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Designing digital health information in a health literacy context

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General discussion

Making informed health decisions starts with the ability to process and understand relevant information. However, for many people, processing health information is difficult due to limited health literacy. To improve the effectiveness of health information, more attention needs to be paid to the design features of health communication. Particularly in digital communication, such as websites or mobile apps, there are great opportunities to present health information in non-traditional ways instead of just written text. To strategically use design features for improving health information effectiveness, insight is needed into how information processing works in a health literacy context and what makes digital health messages effective. The aim of this dissertation was therefore to gain insight into how information processing is influenced by health literacy and to identify message design features that optimize health communication effects in different health literacy groups.

Using different research methodologies, this dissertation adds to the body of knowledge about message design and health literacy and contributes to the literature in different ways. First, it revealed that specific design features of digital health communication improve information processing among people with limited health literacy. Messages that are low in text-complexity, or messages that include spoken text or animations, are easier to process for people with limited health literacy, resulting in better information recall. Adding illustrations to clarify the text also improved recall in people with limited health literacy, but only in case of complex messages. Thus, illustrations can be used to support information processing when the complexity of the text cannot be further reduced. This dissertation also showed that information presented as an animation improves information processing among limited health literacy groups to such an extent that traditional recall differences between these groups disappeared. When exposed to health animations, people with limited health literacy recalled the same amount of information as their adequate health literate counterparts, which is a promising result. These insights can be used to develop health messages, particularly in digital environments, that are based on theory and empirical evidence. This dissertation hereby responds to a call for theory-based research on health literacy and e-health (Mackert, Champlin, Holton, Muñoz, & Damásio, 2014).

Second, this dissertation showed that health information that is adapted to people with limited health literacy is also appreciated by people with adequate health literacy. Messages that are low in complexity, illustrated, spoken, or animated, are not counterproductive in adequate health literacy groups. The different chapters of this dissertation consistently showed that people with limited and adequate health literacy

have comparable attitudes and intentions towards health messages. The design factors of these messages do not negatively influence peoples' responses in one of the groups. Moreover, it appeared that most informed decisions regarding cancer screening were made by people who were exposed to non-complex information. This applied to both health literacy groups. Health communication professionals should therefore not be hesitant to use these features in their materials because there is no risk of deterring people with higher health literacy.

Third, in addition to the effects of health communication, the research presented in this dissertation examined people's attention to digital health information. Eye-tracking research has rarely been done in the context of health literacy. The findings of this particular study showed that the attention-recall relationship differed between health literacy groups. In line with other studies presented in this dissertation, the eye-tracking study showed that people with limited health literacy benefit from illustrated health information. The more attention people with limited health literacy paid to the illustrations, the better the information was recalled. Increased attention to the text did not lead to more recall in this group, indicating that illustrations can make a difference for people with limited health literacy as long as these illustrations are attended. Recently, an overview article was published that discusses several design features of health information that influence attention among people with limited health literacy. These are for example visual complexity and persuasive imagery (Lazard & Mackert, 2015). The use of attention getting techniques is needed because only illustrations that are actually attended improve information processing of complex health materials in limited health literacy groups.

Fourth, this dissertation investigated the mechanisms that underlie the relationship between health literacy and respectively information recall and attitudes to the information. Different scholars have argued that processing differences between health literacy groups are caused by the cognitive demands that health messages place on people (e.g., Squiers, Peinado, Berkman, Boudewyns, & McCormack, 2012; Wilson & Wolf, 2009), however, this mechanism was not empirically tested. The research in this dissertation showed that the cognitive load that is placed on the audience by health messages indeed plays a role in the relationship between health literacy and both recall and attitudes. For people with limited health literacy, processing health information is more cognitively demanding than it is for people with adequate health literacy, resulting in reduced information recall and less positive attitudes towards the information. People with limited health literacy also find it more difficult to imagine the

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content of the health messages compared to people with adequate health literacy, which negatively influences people's attitudes. These insights in the mechanisms that underlie health information processing as a result of health literacy can be used to reduce information processing disparities between people with limited and adequate health literacy.

Finally, since the start of health literacy research, the vast majority of the studies in the field have been conducted in the United States. In Europe, research on health literacy is growing, which mainly resulted in epidemiological studies that describe the prevalence of limited health literacy in the European countries and the association between health literacy and several health outcomes (see for example HLS-EU Consortium, 2012). Studies on health literacy and health communication are still scarce, but highly needed. In Europe, and the Netherlands in particular, policy makers and the government place much emphasis on people's rights to receive understandable information in many contexts, such as finance and health. To achieve this, research is needed into how understandable health communication should be designed for European populations (van der Heide, 2015). This dissertation responds to this call.

In this dissertation, health literacy is perceived as a general, personal characteristic that is predictive of information processing in different health contexts. The different chapters support this perspective, by showing that health literacy is a good predictor of information recall regarding colorectal cancer screening, lung cancer treatment, and fibromyalgia. These findings imply that when people's general health literacy skills are improved, this will result in better information processing of any kind of health information, irrespective of the health domain. This is important to note, because many scholars in the field recently started to develop and apply context specific health literacy measures. These measures assess for example colon cancer literacy (Pendlimari, Holubar, Hassinger, & Cima, 2012), oral health literacy (Naghbi Sistani, Montazeri, Yazdani, & Murtomaa, 2014), or diabetes literacy (Yamashita & Kart, 2011). The growth of context specific health literacy measures is seen as a key development in the field, which has both advantages and disadvantages. One of the potential risks of putting much effort in the development of specific health literacy measures is stagnation of the general health literacy field (Mackert et al., 2015). The findings of this dissertation emphasize the importance of the general health literacy concept in relation to information processing and the need to develop this field further as well.

As this dissertation perceives health literacy as a personal characteristic reflecting people's health-knowledge base, this also implies that health literacy is something dynamic that can be improved by learning or personal experience. During the life course, most people get ill, visit physicians, have medication prescribed, search for health information, and talk to others about their health status. All these daily experiences contribute to someone's health literacy. In this perspective, the most health literate people should be the ones with the most years of experience, thus older adults. The data collected for this dissertation support this assumption. Analyses on a sample that is representative for the Dutch population showed that health literacy was positively associated with age in people under the age of 55. When participants were older than 55, age and health literacy were unrelated. These findings are not in line with studies that showed a negative association between age and health literacy, based on which older adults are often classified as a risk population for limited health literacy (e.g., Baker, Gazmararian, Sudano, & Patterson, 2000). Possibly, the use of different measures to assess health literacy (e.g., REALM, TOFHLA, NVS, SAHL-D, or 3HL) plays a role in this discrepancy of findings, however, future research should further investigate the relationship between age and health literacy, particularly in an European context.

The idea that health literacy can be developed during the life span is encouraging. The different chapters in this dissertation demonstrate the benefits of adequate health literacy with respect to the ability to process and recall health information. This 'positive perspective' on health literacy is encouraged by a growing group of scholars, who argue that research should focus on the benefits of adequate health literacy rather than emphasizing the risks of limited health literacy (Nutbeam, 2000; Pleasant, Cabe, Patel, Cosenza, & Carmona, 2015). In their view, effort should be put into the development of strategies to improve people's health literacy level, in order to achieve ultimate goals such as a healthiness and empowerment. To improve health literacy, it is important that processing gaps with respect to health information start to decline. The findings of this dissertation can be used as a starting point, to design effective health messages that are easily processed by people of different health literacy levels. As a result, the information is better remembered and the newly created knowledge will facilitate health information processing in the future.

Theoretical implications

This dissertation studied the interaction between message design features and health literacy from a cognitive resources perspective, which is in line with previous research

(Squiers et al., 2012; Wilson & Wolf, 2009). Our hypotheses were mainly based on the cognitive theory of multimedia learning (Mayer, 2002) and Lang's limited capacity model of motivated mediated message processing (LC4MP, 2006). The findings of this dissertation imply that this cognitive view is useful to predict and explain recall differences between limited and adequate health literacy groups and that this perspective can be used to develop messages that improve information processing in people with limited health literacy. However, the cognitive perspective does not provide a theoretical base for how different features of digital health messages might influence people's attitudes towards these messages and intentions to perform the behaviors that are advocated in the communication. Based on the resources matching hypothesis (Anand & Sternthal, 1989), we hypothesized that messages with little cognitive demands would result in more positive attitudes and behavioral intention among people with limited health literacy compared to people with adequate health literacy, but this was not found. Both experimental studies showed no association between health literacy and message attitudes, indicating that all experimental messages were similarly evaluated in both health literacy groups. The results of the survey however, based on real health websites and a sample that is representative for the Dutch population, indicate that the ease with which information can be imagined plays a role in attitude formation. This is in line with the idea that vivid information positively influences attitudes (Coyle & Thorson, 2001; Sundar & Kim, 2005), and a message's ease of imagination was found to depend on health literacy. However, there is no theory available to explain these effects. Over the last years, many conceptual frameworks on health literacy have been developed (e.g., Paasche-Orlow & Wolf, 2007; Sørensen et al., 2012; von Wagner, Steptoe, Wolf, & Wardle, 2009). Although these models point to the effects of health literacy on for example health attitudes and beliefs, they do not specify the direct effects of health communication such as attitudes towards the message or behavioral intention. Therefore, there is a need for an overarching theory on how different message features influence attitudes and intentions and whether this might be different between people with adequate or limited health literacy.

Practical implications

Over the last decades, health literacy received much scientific attention. However, this awareness is still lacking among professionals in health care and health communication (Mackert, Ball, & Lopez, 2011). This is unfortunate, as the results of this dissertation emphasize the importance of well-designed health information for limited health literacy groups. It is therefore important to educate professionals in health communication

about the prevalence of limited health literacy and how the design of health materials influences information processing. Another important result of this dissertation for health communicators is that the message features that are recommended for limited health literacy groups are also effective among people with adequate health literacy. The hypothesis that adapted messages would negatively affect attitudes or intentions in people with adequate health literacy was not supported.

With respect to textual information, this dissertation showed that non-complex information is better recalled and evaluated by people of all health literacy levels. Communication professionals should therefore not be hesitant to evaluate their messages with respect to complexity and try to simplify the text to such an extent that it is easy to understand but not infantile. It should be noted that evaluating the complexity of a text is something different than assessing the readability level. Readability formulas assess the total number of words or syllables in a text, but they do not evaluate the presence of complex words for example. It has been shown that readability and comprehensibility are not always related (Friedman & Hoffman-Goetz, 2007). In this dissertation, non-difficult information was characterized by short and concrete sentences that were written in an active voice, avoiding jargon or unnecessary medical terminology.

In contrast to what is called 'the pictorial effect' (Houts, Doak, Doak, & Loscalzo, 2006), this dissertation showed that illustrated texts are not always more effective than text-only information. The study on text difficulty and illustrations revealed that explanatory illustrations only improve information recall in case of complex texts. For health communication professionals, this implies that it is not necessary to illustrate every piece of the information on a website, leaflet, or app. Only the parts or concepts that are difficult to understand require illustrations. Images that depict the content of the text reduce the risk of cognitive overload and provide a mental representation of the information, which supports understanding of health materials. However, adding illustrations only improves information recall among people with limited health literacy when people actually pay attention to the images, which emphasizes the need for pretests before the materials are actually used.

Nowadays, much health communication takes place on digital platforms such as websites or apps. Digital communication offers great opportunities for audio or video based messages, which are particularly effective for people with limited health literacy. Offering the possibility to read out the text is also useful to this group. This dissertation

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showed that when complex information is presented as a narrated animation, recall differences between health literacy groups tend to disappear. Thus, an animation is especially effective among people with limited health literacy. Health communication professionals should therefore consider this format in their digital health communication as long as the content of the information suits the format of an animation. This is for example the case when a process is explained, such as the development of cancer.

Limitations and directions for future research

The research described in this dissertation has some limitations. First, we used the SAHL-D, to assess people's health literacy, but this measure does not cover the entire health literacy spectrum. In its current definition, health literacy encompasses people's ability to obtain, process, understand, and use information (Berkman et al., 2010; Sørensen et al., 2012), whereas the SAHL-D assesses peoples' knowledge and understanding of a wide range of health-related concepts. Consequently, it tests peoples' ability to process and understand health information, without considering the ability to obtain and use this information. Nevertheless, we are confident that the SAHL-D was the best measure to be used in this dissertation. The aim of this research was to investigate the way in which health literacy interacts with specific message characteristics in information processing and how these processing differences influence health communication effects such as information recall. Considering the focus on information processing, the SAHL-D was the best option to choose. Future research should address the other aspects of health literacy, such as people's ability to obtain, evaluate and use health information. Especially online, where much health information is available, people require the skills to find information and to evaluate its reliability. It would therefore be useful to investigate how people with limited health literacy obtain and evaluate online materials and how these skills can be improved.

A second limitation of the research in this dissertation is that only the short-term effects of health communication were assessed. The message effects were found soon after the exposure, but it is unclear whether these effects are sustainable over a longer period of time. A study on differences between print and video information for example only found short-term effects on information recall but no long term effects (Wilson et al., 2010). Whether the duration of effects is relevant depends on the context. Sometimes it is important that health messages have long term effects. For example when people have to remember information provided by a health care provider, or when people receive the invitation letter to have cancer screening and decide to postpone their decision. However, when people turn to the Internet to find certain information, they

will probably use this information immediately and therefore the long term effects of health information might be less important in this context.

Third, the message features that were studied in this dissertation are a combination of traditional ones (e.g., text and illustrations) and ones that are typical for digital communication (e.g., narrated text and animation). The studies were all conducted on a computer or tablet. However, the use of smartphones for health-related purposes increases rapidly. The health applications that are currently available often incorporate features such as interactivity, data sharing, self-assessments, avatars, and feedback based on personalized data. The variety of message features is growing, and for many of these it is still unclear how they influence information processing in relation to health literacy. Future research should therefore investigate the relation between health literacy and the effects of such features, but also how people can be motivated to use mobile health applications.

Finally, this dissertation focused on how health information can be optimally designed to improve information processing in different health literacy groups. The outcome measures were therefore mostly information recall and attitudes towards the message, and a few times attitudes towards health behavior and intentions were taken into account. The question is whether improved knowledge results in better health behaviors. Several studies have shown that health literacy and health are positively associated (e.g., HLS-EU Consortium, 2012; van der Heide et al., 2013), and adequate knowledge is a prerequisite for informed health decisions (Marteau, Dormandy, & Michie, 2001). Future research should therefore focus on the relationship between health literacy and actual health behaviors. It should make clear under what conditions health messages can be used not only to increase knowledge among people of different health literacy levels, but also to motivate individuals to take certain health-related actions.

Conclusion

Digital health information is widely available, but not everyone fully benefits due to limited health literacy. Until now, little was known about how health literacy influences information processing and how design features of digital health information can be used to create optimal health messages for different health literacy groups. This dissertation showed that processing health information places more cognitive demands on people with limited health literacy, resulting in less recall of the information and less positive attitudes towards the message compared to people with de adequate health

literacy. Also, people with limited health literacy find it more difficult to imagine the content of health information, resulting in less positive attitudes. Optimally designed messages are therefore low in cognitive load and appeal to the imagination. Such messages are composed by non-difficult texts, illustrated, offer spoken text, and use animations. Furthermore, information that is suitable for people with limited health literacy appeared to be effective in adequate health literacy groups as well. Health communication professionals should therefore not be hesitant to apply these design features in their materials. Carefully designed health messages improve information processing in limited health literacy groups, resulting in a more knowledgeable population and better informed health decisions.

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