"Should I trust or should I go?" or what makes health-related websites appear trustworthy?
An empirical approach of perceived credibility of digital health information and the impact of user diversity

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Abstract: An abundance of information is available on the Internet. At the same time the quality of information fluctuates largely. When people use such information for making important decisions, this becomes an issue. "Health" is one of the most searched topics on the Web and search results might have the biggest consequences for one's life. However, trust in found information, or lack thereof, filters usage. To understand which elements on a website convince people to trust the information or not, we conducted a study with two aims: firstly, identify factors which trigger credibility; secondly, investigate to what extend both the medial presentation and the severity of the related disease influence the assessment of credibility. Possible factors were first collected in three focus groups and then operationalized in a questionnaire. We collected 184 responses where three different health websites differing in complexity and in the severity of disease (light vs. life striking) were presented and assessed. Results show that for more severe diseases more complex information is preferred. Further actually being ill influences the criteria significantly.

1 INTRODUCTION

In times of digitalization the Internet plays a dominant role in people's life. Besides of being used for reasons of communication and entertainment, the Internet represents a medium for the search of information. The development of digital information is increasing. Day by day, the amount and volume of information is rising. Information about e.g., places, persons, opening times, or news represent only some search topics. One of the most often searched areas embodies topics about health (Fischer & Dockweiler, 2016). Especially through a new awareness for health and lifestyle (quantified self) as well as through the development of the informed patient, information becomes more relevant than ever before. Apart from only informing about health topics, people also take information as a basis for decision making regarding treatment or the intake of medicine (Andreassen et al., 2017). There are many advantages to digital health information. Health information is available whenever and wherever it is required. For many people, it enables access to medical information (Trepte et al., 2015). They can actively participate in issues regarding their health and even connect with other people who are dealing with similar issues (Cline & Haynes, 2001). However, disadvantages of so much information circulating the Internet are also present. There is much unserious and incorrect information available, which is not detected as wrong or outdated (Trepte et. al., 2015) by the reader. Thus, psychological or physical consequences might occur due to delayed medical consultations or wrong intake of medicine (Eysenbach, 2003).

Therefore, it is a big challenge to assess the quality and credibility of a website for any user looking for health information (Dierks et al., 2002). People focus on different criteria for assessing information as correct (Kim et al., 1999). There is a growing need to understand how this type of information is being accessed and used. What kind of criteria are important for people's decisions to trust information. On the other hand, how diverse are users? Which kind of user

prefers which kind of presentation? In this study, we investigate these kinds of questions. The aim of the study is to find out and understand in how far both the medial presentation of a health website and the severity of a described illness play a role in the assessment of credibility. Moreover, the study goal is to comprehend what kind of user characteristics have an impact on the website assessment.

2 STATE OF THE ART

To understand how medical information is available on the Internet, we present an overview of digital health information, credibility factors, health websites and their complexity as well as the topic of eHealth literacy.

2.1 Digital Health Information

Information about health are commonly searched for online. More than 70% of people search this kind of information on the Internet (Fischer & Dockweiler, 2016). Most of the people inform themselves about their own health issues. Main search topics are symptoms of diseases, prognoses, and treatment possibilities (Medlock et al., 2015). In a study of Stadtler et al. (2009) investigating on the impact of patient's online search on the patient-physician interaction, 61% of users reported that the information they have found influences their own health. This result emphasizes the need to understand people's reasons for assessing information as trustworthy whenever it has an impact on their health.

2.2 Quality of Health-related Websites

Health information is frequently accessed on the Internet. Even though many tools and guidelines already exist for site developers to keep their information qualitatively high (Wilson, 2002), health-related information and its quality still fluctuate largely on the Internet (Fahy, 2014). Aspects of lack in quality of information show a huge range from information being not serious, not up-to-date, or containing false information among others. Furthermore, websites often serve rather as a platform for commercials than as a platform for evidence-based sources. One of the biggest challenges for information seekers is therefore to evaluate the information. However, not only the content but rather the presentation of information including layout,

structure, pictures, etc. are aspects influencing the evaluation by the user.

2.3 Credibility Factors of Health-related Online Information

The amount of information which appears online, whenever a search for information about health issues on the Internet, is overwhelming. Still, people have developed their own search behavior and coping strategies. When it comes to assess e.g. websites with health information they focus on specific aspects. What are the so-called credibility factors that make digital information appear useful and trustworthy?

Many studies have been conducted on this phenomenon. Eysenbach and Köhler (2002) reported that for instance a list of references, information about the latest update, as well as information about the authors and pictures are important credibility factors of websites that are perceived as trustworthy. Furthermore, information about alternative treatment options as well as side effects on health-related websites belong to further credibility factors (Bates at al., 2006). Benigeri and Pluye (2003) made an attempt of describing facilitating criteria for the quality assessment of health-related digital information. However, even though plenty of catalogues of credibility factors already exist, the assessment of quality still varies.

It seems that user-diversity determines the different aspects strongly. Barnes et al. (2003) stated that e.g. the extend of people's personal involvement has an impact on the information assessment. Less involved people seem to focus more on layout than on content and up-to-datedness as more involved people do. Moreover, younger people focus more on website layout (Fogg et al., 2004) compared to older users who care more about references (Huntington, 2004). This study aims at supporting these results as well as identifying more specific aspects taking user-diversity into account.

2.4 E-health Literacy

Besides objective criteria such as above-mentioned credibility factors, subjective ability factors play an important role regarding the assessment of digital health information. Literacy is one very important aspect. People who possess the capability to read and write and are literate, integrate and participate easier in social life and are able to understand and carry out a higher degree of control over everyday events (Nutbeam, 2008). The term "eHealth literacy"

describes the ability to seek, find, read, understand, and appraise health information from electronic sources. It means that people own the skill to apply the knowledge gained and address or solve a health problem (Norman, 2006). A higher literacy in health correlates with better health outcomes. Health literacy influences the utilization of health care, patient-physician relationship and self-care (Paasche-Orlow et al., 2007). It is apparent that due to the individually trained competence, assessment of digital health information differs strongly. To find out about the phenomenon of health literacy it is integrated in our investigation.

3 RESEARCH METHODOLOGY

This paper raises the question how digital healthcare information is assessed by its recipient and in how far it differs according to the disease severity. It focusses on the perceived credibility of different medial presentations of websites in conjunction with two different disease severities. The aim of the paper is to identify credibility factors which have an impact on the recipients' attitude to assess a website with health information as being trustworthy. To identify, evaluate, and quantify these factors, a two-fold multi-methodological approach was chosen. In a first step data were collected qualitatively by focus groups. Based on the results a questionnaire was developed and data were collected quantitatively. The main research question guiding the investigation were:

(1) Which are the *most important trust elements* of a website presenting health information in general? Do *age and gender* have an impact on the assessment of credibility factors? Does the importance of credibility factors differ regarding the *severity of disease*?

 (2) In how far do the medial presentation of a health website and the severity of disease play a role according to the *user's assessment*?

(3) To which extend do user factors such as *age and gender affect the assessment* of health information of different disease severities, respectively?

3.1 Previous Focus Group Study

The focus groups aimed at identifying different factors which have an impact on the assessment of the credibility of a website. Therefore, three focus groups with 17 participants were conducted with three different age ranges ("digital natives"=14–19 years

(N=5), "digital immigrants"=30–54 years (N=6), "silver surfers"=55–69 (N=6)) .In the beginning, participants were encouraged to brainstorm about sources they use when informing themselves about health information. In a free discussion participants started to share experiences. In a further step, participants were asked to rate the mentioned factors. Findings show that objectivity of health information is rated as very important throughout all age groups. Younger participants rated author information, a list of sources, as well as the date of publication as very important. Comprehensibility was rated very highly by middle-aged participants as well as the website layout. Older participants assessed the structure of the page as very important.

3.2 Questionnaire Study

To quantify the findings from the focus group discussions with a larger sample, a questionnaire was developed. The survey consisted of four parts, dealing with user factors, theoretical concepts, website scenarios, and credibility factors.

Demographic data and further user factors. The first part of the questionnaire assessed age, gender, highest education level, current activity and health status. Moreover, general familiarity with the Internet usage as well as general Internet activities were collected. At last, usage frequency of information sources regarding health topics, usability of online sources such as search engines, platforms, forums, chats, websites were measured.
Health Literacy Scale. Items regarding health literacy were taken from Cameron D. Normen and had to be answered on a 6-point-Likert scale from 1=is not true at all to 6=is totally true (e.g. *"I know how to find helpful health resources on the Internet." or "I feel confident in using information from the Internet to make health decisions.")* The respective items were added after having checked the scale reliability (Cronbach's α = .890).
Website scenarios. To find out in how far information about health topics are perceived and assessed on websites, three existing electronic health websites were chosen by authors and were arranged to fictive collages without naming the website brand. These developed websites could be distinguished according to their complexity of content and presentation. Regarding complexity, we consider a website complex when the information is more detailed and the layout contains more subunits.
At last, one website with low content and low presentation was built (LowRep), one with a middle

degree of complexity (MidRep) and a third one with a very high complexity (HighRep). Furthermore, two diseases with different degrees of severity were chosen. For a marginal but still serious disease hay-fever was described. Breast cancer was taken as an example for a very severe and life striking disease. Participants were asked to look at the website leisurely and report their impression. Therefore, they were asked to rate 5 items afterwards on a 6-point-Likert scale (1=not at all to 6=yes, in any case) *(1) "Do you like the website?" (2) "Do you think you are sufficiently informed about the disease?" (3) "Did you perceive the website as trustworthy?" (4) "Would you, after having seen the information, still continue your search?" (5) "Would you, after having read the information on that website, still want to see a physician?".*

Items were analyzed regarding the different websites types using factor analysis (principal component analysis using varimax-rotation). Two factors could be identified. The first one included items one, two and three asking about the benefit, convenience of information and credibility, showing high internal reliability (Cronbach's α = .840). Resulting, a scale was built and called *assessment* scale. The second factor consisted of the items four and five asking whether more information is desired or a consultation with a physician is still wanted. Cronbach's alpha did not allow to calculate a second scale (α = .571).

Overall, 6 websites were presented; three for each disease (3 websites x 2 diseases). To avoid fatigue and ordering effects, the order of websites was randomized between participants.

Credibility factors. After one "disease set", namely three website versions, participants were asked to rate which kind of criteria a website must have to be rated as being trustworthy.

Therefore, participants had to name five out of 18 criteria personally most important criteria (such as e.g.: date of publication, source, seal of quality, etc.). These criteria were based on results of the qualitative pre-study.

3.3 Statistical Method

All subjective measures were rated on six-point Likert scales. Data were analyzed quantitatively by using Pearson correlations, ANOVA with repeated measurement, and MANOVA. The level of significance was set to $p = .05$. This means that significant findings have a probability to appear in 1 out of 20 such studies, even if the effect is not existent.

3.4 Sample Description

The questionnaire was completed by N=184 participants.

Demographic data and further user factors. The sample was divided into three age groups. It consisted of a heterogeneous education level (see Table 1). The current activity was wide spread (e.g. commercial area (36%), technical area (19%), social field (16%), medical field (7%)). In general, the sample constituted a rather healthy group with M=4.2 (SD=0.85; 6 points max.).

When asked about familiarity with Internet usage, the sample reported to be rather familiar (M=4.93, SD=0.4). The highest duration of Internet activities such as reading newspaper (M=2.53, SD=1.59), posting in newsgroups (M=2.12, SD=1.28), getting information about products (M=2.83, SD=1.17) or buying products (M=2.25, SD=0.97) were limited to an average duration of 0–60 minutes per week.

When asked about how often participants use different sources when informing themselves about health topics, participants reported that they used the Internet on a monthly basis (M=4.44, SD=1.21), followed by relatives (M=4.44, SD=1.15). Physician (M=5.06, SD=0.66), medical journal (M=5.49, SD=0.9), or self-help books (M=5.51, SD=0.89), were considered or used 2–3 times a year.

Furthermore, when asked about how helpful different sources were for the search of health information, search engines (M=5.52, SD=1.17) were described as most helpful followed by websites (M=4.22, SD=0.98), platforms (M=3.41, SD=1.24), forums (M=3.12, SD=1.21), and last chats (M=2.44, SD=1.09).

It was also of interest what kind of information participants search for on the web. As the top priority information about a healthy lifestyle (M=4.13, SD=1.22) was given, followed by information about therapy of serious diseases (M=3.85, SD=1.17). Information about medical treatments (M=3.85, SD=1.26) and physicians (M=3.75, SD=1.4) was reported before reasons (M=3.79, SD=1.22) or diagnosis of diseases (M=3.61, SD=1.26). The least important search topics among health information were given as causes for a cold (M=2.6, SD=1.27) and diagnosis of a cold (M=2.49, SD=1.14).

Health Literacy Scale. The health literacy level was averagely high with M=3.84 (SD=0.79). For a detailed description of the demographic characteristics, see Table 1.

Table 1. Demographic characteristics of the aggregated sample (N=184).

Demographic characteristics		Percentage of respondents
Age [years]	mean (SD)	43.5 (15.77)
	17-32 digital *natives*	33.2%
	33-53 *digital immigrant*	33.7%
	54-79 *silver surfer*	33.2%
Gender	women	59.8%
	men	40.2%
Education level	No college	61.9%
	College or higher	38.1%

4   RESULTS

The presentation of the results is guided by the research questions.

4.1 Factors Influencing Credibility

To identify credibility factors which have an impact on the recipients' attitude to assess a website with health information as being trustworthy, participants had to name five out of 18 criteria which are rated as personally most important. As most important comprehensibility was mentioned, followed by objectivity of information, clear structure of website reference as well as indication of negative side effects or risks. Factors with low weighted credibility were links to other websites, access to forums or chat rooms or pictures of authors. Considering the severity of diseases, a different picture occurs. Table 2 shows the results.

Table 2: Five most important assessed credibility factors of health-related Websites with different disease contexts in % (N=184).

Light Disease	In %	Severe Disease	In %
comprehensibility	64.7	comprehensibility	62
clarity	54.3	objectivity	48.4
objectivity	49.5	references	46.2
references	39.7	clarity	39.7
details about author	29.9	date of publication	33.2

Comparing the five most mentioned credibility factors of a light disease and a severe disease, it turns out that four aspects are the same only with differently attributed importance. Comprehensibility e.g. is assessed as the most important aspect of health-related information for both. Further mentioned factors differ due to the severity of disease. Whereas clarity of a Website plays the second most important role for health-related information of a light disease, objectivity is mentioned on the second stage. Stage five contains details about authors as a credibility factor for a light disease. In contrast to that, date of publication is assessed as a further important credibility factor regarding digital health information of a severe disease.

Taking the three different age groups into consideration, the named factors stay the same only the order of mentioned factors differs slightly.

4.2 Assessment of Different Websites

To find out in how far the medial presentation of a health website and the severity of disease play a role according to the user's assessment, a repeated measure was calculated. Taking only the medial presentation of all three website into account without the content of diseases, no significant difference could be detected ($F(1.82, 300.57)=2.57$, $p=.084$). Still, the most complex version was rated best ($M=3.49$, $SD=0.77$), followed by the second complex version ($M=3.44$, $SD=0.78$) and finally the version with the least complexity ($M=3.34$, $SD=0.88$). Interestingly, including the different severity of diseases significant differences were found ($F(3.7, 581.5)=5.75$, $p<.01$).
Since, Mauchly's test indicated that the assumption of sphericity had been violated $X^2(14)=113.48$, $p<.01$, the Greenhouse-Geisser corrected tests are reported ($\varepsilon=.74$). For the less severe disease, version two achieved the best rating ($M=3.64$, $SD=0.87$). In contrast to these findings, among the three different website versions, version three was rated best for the more life striking disease ($M=3.44$, $SD=0.9$).

Results indicate, that the assessment of complexity of websites starts to play an important role whenever a specific disease is described. More severe diseases are more favored to be read on a middle complex website in contrast to a light disease. In our case participants liked to read information about a light disease in a fancier way. When asked if after having seen the website along with the kind of disease, participants would want to search for more information or see a physician, also significant results

were found ($F(4.42, 680.15)=25.72$, $p<.01$). Figure 2 portrays the different characteristics.
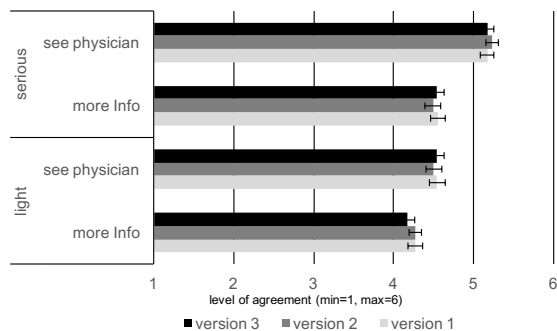

Figure 2: Assessment of website regarding if more information is wished for and if a physician wants to be seen after having seen website. Error-bars denote standard error.

The desire, to receive more information and to see a physician, increases with the severity of disease. Regarding the assessment of website versions, a different picture is shown. The most complex looking website seems to inform better in case of a light disease than in case of a serious disease in contrast to the other versions. However, the less complex website versions one and two seem to convey satisfactory information regarding the more serious disease than regarding a lighter disease. The same results can be seen regarding the item if a physician wants to be consulted afterwards. The less and most complex websites seem to portray trustworthy information. To sum up, at first glance the severity of disease plays an important role however, small deviations between disease and website version could be detected.

4.3 Impact of User Diversity on Assessment of Websites

To investigate to which extend user factors such as age, gender, health status, or health literacy affect the assessment of health information of different severities of disease a MANOVA was run. The health status and literacy variable were computed each into three equal groups. Findings show, that three significant interactions were found between gender and assessment, age and health status. Female participants rated the least complex presentation of the light disease better than men ($F(1, 113)=5.997$, $p=.016$ / $M_{female}=3.39$, $SD=0.93$; $M_{male}=3.23$, $SD=0.92$). The least complex presentation of the severe disease was rated better by digital natives

($M=3.81$, $SD=1.14$) than by digital immigrants ($M=3.23$, $SD=0.88$) and silver surfers ($M=3.13$, $SD=0.77$) with $F(2, 113)=4.915$, $p=.009$. A further significant result could be found referring to the health status of participants. In general, participants with a better health state (values for light disease version: $M_{bestHealth}=3.57$, $SD=0.7$; $M_{middleHealth}=3.25$, $SD=0.86$; $M_{badHealth}=2.75$, $SD=0.85$) rated the least complex presentation of both diseases better than not so healthy people ($F_{lightdisease}(2, 113)=5.382$, $p=.006$ / $F_{severedisease}(2, 113)=4.443$, $p=.019$). Two interactions were found between gender and literacy as well as age and literacy. The first interaction was detected on the assessment of the least complex presentation of both diseases ($F_{lightDisease}(2, 113)=5.579$, $p=.005$ and $F_{severeDisease}(2, 113)=3.854$, $p=.024$). Women with a significant higher health literacy rated the website version better than men with a comparable low health literacy. Findings regarding the lighter disease and severe disease are very similar. Due to the spatial limitations of this article only one finding according to the light disease is shown in figure 2.
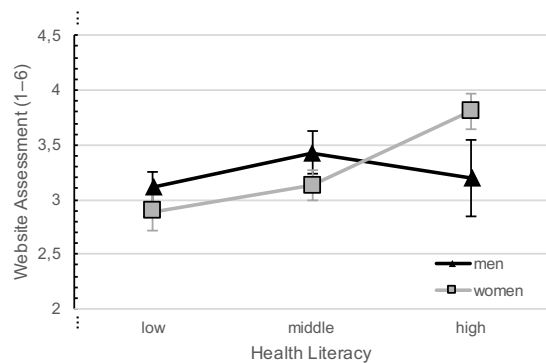

Figure 1: Interaction of gender and eHealth literacy (low, middle, high) regarding assessment of least complex presentation of light disease. Error bars denote standard error.

A further interaction can be reported about age and eHealth literacy referring to the most complex website presentation and light disease ($F(4, 113)=2.655$, $p=.037$). As can be seen in Figure 3 the youngest age group with a high eHealth literacy value rates the most complex website version better than the middle and older age-group.
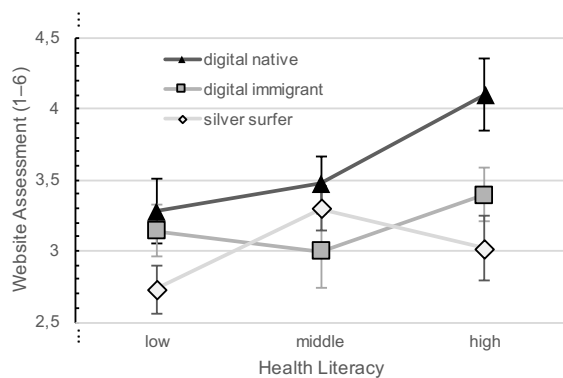
Figure 2: Interaction of three age-groups (digital native, digital immigrant and silver surfer) and eHealth literacy (low, middle, high) regarding assessment of least complex presentation of light disease. Error bars denote standard error.

5 DISCUSSION & GUIDELINES

In this article, we investigated factors of websites with health information which trigger credibility. We also examined to what extend both the medial presentation of health websites and the severity of the related disease play a role in the assessment of credibility. To find out in how far information about health topics are perceived and assessed on websites, we chose three existing electronic health websites and arranged them to fictive collages without naming the website brand. These developed websites could be distinguished according to their complexity of content and presentation. Regarding complexity, a website was considered more complex when the information was more detailed and the layout contained more subunits. The results presented above and illustrated in Table 2 show, that in general users searching for health information pay attention to a range of factors when deciding if the information is trustworthy. Factors range from content-related factors to layout-factors. The five most outstanding factors and the meaning of them are described as followed: Comprehensibility was one of the most important factors triggering trustworthiness on health-related websites. In other words, users attach importance to information that is written and prepared in an understandable way. A further mentioned aspect refers to a clear structure of information. A clear structure guides the users and leaves them confident in their understanding of the information. Objectivity of information counts to a further credibility aspect. Information that conveys a neutral position is accepted more than subjective descriptions of health details. References to sources were also mentioned among the five most important trustworthy elements. Further, information about the sources are considered to be important. More so, users want to learn about the details about authors. In this regard, our findings match the results of Eysenbach and Köhler (2002). In our study, it was of additional interest in how far aspects that trigger trustworthiness of information differ, when searching for illnesses of different severity. It turns out that the types of factors stay the same, only the order of priority varies.

Comprehensibility remains the most important aspect. Whereas for a light disease factors such as clarity illustrate a factor of trustworthiness, for a more severe disease, objectivity is demanded more strongly. A further difference that we found was that details about authors are of interest when informing about a light disease (in this case hay fever) compared to date of publication which triggers credibility when searching for a more life striking disease. In the latter case patients have a stronger urge to stay up-to-date and not overlook the most recent advances in therapy. Our findings referring to our three website scenarios, differing in the grade of complexity and content clarity, indicate that in general all three versions are accepted averagely well. This also changes whenever the search intention differs. When participants had to imaging searching for information referring for a specific grade of disease severity, versions were considered more critically. When the participant was searching with the intention to receive information about a rather light disease, the most complex website version was rated best. In contrast to that, users favor to read information about more severe diseases in a simple or middle complex website version. It can be noted that the more severe a disease the less fancy the presentation of information should be.

It is interesting to note that differences of the perception of credibility do not solely stem from differences in information complexity. There are no differences in the assessment when a simple comparison of means compares their ratings. Only when user factors or the type of illness is incorporated differences occur. This is important to know, as on average all websites seem to do rather ok. When looking at the details it becomes clear that for some people some websites are very credible, while others consider the same websites non-credible. Since there are systematic variations in the judgements depending on health literacy, gender, and age, these factors should not be ignored when designing a health-related website. It seems that no "one-size-fits-

all" solution exists when it comes to health information on the Internet. Information providers should be aware of how to design websites for different target user groups and possibly consider methods of participatory design to determine, who needs what information when and how.

6 LIMITATIONS AND FUTURE RESEARCH

As with any empirical study limitations apply to our findings. The investigated interaction effects lend themselves to relatively small subgroups of participants. For example, the older male participants with high health literacy are a rather small subgroup of users. This can be seen in the size of the larger error bars in the figures. Nevertheless, effects are present even with higher error margins in mind. As our findings are in line with previous research, further confirmation and transferability of results would require significantly larger samples or meta-analytical methods to improve on the evidence. Since the settings were generated from fictitious websites constructed by the authors, we cannot be sure that our perspective on complexity is shared equally among all users. We have put effort into designing the websites to increase in complexity in "equidistant" steps. However, as the texts and images we used were taken from actual websites, it is not easy to guarantee this. The illnesses we selected (hay-fever, breast-cancer) have very specific target groups. Men that took part in the study noted that it was hard for them to imagine themselves into a setting requiring therapy for breast cancer. Although men might in reality contract breast cancer, it was strongly considered to be a women's illness. As with all scenario based questionnaires one must take all results with a grain of salt, as the social desirability bias might distort answers more strongly in settings more alien to the participant.

Our findings indicate that websites trying to inform the public about health issues must consider their information and communication concept. It is crucial to understand the intended audience and their requirements for health information. Possibly, adaptable websites that allow the user to seamlessly increase the amount of complexity for a given illness without impeding clear and simple information access, could provide a solution to such challenges. In this regard, the use of recommendation system that is aware of the user's health (Schäfer et al. 2017),

could be applied to identify information needs from the user depending on the interaction on the website (Calero Valdez et al. 2017). When other users interact with information in forums or comments, additional non-verified information enters the stage to. In such health-related social media, certain users are more active than others (Schaar et al. 2012). Information and more importantly meta-information could "drift" because of user interaction—especially when algorithms determine the presentation of information (e.g. by rating, liking). Integrating human-oversight in doctor-in-the-loop approaches could be interesting to investigate (Holzinger et al. 2016).

When such solutions are addressed, naturally questions regarding ethics, privacy (Vervier et al. 2017), and trust play an important role. What information are users willing to share to improve their online experience on health-related websites? Here, user diversity factors play an even bigger role (Zeissig et al. 2017). Therefore, it is necessary to understand the interplay of all user related factors and the benefit users see in using such websites. By modelling trade-offs of utility and privacy, better services or mobile phone apps with better information quality can be conceived. These services self-tailor their presentation and complexity to the needs and desires of the users even incorporating their current usage context. Are they looking for help or just browsing? Should they trust the information they find or should the go see a doctor? Either way, the factors that determine the credibility of health information are crucial in helping patients, both online on the Web or offline by a doctor.

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