention and whether these effects differ between people with limited and adequate health literacy. A two (non-difficult vs. difficult text) by two (illustrated vs. text-only) between-subjects design was used in this study. In total, 559 participants of 55 years or older were randomly exposed to one of the four messages about colorectal cancer screening. The messages used in this study were carefully developed. The illustrations were made for the purpose of this study and therefore clearly reflected the content of the text. Furthermore, two pretests were used to develop the two experimental texts that had to be significantly different from each other in terms of difficulty, but comparable in terms of content and number of words (i.e., 449 and 450 words). In all conditions, the texts were divided in fifteen short segments, and exposure was self-paced. In the illustrated conditions, the images covered a large part of the screen and the text was presented under the illustration. Health literacy was measured using the 33-items version of the Short Assessment of Health Literacy in Dutch (SAHL-D). The results of this study showed three main effects of the independent variables on recall. First, non-difficult information was significantly better recalled than difficult information. Second, illustrated messages led to higher recall scores compared to non-illustrated information. And third, people with adequate health literacy recalled more information than people with limited health literacy. No differences in attitudes or behavioral intention were found between health literacy groups, non-difficult messages were better liked in general. A three-way interaction was found between message complexity, illustrations, and health literacy. When people with limited health literacy were exposed to difficult texts, recall and attitudes improved when people saw the

illustrated message. This positive effect of illustrations was not found among people with adequate health literacy. Regarding informed decisions, the results in chapter 2 showed that non-difficult and illustrated messages led to most informed decisions in the limited health literacy group, whereas the adequate health literacy group benefited from non-difficult text in general, regardless of illustrations. Based on the findings presented in this chapter, it can be concluded that the most important strategy to improve information recall is to reduce the message complexity. Adding illustrations is useful to clarify information of which the complexity cannot be further reduced. As no differences in attitudes were found between health literacy groups, this means that materials that meet the needs of limited health literacy groups can also be effective in a general audience.

In **chapter 3**, we continued investigating the influence of message features and health literacy on health communication effects, but shifted from traditional features to message features that are typical for digital information. More specifically, the effects of spoken texts and animated visuals were investigated. Using a two (text format: spoken vs. written text) by two (visual format: illustration vs. animation) between subjects design, an online experiment was conducted among 231 participants (aged 55 years or older). Participants were randomly exposed to one of the four experimental messages. The manipulation of text format included on-screen text in the written conditions and the same text was narrated by a professional voice over in the spoken conditions. The manipulation of the visual presentation involved static illustrations that were presented with the text versus an animation in which the same illustrations were moving. All messages provided the same information about colorectal cancer screening, in which the risks of the disease, the development of colorectal cancer, and the benefits of early detention were discussed. Health literacy was measured, using the 33-item version of the SAHL-D. Results showed that spoken messages significantly improved recall and attitudes compared to written texts among people with limited health literacy. Furthermore, animations by itself did not improve recall, but when they were combined with spoken text, animations significantly improved recall in this group. When people with limited health literacy saw spoken animations, they recalled the same amount of information as their adequate health literate counterparts, whereas in all other conditions people with adequate health literacy recalled more information compared to limited health literate individuals. For people with limited health literacy, positive attitudes mediated the relationship between spoken text and the intention to have a colorectal cancer screening. It is therefore concluded that spoken animations are the best format to communicate complex health information to people with limited

health literacy. This format can even bridge the information processing gap between audiences with limited and adequate health literacy as the recall differences between the two groups are eliminated. Moreover, animations do not negatively affect recall or attitudes in people with adequate health literacy. In line with the previous chapter, it is concluded that information adapted to audiences with limited health literacy suits people with adequate health literacy as well.

Subsequently, **chapter 4** shed light on how people with either limited or adequate health literacy attend to online health information and whether these attention patterns are related to information recall. Sixty-one healthy participants in the age between 24 and 88 came to the research location where they were randomly exposed to one of two experimental webpages. Both pages were based on a website by the Dutch Cancer Institute (NKI-AVL) presenting information about the lung cancer treatment RFA. This topic was chosen because it is relatively unknown, reducing the likelihood that people's recall scores would be affected by someone's prior knowledge. Two versions of the website were created. One version consisted of a two-paragraph text and the other version included the text supplemented by two illustrations. The text on the website discussed the treatment procedure and possible complications. During people's exposure to the website, eye tracking was used to register people's attention patterns on the website after which information recall was measured as well as health literacy. The 33-item version of the SAHL-D was used to assess health literacy. In contrast to the other chapters in this dissertation, both parts of the SAHL-D (comprehension and word recognition) were administered. To assess comprehension, the health-related words that are part of the SAHL-D (such as obesity and palliative) appeared one by one on the screen that was in front of the participant. Multiple meanings of the words appeared on the screen and the participant had to select the correct answer. In addition to the comprehension test, we were able to take the word recognition (pronunciation) test in this study because the participants were physically present at the research location. Participants where asked to read each word aloud, which was audiotaped and coded for correctness afterwards. Results of chapter 4 showed a positive association between attention towards the information and recall of the information. However, this association differed between health literacy groups. Attention to the illustrations positively affected information recall for people with limited health literacy, whereas attention to the text improved recall in the adequate health literate group. Thus, attention to different parts of online health information leads to different effects in people with different levels of health literacy. In line with previous chapters, the study in chapter 4 concludes that limited health literacy groups primarily benefit from illustrated health materials.

Finally, **chapter 5** addresses the mechanisms that underlie the relationship between health literacy, health information processing, and health communication effects. Based on health communication literature, three possible mechanisms were hypothesized. First, individuals have a limited amount of cognitive resources available for information processing. People with limited health literacy might easily become cognitively overloaded, resulting in less successful message processing compared to adequate health literate people. We therefore expect that health information processing requires more cognitive capacity from people with limited health literacy. Second, an individual's ability to visualize a message supports the creation of a correct mental representation, which contributes to successful information processing. People with limited health literacy are expected to find it more difficult to imagine the content of health information compared to people with adequate health literacy. Third, if people are involved with information that is presented on a website, this will positively influence processing ability. Based on this, it is expected that people with limited health literacy might be less involved with health information leading to worse information processing compared to people with adequate health literacy. The hypotheses were tested in two independent online surveys (N = 423 and N = 395). The samples of both surveys were representative for the Dutch population in terms of gender and education level, the respondents' age ranged from 18 to 78 years. In both surveys, people were exposed to a real website about fibromyalgia. This topic was chosen because it is the second most often health-related key term searched for in the Netherlands using Google.nl (after Ebola). In the first study, the participants saw the fibromyalgia page of Thuisarts.nl, a website owned by the Dutch society of general practitioners (NHG). In the second study, the participants saw the fibromyalgia page of Gezondheidsplein.nl, which is a commercial health website. The 22-item version of the SAHL-D was used to assess health literacy. Results of both surveys showed that cognitive load significantly mediated the relationship between health literacy and information recall, as well as attitudes. Ease of imagination was found to mediate the health literacy-attitude relationship in both websites. For one website (Gezondheidsplein), ease of imagination also mediated the relation between health literacy and information recall. The third proposed mediator, website involvement, showed the least consistent results; in one website (Gezondheidsplein) it significantly mediated the relation between health literacy and recall as well as attitudes, whereas no mediation effects were for the other website (Thuisarts). The results of chapter 5 indicate that processing health information places less cognitive demands on people with adequate health literacy compared to limited health literacy groups. As a result, the information is better recalled and evaluated by people with adequate health literacy. Furthermore, health information

appeals more to the imagination of people with adequate health literacy resulting in more positive attitudes.

This dissertation showed that features of digital health information can be used to design optimal health messages for people with limited health literacy without being counterproductive in adequate health literacy groups. We found that information processing requires more cognitive effort from people with limited health literacy and people in this group find it more difficult to imagine the content of health information compared to people with adequate health literacy. Effective health messages are therefore the ones that place low cognitive demands on their readers and appeal to the imagination. These messages are composed by non-difficult language, offer the possibility to have the text read out, and, if this format suits the content, the information is presented in an animation. Adding illustrations that clarify difficult parts of the texts is recommended, however, pretests should certify that people actually notice and pay attention to the illustrations. Moreover, the studies in this dissertation revealed that messages that are suitable for people with limited health literacy are also effective in adequate health literacy groups. Professionals in health communication and health care should therefore not be hesitant to use these design features in their materials. When digital health information is carefully designed, this improves information processing among people with limited health literacy. As a result, health information becomes more useful for the entire population, leading to better informed health decisions.