EJHC | European Journal of Health Communication

ISSN 2673-5903
ejhc.org

Article

Vague Language in Online Medical Consultation

An Experimental Study of Uncertainty and Its Consequences

DOI: 10.47368/ejhc.2021.001
2021, Vol. 2(1) 1-28

Linwei He
Department of Communication and Cognition, Tilburg University, the Netherlands

Eline Smit
Department of Communication Science, University of Amsterdam, the Netherlands

Abstract

Online medical consultation has become increasingly popular, while little is known about what features of such service can impact users' emotions and behaviours. This study looked into the language features of online text-based medical consultation. Specifically, the aim of this paper was to examine the effects of vague language (i.e., non-specific, imprecise language) on health-related uncertainty, and its affective and behavioural consequences, while considering individual differences in regulatory focus. A between-subject (vague language vs. precise language vs. control condition) web-based experiment was conducted (N = 249), where participants in the experimental groups read virtual doctor-patient conversations where the doctor used either vague or precise language. Results showed that vague language induced more uncertainty than precise language (p = .010); such uncertainty was appraised as a danger (r = .18, p = .004) but not an opportunity (r = .01, p = .932), and subsequently led to negative emotions (r = .45, p < .001). No effects were found on behavioural outcomes, and there was no moderation from regulatory focus. The results suggest that online healthcare providers should refrain from using vague language in communication with patients to avoid eliciting uncertainty and subsequent negative feelings. Future research is needed to further examine the behavioural effects of uncertainty and explore factors that could foster the appraisal of opportunity.

Corresponding author:
Email: l.he_1@tilburguniversity.edu

Keywords
Online text-based medical consultation, vague language, uncertainty, appraisal of danger, appraisal of opportunity, affective response, behavioural response.

The use of the Internet as a source of health-related information has been increasing in recent years (Kummervold et al., 2008; Ybarra & Suman, 2006). In 2014, six out of 10 European citizens used the Internet to search for health-related information within the last 12 months (European Commission, 2014). The download of health applications in 2016 reached 3 billion globally and is expected to increase at a yearly growth rate of 16% (Research2Guidance, 2017). With the significance of the Internet in the healthcare field, developing innovative ways for doctor-patient interaction has been of interest to researchers, practitioners, and patients (Dicianno et al., 2014; Jung & Padman, 2015). Online medical consultation is a recent innovation, which does not require a face-to-face visit and enables more flexibility for both patients and doctors (Lin et al., 2005; Whitten et al., 2007). Online medical consultation was found promising in high patient satisfaction level in terms of access, cost, convenience, and empowerment (Albert et al., 2011; Lu et al., 2011). As a consequence, this service has been gaining increasing popularity. A review has found that the service of online medical consultation has grown at an average rate of 150% every five years since the year of 2000 (Al-Mahdi et al., 2015). Furthermore, a very recent survey reported that more than 50% of clinicians in Europe have adopted digital technologies such as apps and telemedicine to provide healthcare services (Deloitte Centre for Health Solutions, 2020). A new surge of research on this topic has been growing, concerning user motives and barriers (Flynn et al., 2009; Nijland et al., 2009), usage patterns (Jung & Padman, 2014), and service modality (Al-Mahdi et al., 2015). Whereas knowledge of online medical consultation has been increasing, providing insights into the technology as well as its users, the research remains mainly descriptive, and more explanatory studies are needed. The question of what features of online medical consultation have an impact on users' post-use experience (e.g., their emotions and behaviours), for example, remains unanswered.

More recently, the need for online health information has experienced rapid growth due to the COVID-19 outbreak (Bento et al., 2020; Lucas et al., 2020). The pandemic has caused many outpatient in-person visits to be cancelled or postponed (Hau et al., 2020), and medical centres are now adopting digital tools such as telemedicine and virtual care to deliver healthcare services (Bokolo Anthony Jnr., 2020). Miscommunication and misinformation are, however, omnipresent online and have been shown to have a negative impact on coping with the pandemic (Cuan-Baltazar et al., 2020; Ioannidis, 2020). Therefore, appropriate and evidence-based online health communication is crucial.

Among various modalities of online medical consultation, text-based services account for a significant part and have been adopted by numerous countries, e.g., Sweden (Umefjord et al., 2003), Greece (Labiris et al., 2002), Croatia (Klinar et al., 2011), and Iran (Deldar et al., 2011), and their verbal features are of particular interest to this study. Regarding medical discourse, there is a common yet scarcely studied phenomenon – the use of vague language. According to a study reviewing diagnostic letters written by clinicians, nearly two-thirds of the letters contained vague

language (Linedale et al., 2016). Health professionals often use vague language to increase conceptual "fuzziness" and make the information more understandable for non-specialist patients (Varttala, 1999). Vague language is also regarded as a self-protective device to ease tension in conversations (Trappes-Lomax, 2007). Yet, these ideas are all derived from a sender perspective, while empirical findings from a receiver perspective are more mixed. One study has found that vague language increased the persuasiveness of commercial advertisements but also caused false interpretation and misunderstanding among consumers (Zhu & Li, 2013). Another study, among patients with functional gastrointestinal disorders, concluded that uncertain diagnostic language may hinder patients' acceptance of the diagnosis (Linedale et al., 2016). Such contradiction between expectations from the sender perspective and empirical findings from the receiver perspective calls for more research to examine the actual effect of vague language.

From a linguistic perspective, vague language includes properties such as probability, ambiguity, and impreciseness (Carter & McCarthy, 2006; Mishel, 1988). Such features may induce a sense of uncertainty, a common experience during medical encounters (Brashers et al., 2003). Health-related uncertainty plays an important role in patient emotion and behaviour change, both positively and negatively (Liao et al., 2008; Mu, 2005; Wineman et al., 2003). Therefore, understanding uncertainty and predicting its consequences can help improve the online medical consultation service by avoiding negative outcomes and fostering positive ones. However, little research has studied uncertainty in the context of online medical consultation.

The state of uncertainty intrinsically indicates the inability to accurately predict possible outcomes (Mishel 1988), and such predictions might vary among individuals depending on their individual characteristics in regulatory focus. Regulatory focus is a motivational principle that determines people's sensitivity to potential positive or negative outcomes (Higgins, 1998). Individuals with a promotion focus tend to be more sensitive to positive outcomes, while prevention-focused people are usually biased towards the negative possibilities (Förster et al., 2001; Grant & Higgins, 2003; Hazlett et al., 2011). Thus, when facing an uncertain situation, people may differ in their perception of this situation and respond with different emotions and behaviours. In other words, the effects of uncertainty might depend on an individual's regulatory focus.

To address the aforementioned gaps in the current literature regarding online text-based medical consultation, the present study aims to explore affective and behavioural consequences of vague language and health-related uncertainty and to re-evaluate its effectiveness as a sender strategy, taking into consideration individual differences in regulatory focus.

Theoretical Framework

The Nature of Uncertainty

Uncertainty is a common human experience (Berger & Bradac, 1982), and has been explored in various domains such as organisational change (e.g. Bordia et al., 2004; Elving, 2005), interpersonal relationships (Parks & Adelman, 1983; Knobloch & Carpenter-Theune, 2004), and health communication (Middleton et al., 2012; Brashers et al., 2000). On a broad notion,

uncertainty is described as a cognitive state resulting from people's assessment of alternative predictions for the future (Babrow, 1992; Berger & Calabrese, 1975). In the health-related context, Mishel (1988, p.225) defined uncertainty as "the inability to determine the meaning of illness-related events and accurately anticipate or predict health outcomes". In other words, uncertainty is the cognitive state when an individual is unable to fully understand the current status of one's health and make predictions of the future.

Several theories attempted to explain the occurrence of uncertainty and identified a number of sources of uncertainty. As an early and fundamental framework, Mishel's (1988) Uncertainty in Illness Theory proposed that inconsistent symptoms, lack of familiarity with the illness, and incongruence between expectation and experience (e.g. when someone expects the treatment to release the pain, but it does not) may lead to uncertainty. Moreover, a low education level of the patient, low credibility of the doctor, and a lack of social support could raise uncertainty. Later, Brashers (2001) focused on the communication process and developed the Uncertainty Management Theory, which identified another source of uncertainty: insufficient information about the diagnosis, including ambiguity of diagnosis and unclear meaning of diagnostic test (Brashers et al., 2003). Other studies narrowed their focus to characteristics of the medical information and identified three properties of information that cause uncertainty: probability, ambiguity, and complexity (for a review see Hillen et al., 2017). Probability refers to the randomness or indeterminacy of future outcomes. Ambiguity happens when the information lacks reliability, credibility, or adequacy. Complexity refers to features of the information that make it difficult to understand such as multiple interpretive cues. In summary, health-related uncertainty can be triggered by various sources, such as symptom-related sources (e.g. symptom pattern), characteristics of the doctor and the patient (e.g. credibility, education), and properties of medical information received (e.g. ambiguity and complexity).

Among these sources, properties of medical information are of particular interest for communication science research, as a doctor's communication style is modifiable and can therefore have an impact on the patients (Bradley et al., 2001; Rowland-Morin & Carroll, 1990). Certain language styles might contain some of the abovementioned properties and therefore trigger uncertainty. However, little research is available in this regard. This study aims to fill this gap by linking uncertainty with the doctor's language style, specifically focusing on the use of vague language.

Vague Language as a Source of Uncertainty

Defining vague language has long been an endeavour among scholars, and a wide range of definitions has been proposed (Adolphs et al., 2007). In an early stage, Channell (1994, p. 20) broadly defined vague language as "expressions that can be contrasted with another word or expression which appears to render the same proposition and that are purposely and unabashedly vague". Later, Carter and McCarthy (2006, p. 928) took a closer look and examined vague language on a lexical level. They defined vague language as "words or phrases which deliberately refer to people and things in a non-specific, imprecise way". The feature of deliberateness was affirmed by Trappes-Lomax (2007), who defined vague language as "any purposive choice of language to make the degree of accuracy, preciseness, certainty, or clarity with which a referent or

situation is described less than it might have been" (Trappes-Lomax, 2007, p. 122). Although variations exist regarding the definition of vague language (Adolphs et al., 2007), the principal features of purposiveness and impreciseness are commonly shared. In this study, Carter and McCarthy's definition was adopted, as it covered both main features and focused on a lexical level, making it the most specific definition of all.

According to Carter and McCarthy's definition, vague language consists of non-specific and imprecise words and phrases. In terms of medical discourse, such impreciseness of information is believed to be a source of uncertainty (Brashers et al., 2003; Han et al., 2011). Moreover, without a definitive meaning, vague language contains multiple interpretive cues regarding one's health, which contribute to the complexity of the medical information – another source of uncertainty (Han et al., 2011). Thus, with these characteristics, vague language in a medical consultation is expected to result in uncertainty. Therefore, the following hypothesis is proposed:

H1: Vague language results in more uncertainty than precise language.

Uncertainty and Its Consequences

A major assumption shared by several uncertainty theories is that it is human nature to manage uncertainty (Berger & Calabrese, 1975; Brashers, 2001; Kramer, 1999). However, the initiation and nature of such management depend on how individuals cognitively perceive uncertainty, as the state of uncertainty is not intrinsically desired or unwanted until the individual attaches personal understanding to it (Mishel, 1988). This cognitive process of determining the meaning of uncertainty is referred to as appraisal.

Uncertainty in Illness Theory suggests that when encountering health-related uncertainty, individuals appraise it as either a potential danger or a potential opportunity (Mishel, 1988). When people believe that the current situation would result in negative outcomes, they appraise uncertainty as a danger. Uncertainty was proved to be associated with a pessimistic outlook on the future in many studies. For example, a high level of uncertainty predicted danger appraisal among women with rheumatoid arthritis (Bailey & Nielsen, 1993). Similar results were reported in studies conducted among patients with heart disease (Kang, 2008), HIV or AIDS (Brashers et al., 2000), and prostate cancer (Kazer et al., 2012). Uncertainty can also be appraised as an opportunity when the individual believes that the situation would result in positive outcomes. For instance, studies among patients with long-term breast cancer identified a positive appraisal of the uncertain situation (Wonghongkul, Dechaprom, et al., 2006; Wonghongkul, Moore, et al., 2000). A series of qualitative interviews with prostate cancer patients reported similar results, i.e. they viewed the uncertainty as a possibility that the cancer might be unharmful or would not spread (Bailey et al., 2007). To sum up, uncertainty can be appraised as either a danger or an opportunity, depending on the individual's perception of the situation.

After appraising the uncertainty as a danger or an opportunity, individuals then tend to respond to it accordingly. The mental and physical responses used to manage uncertainty are referred to as coping (Zhang, 2017). A number of coping strategies have been identified and classified in several uncertainty theories (e.g. Uncertainty Management Theory, Brashers, 2001; Integrative Model of Uncertainty Tolerance, Hillen et al., 2017; Uncertainty in Illness Theory, Mishel, 1988). To summarize their work, coping strategies include both affective and behavioural responses, which

can be either positive or negative. Individuals might have positive (e.g. hope, courage, calm) or negative (e.g. fear, worry, despair) feelings towards uncertainty depending on their appraisals. Examples of behavioural responses include information seeking/avoidance, taking direct action/disengagement, and looking for social support.

The responses individuals use to cope with uncertainty are, however, determined by their appraisal of this uncertainty. When uncertainty is appraised as a danger, individuals are most likely to have negative affective and behavioural responses. When appraised as an opportunity, uncertainty is likely to be managed through positive affective and behavioural responses (Mishel, 1988; 1990). Empirically, the association between appraisals of and responses to uncertainty has been well documented yet biased towards a focus on danger. For example, the appraisal of danger was found to be positively related to anxiety (Kang, 2003), low fighting spirit (Kennedy et al., 2008), and avoidance (Hilton, 1989). Regarding positive responses, evidence is relatively scarce. One study suggested that positive appraisal was predictive of the positive feeling of hope (Ebright & Lyon, 2002). Another study found that individuals with a lower level of ambiguity-aversion (i.e. with a positive perception of uncertainty) were more willing to take colonoscopy screening (Han et al., 2014).

To summarize, the preceding discussion suggests that individuals first initiate an appraisal of uncertainty and subsequently use certain coping strategies to manage uncertainty accordingly. Therefore, it is expected that the affective and behavioural consequences of uncertainty are explained by its appraisal. This leads to the following hypotheses:

> *H2*: Uncertainty leads to negative affective (H2a) and behavioural (H2b) responses through the appraisal of danger.
>
> *H3*: Uncertainty leads to positive affective (H3a) and behavioural (H3b) responses through the appraisal of opportunity.

Regulatory Focus as a Moderator

As discussed in the above rationale, an individual's appraisal of uncertainty is an essential process for understanding the consequences of this uncertainty. Whether uncertainty is appraised as a danger or an opportunity, however, may depend on individual dispositional characteristics. Studies show that people differ in regulatory focus, which regulates their perception of the future, and as such might influence their appraisal of an uncertain situation (Halamish et al., 2008; Zacher & de Lange, 2011). Regulatory Focus Theory (Higgins, 1998) posits that humans could have two motivational states: a promotion focus and a prevention focus. A promotion focus, reflecting the pursuit of hope and achievement, is associated with a strong sensitivity of positive outcomes, whereas a prevention focus implies a sensitivity of negative outcomes (Higgins, 1998). This assumption suggests that when considering the future of a situation, promotion-focused individuals would think in a more positive direction while prevention-focused people tend to have a more pessimistic outlook. Support for this assumption has been found in many studies (Förster et al., 2001; Molden & Higgins, 2004; Zacher & de Lange, 2011). It is, therefore, expected that when encountering an uncertain situation, individuals would think towards potential danger or opportunity depending on their regulatory focus.

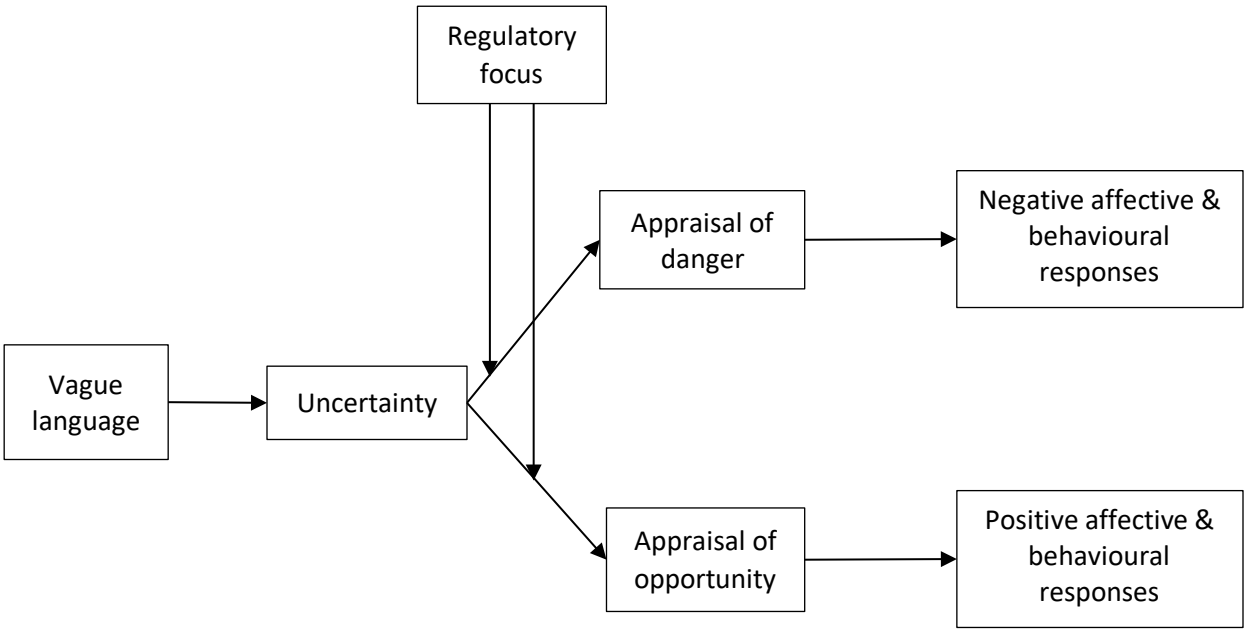


Figure 1. A conceptual model of the relationship between vague language and uncertainty and its consequences.

This leads to the last hypothesis stating:

> *H4a*: Uncertainty results in appraisal of danger, and this effect is stronger for prevention-focused individuals than for promotion-focused individuals.
>
> *H4b*: Uncertainty results in appraisal of opportunity, and this effect is stronger for promotion-focused individuals than for prevention-focused individuals.

Taken together, these hypotheses form a conceptual model (see Figure 1) with which this study aims to examine the effect of vague language on uncertainty, and the subsequent affective and behavioural consequences, taking into consideration individual differences in regulatory focus.

Methods

Design and Materials

A between-subjects experimental design was employed. Participants were randomly assigned to one of three conditions: a vague condition, a precise condition, and a control condition.

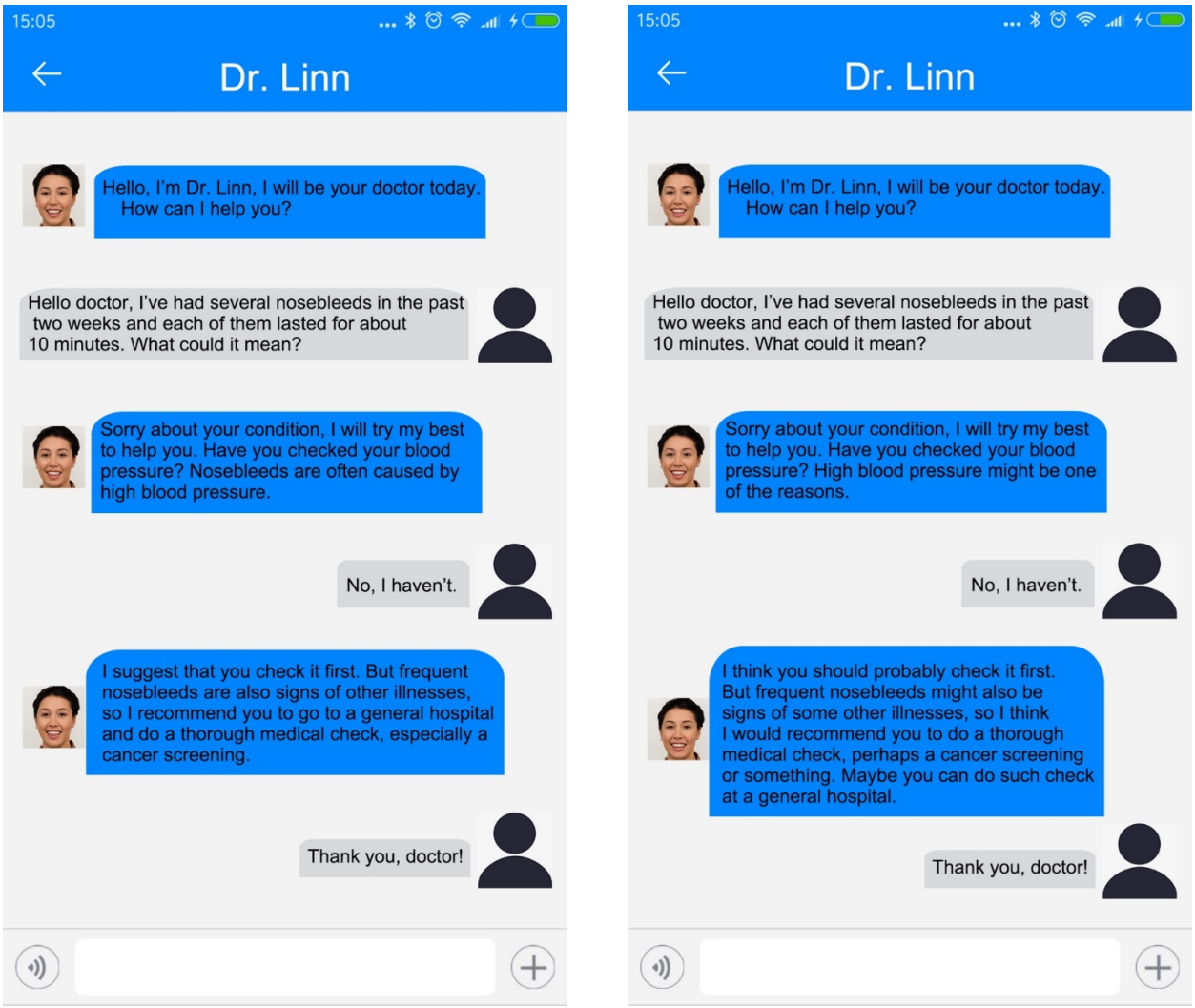
The research was conducted in compliance with the ethical regulations of the Department of Communication Science, University of Amsterdam (project number 2020-PC-12373).

Materials. A virtual chat page was created where a doctor and a patient discussed the symptom of frequent nosebleeds. The symptom was chosen because frequent nosebleeds could be caused by both severe (e.g. nasopharyngeal cancer) and less severe (e.g. high blood pressure) disorders, and therefore has the potential to induce appraisals of danger and opportunity (Schoenberg & Drew, 2002; Zapf et al., 1981). In terms of message content, the conversations were developed based on the first author's real-life experiences of consulting with doctors about frequent nosebleeds on two existing medical consultation websites (i.e. Icliniq in English & Chunyuyisheng in Chinese), on which all doctors are licenced, ensuring the reliability of the materials.

The materials were designed to simulate a real-time chat consultation. Participants were presented with a chat page where they took the perspective of the patient, and messages popped out one by one upon the participant clicking a "next" button, which resembled a real chat session and enabled participants to engage in the conversation at their own pace. During the virtual consultation, the doctor first introduced herself, followed by the patient describing the symptom. Then the doctor made a diagnosis and gave medical suggestions. Messages for the diagnosis and suggestions were manipulated in language vagueness.

Manipulation. In the healthcare context, Adolphs et al. (2007) identified specific manifestations of vague language. One is the use of "approximators", such as "somewhat". Another is the use of "shields", such as "I think". Tseng and Zhang (2018) proposed a similar concept of "elastic terms" to describe properties of vague language, examples are "maybe", "perhaps", and "sounds like". In the present study, vague language was operationalised as the use of a combination of these terms. Specifically, messages in the vague condition included the aforementioned manifestations (e.g. "*I think* you should *probably* check your blood pressure", "*perhaps* a cancer screening *or something*") while messages in the precise condition did not (See figure 2 for the experimental stimuli).

While online medical consultation is rapidly growing in Europe, China holds one of the biggest markets for this service outside of Europe – by 2013, more than 2,000 hospitals had adopted remote medical service and the most popular online consultation platform, Chunyuyisheng, has 50,000 visits per day, more than 40 million registered users and 40,000 certified doctors (Milcent, 2018). Therefore, having insights from Chinese participants could increase the generalizability of this study to the Asian contexts. Nevertheless, according to a review by Al-Mahdi et al. (2015), most (i.e. 79% of the sample, $n = 28$) online medical consultation platforms provide their services worldwide, and English is the most commonly used language on these platforms. Therefore, both an English and a Chinese version of the study materials were created and tested in this study. Two independent translators completed the translation task. The first translator translated the original English version into Chinese. The second translator, who has a medical background and was blinded from the original version, then back translated the Chinese version into English. The original and the "back-translated" versions were compared and discussed by the two translators until they reached a consensus.



Precise Conversation Vague Conversation

Figure 2. Experimental Stimuli

Pilot. Before the actual experiment, a pilot test was conducted among a small sample of 23 people (seven pilot tested the Chinese version and 16 tested the English version). The pilot test had two aims. First, it aimed to test the clarity of instructions and message content for the live chat. Participants indicated whether the instructions and the conversation were clear to them with a scale ranging from 1 (*not clear at all*) to 5 (*very clear*). Besides, an open-ended question was included for participants to elaborate on the unclear parts. The results revealed that some participants had difficulty understanding medical terms, therefore, such terms (i.e. nasopharyngeal cancer and leukaemia) in the original stimuli were replaced with a more general term (i.e. other illness).

Second, the pilot test aimed to examine whether the manipulation was successful. Participants were asked to rate their perceived vagueness of the doctor's language on a 5-point semantic differential scale with five pairs of adjectives (e.g. *exact*/*ambiguous*, *precise*/*vague*). Participants in the vague condition ($M = 2.68$, $SD = 0.93$) perceived the language as vaguer than those in the

precise condition (M = 1.65, SD = 0.56); the mean difference was significant, p = .043, thus, the manipulation was considered successful.

Participants and Procedure

An a-priori statistical power analysis (Faul et al., 2007) suggested that a minimum of 246 participants were needed to detect a small to medium effect size (effect size f = .2, power = .8). A total of 333 participants were recruited via convenience sampling on social media platforms. To be eligible to take part in the online experiment, participants had to be at least 18 years old and able to read English or Chinese.

Upon starting the survey, participants first answered questions assessing their demographic information and regulatory focus. In the second part, participants were asked to imagine a scenario where they had several nosebleeds during the past two weeks, which each lasted for about 10 minutes. Participants in the experimental groups were further instructed to imagine that they went online and had a consultation with a doctor, where they were presented with either the vague or the precise conversation. Participants in the control group were directed to post-test measures after imagining the symptom and were not exposed to the virtual consultation. Upon completion, all participants were debriefed.

Measures

Pilot. Demographic variables (i.e., age, gender, education, and nationality) were measured via single items. Experiences with online medical consultation and nosebleeds were assessed through the number of online medical consultations and nosebleeds that participants had in the past year. Participants were asked to indicate their diagnostic history of relevant diseases (e.g. hypertension) via a single question.

Regulatory Focus. Regulatory focus was assessed using the Regulatory Focus Questionnaire developed by Higgins et al. (2001). This instrument is composed of two subscales that measure promotion and prevention focus respectively. On a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), participants indicated the extent to which they agreed with statements that reflect a promotion focus (e.g. "I often accomplish things that get me 'psyched' to work even harder") and statements that reflect a prevention focus (e.g. "I often obeyed the rules and regulations that my parents established"). The statements were presented in a randomised order. Mean scores for the two subscales were computed respectively (promotion focus scale: Cronbach's α = .73, M = 3.43, SD = 0.67, prevention focus scale: Cronbach's α = .68, M = 3.05, SD = 0.78). A final score was computed for each participant, by subtracting the score on the promotion focus scale from the score on the prevention focus scale. Participants were then categorized as either prevention-focused (i.e. with a final score above 0) or promotion-focused (i.e. with a final score below 0).

Uncertainty. Uncertainty was measured using a short form of the Mishel Uncertainty in Illness Scale (MUIS) (Mishel, 1990). This short form consists of five items (e.g. "I am unsure if my symptoms will get better or worse") that can be answered on a 5-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*) and previously proved a valid measure of uncertainty (Hagen et

al., 2015). A total mean score of the scale was computed, with a higher score indicating a higher level of uncertainty (Cronbach's α = .63, *M* = 3.31, *SD* = 0.73).

Appraisal. Appraisal was measured using the Stress Appraisal Measure (SAM; Peacock & Wong, 1990). SAM was constructed based upon the Theory of Stress Appraisal and Coping (Lazarus & Folkman, 1984), of which the main concepts are appraisals of threat and challenge. Mishel and Sorenson (1991) suggested that appraisals of threat and challenge are conceptually comparable with appraisals of danger and opportunity. Therefore, subscales of SAM assessing threat and challenge were adopted in the present study to assess appraisals of danger and opportunity, respectively. Participants were presented with eight randomly ordered questions that could be answered on a 5-point Likert scale (where 1 = *not at all* and 5 = *extremely*). Four questions each measured the appraisal of danger (e.g. "Will the outcome of this situation be negative?") and the appraisal of opportunity (e.g. "Is this going to have a positive impact on me?"). Two mean scores were computed for the appraisal of danger (Cronbach's α = .85, *M* = 2.89, *SD* = 0.86) and opportunity (Cronbach's α = .60, *M* = 2.66, *SD* = 0.73), respectively. The higher the score, the more appraisal was triggered.

Affective Responses. Five items with a 5-point semantic differential scale, presented in a randomised order, were used to measure participants' affective responses. The items were adopted from The Integrative Model of Uncertainty Tolerance (Hillen et al., 2017), which integrates previous studies on coping with uncertainty and identifies a list of common affective responses. Participants indicated their feelings using the following anchor points: worry/calmness, fear/courage, despair/hope, disinterest/curiosity, and aversion/attraction (Cronbach's α = .77, *M* = 3.14, *SD* = 0.78).

Behavioural Responses. The Integrative Model of Uncertainty Tolerance (Hillen et al., 2017) also identifies a list of common behavioural responses individuals use to cope with uncertainty. As the present study measured behavioural responses directly after exposure to the manipulations, intentions to perform these behaviours were assessed. Participants were presented with eight randomly ordered items that could be answered on a 5-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*). Four items each measured negative (e.g. "I will avoid thinking about this situation", Cronbach's α = .86, *M* = 2.39, *SD* = .94) and positive (e.g. "I will seek more information about this situation", Cronbach's α = .81, *M* = 4.04, *SD* = 0.67) behavioural intentions.

Statistical Analysis

To test for equal distribution of background variables across conditions, Chi-square tests and analyses of variance (ANOVAs) were conducted. For testing the effect of vague language on uncertainty, an analysis of variance (ANOVA) was conducted with uncertainty as dependent variable and condition as independent variable. Model 4 in PROCESS was used to test the effect of uncertainty on affective and behavioural responses through the appraisals. Model 7 was used to investigate the moderating effect of regulatory focus in the mediating relationship. All analyses were conducted with IBM SPSS 25.0.

Results

Sample Characteristics

During November 27 to December 10, 2019, a total of 333 participants were recruited. Seventy-nine participants were removed from analysis for incomplete responses and five were excluded for too short or too long completion time (i.e. with a z-score > 3), leaving a final sample of 249 participants. Among these 249 respondents, 59.1% were female. The majority (61%) was aged between 18 and 29 years old, and 81.9% of the respondents had at least a bachelor's degree. Most of the respondents were from Asian (44.2%) and European (45%) countries. Table 1 provides an overview of sample characteristics.

Table 1. Sample Characteristics (N = 249)

Characteristics		*n*	(%)
Gender	Female	146	(59.1%)
	Male	100	(40.5%)
	Other	1	(0.4%)
Age	18-29	152	(61.0%)
	30-39	43	(17.3%)
	40-49	42	(16.9%)
	50-60	10	(4.0%)
	over 60	2	(0.8%)
Education Level	Low	3	(1.2%)
	Middle	42	(16.9%)
	High	204	(81.9%)
Nationality	Asian	110	(44.2%)
	European	112	(45.0%)
	North American	18	(7.2%)
	South American	3	(1.2%)
	Other	6	(2.4%)
Online Medical Consultations in the Past	None	164	(67.2%)
	1-5	73	(29.9%)
	6-10	6	(2.5%)
	more than 10	1	(0.4%)
Nosebleeds in the Past Year	None	174	(71.0%)
	1-5	52	(21.2%)
	6-10	11	(4.5%)
	more than 10	8	(3.3%)
Diagnostic History of Relevant Diseases	Hypertension	10	(4.0%)
	Nasopharyngeal cancer	1	(0.4%)

Note. [a] Not all n's add up to 249 due to missing data; [b] Education was measured with a single item asking participants to indicate their highest degree obtained (1 = low: *less than high school*, 2 = middle: *high school*, 3 = high: *undergraduate degree/graduate degree/doctoral degree*); [c] Nationality was measured with an open-ended question asking participants to fill in their nationality.

Manipulation Check

Of all eligible respondents, 81 (32.5%) were assigned to the vague condition, 84 (33.7%) to the precise condition, and 84 (33.7%) to the control condition. To test whether the manipulation of language vagueness was successful, an independent samples t-test was conducted. The results showed that participants in the vague condition perceived the language as vaguer ($M = 2.96$, $SD = 1.19$) than participants in the precise condition ($M = 2.30$, $SD = 0.95$), and this difference was statistically significant, $t(163) = 3.94$, $p < .001$. Thus, the manipulation was deemed successful.

Differences in Background Variables between Conditions

To check whether background variables were equally distributed across conditions, a one-way ANOVA and several Chi-square tests were conducted. The results showed that there were no significant differences across conditions in terms of age, gender, nationality, education level, experience with online medical consultation, experience with nosebleed, or diagnostic history of relevant diseases. Therefore, no background variables were included as covariates in any of the following analyses.

Main Analysis

Effect of Vague Language on Uncertainty. To test hypothesis 1 predicting that vague language results in more uncertainty than precise language, a one-way ANOVA was conducted. A significant effect was found for vague language on uncertainty, $F(2, 246) = 4.67$, $p = .010$, $\eta^2 = .04$. A Bonferroni post hoc test revealed that participants in the vague condition ($M = 3.51$, $SD = 0.80$) experienced a significantly higher level of uncertainty, compared to those in the precise ($M = 3.21$, $SD = 0.74$, $M_{diff} = 0.29$, $p = .027$) and the control condition ($M = 3.21$, $SD = 0.62$, $M_{diff} = 0.30$, $p = .024$). This finding supports H1.

Simple Mediation Analyses. Hypothesis 2 predicted that uncertainty leads to negative affective (H2a) and behavioural (H2b) responses, and that this effect is mediated by the appraisal of danger. Similarly, in hypothesis 3, it was expected that uncertainty leads to positive affective (H3a) and behavioural (H3b) responses, and that this effect is mediated by the appraisal of opportunity. To test these hypotheses, Model 4 in the PROCESS macro by Hayes (2013) was used.

Results of the mediation analyses are presented in Table 2. A significant direct effect was found for uncertainty on negative affective responses; the indirect effect through appraisal of danger was also significant, supporting H2a. In terms of negative behavioural responses, neither the direct effect nor the indirect effect through appraisal of danger was significant, which rejected H2b. With regard to H3, the results showed a significant direct effect of uncertainty on positive affective responses. However, the direction of this effect was negative, which is opposite to what was hypothesized. Moreover, the mediation through the appraisal of opportunity was not significant. Thus, no support was found for H3a. However, an additional analysis revealed that this negative effect of uncertainty was mediated by the appraisal of danger. In terms of positive behavioural responses, neither the direct nor the indirect effect was significant, and H3b was, therefore,

rejected. Notably, uncertainty was not appraised as an opportunity. However, the appraisal of opportunity significantly predicted both positive affective and positive behavioural responses.

Table 2. Simple Mediation and Moderated Mediation Analysis Results

	b	*SE*	*t*	*p*	95% CI	
					LL	*UL*
X → M_1	.21	.07	2.88	.004**	0.07	0.36
M_1 → Y_1	.37	.05	7.07	< .001***	0.27	-0.47
X → Y_1	.14	.06	2.27	.024*	0.02	0.26
X → M_1 → Y_1	.08	.03			0.01	0.15*
W → M_1	.30	.51	0.58	.560	-0.71	1.30
X*W → M_1	-.24	.15	-1.61	.110	-0.54	0.05
	b	*SE*	*t*	*p*	*LL*	*UL*
X → M_1	.21	.07	2.88	.004**	0.07	0.36
M_1 → Y_2	-.06	.07	-0.85	.394	-0.20	0.08
X → Y_2	.13	.08	1.51	.134	-0.04	0.29
X → M_1 → Y_2	-.01	.02			-0.06	0.02
W → M_1	.30	.51	0.58	.560	-0.71	1.30
X*W → M_1	-.24	.15	-1.61	.110	-0.54	0.05
	b	*SE*	*t*	*p*	*LL*	*UL*
X → M_2	.01	.06	0.09	.932	-0.12	0.13
M_2 → Y_3	.29	.06	4.49	< .001***	0.16	0.41
X → Y_3	-.22	.06	-3.44	< .001***	-0.35	-0.09
X → M_2 → Y_3	.00	.02			-0.04	0.05
W → M_2	-.18	.46	-0.40	.689	-1.09	0.72
X*W → M_2	.09	.14	0.67	.504	-0.18	0.36
	b	*SE*	*t*	*p*	*LL*	*UL*
X → M_2	.01	.06	0.09	.932	-0.12	0.13
M_2 → Y_4	.21	.06	3.64	< .001***	0.10	0.32
X → Y_4	-.00	.06	-0.01	.995	-0.11	0.11
X → M_2 → Y_4	.00	.02			-0.03	0.04
W → M_2	-.18	.46	-.40	.689	-1.09	0.72
X*W → M_2	.09	.14	.67	.504	-0.18	0.36

Note. 5,000 bootstrap samples; X = uncertainty, M_1 = appraisal of danger, M_2 = appraisal of opportunity, Y_1 = negative affective responses, Y_2 = negative behavioural responses, Y_3 = positive affective responses, Y_4 = positive behavioural responses, W = regulatory focus; *p < .05, **p < .01, ***p < .001.

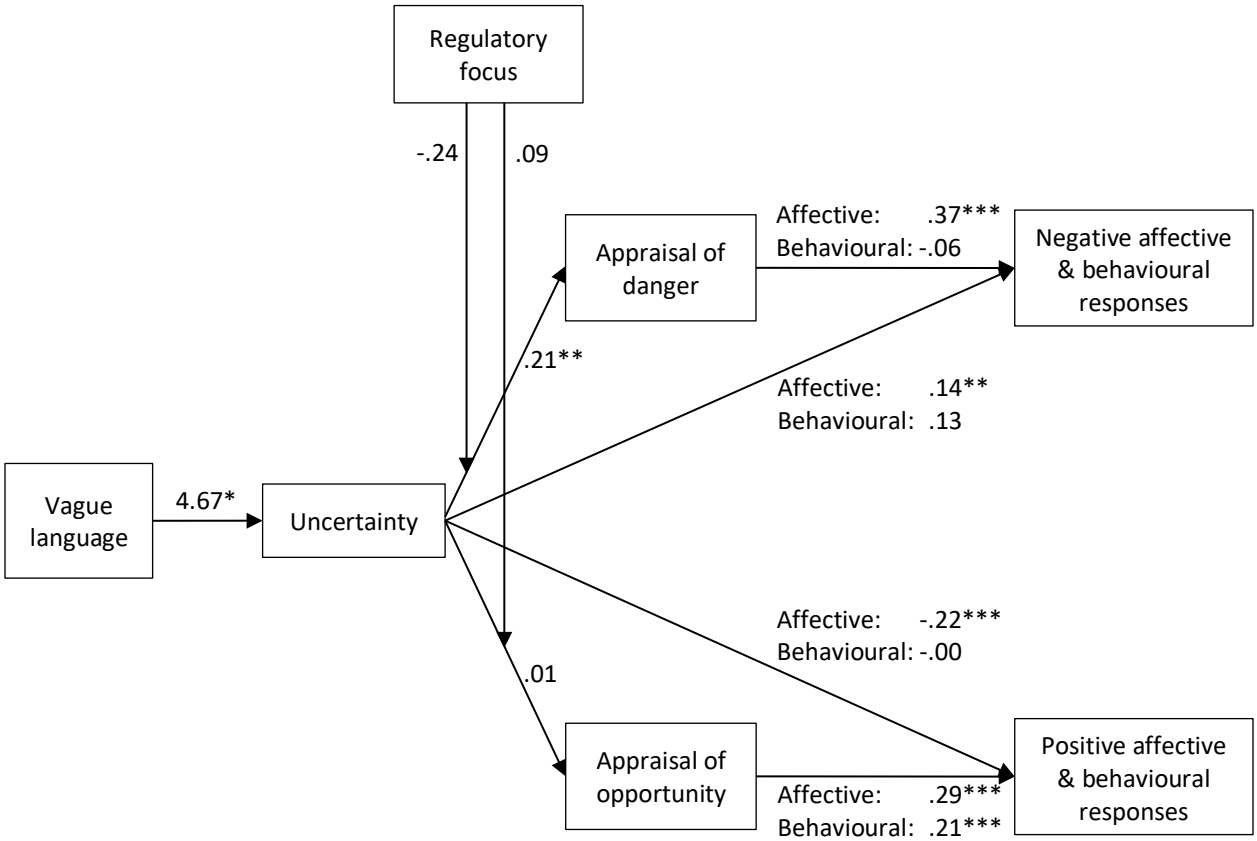


Figure 3. Test results as integrated in the conceptual model.
*$p < .05$, **$p < .01$, ***$p < .001$

Moderated Mediation Analyses. H4a predicted that uncertainty results in appraisal of danger, and this effect is stronger for prevention-focused individuals than for promotion-focused individuals. Similarly, H4b expected the effect of uncertainty on appraisal of opportunity to be stronger among promotion-focused individuals than among prevention-focused individuals. Taking into consideration the mediating role of appraisal of danger and opportunity, H4 altogether predicted a moderated mediation effect. To test this hypothesis, Model 7 in the PROCESS macro by Hayes (2013) was used.

Results showed no significant interaction effect between uncertainty and regulatory focus on either appraisal of danger ($p = .110$) or appraisal of opportunity ($p = .504$). Thus, H4 was not supported. Results for the analyses can be found in Table 2.

See Figure 3 for the results in relation to the conceptual model.

Discussion

Main findings

The present study sought to examine the effect of vague language on uncertainty and its subsequent affective and behavioural consequences in the context of online medical consultation, while considering the possible moderating role of regulatory focus.

Effect of Vague Language on Uncertainty. As expected, this study found a significant and positive effect of vague language on patients' uncertainty level, indicating that when a doctor uses vague language in an online medical consultation, there is a high chance that the client would experience a feeling of uncertainty. This finding confirms earlier studies concerning the potential sources of uncertainty, showing that vague language in medical discourse contributes to the occurrence of health-related uncertainty (Brashers et al., 2003; Han et al., 2011).

Consequences of Uncertainty through Appraisal of Danger or Opportunity. Subsequent analyses attempted to explore the consequences of uncertainty. It was expected that uncertainty would lead to both negative and positive responses through appraisals of danger and opportunity, respectively.

Regarding negative consequences, as expected, uncertainty was significantly associated with negative affect, and this effect was mediated by the appraisal of danger. This result supports previous research findings suggesting that uncertainty can be perceived as a danger and therefore results in negative feelings such as anxiety and fear (Calvin & Lane, 1999; De Graves & Aranda, 2008). However, contrary to what was expected, uncertainty did not predict negative behavioural responses. In fact, participants overall reported a low intention to perform negative behaviours ($M = 2.39$, $SD = 0.94$). A possible explanation of this finding could be drawn from social desirability bias, i.e. a tendency to overestimate desirable traits and underestimate undesirable ones, when using self-report measures (Dadds et al., 1998). A rich body of research has proved that people tend to underrate their intention to perform unhealthy behaviours (e.g. Hébert et al., 2001; Klesges et al., 2004). In the context of the present study, negative behaviours such as avoidance and decision deferral might be considered unfavourable as they are hampering the illness treatment, and participants may have therefore reported low intentions to perform such behaviours. Future research is needed to further test the behavioural effects of uncertainty, preferably objectively measuring actual behaviour instead of self-reported behavioural intentions.

In terms of positive responses, the results showed that uncertainty led to a decreasing level of positive affect through the appraisal of danger; no effect was found on positive behavioural responses. In sum, uncertainty did not have any positive consequences, neither affectively nor behaviourally. This could be explained by our finding that uncertainty was not appraised as an opportunity at all, while appraisal of opportunity did in fact significantly predict both positive affective and behavioural responses. In other words, uncertainty may lead to positive consequences but only when it is appraised as an opportunity – which, in our study, was not the case. This supports what Mishel (1988) and Brashers (2001) argued, namely that uncertainty stays neutral until it is appraised, and individuals respond to uncertainty according to their appraisal.

One possible reason for uncertainty being appraised only as a danger and not as an opportunity could be that participants had generally little experience and knowledge regarding the symptoms described in this study. Such unfamiliarity is likely to cause a low sense of mastery, which may induce an appraisal of danger (Mishel, 1988). Moreover, Hilton (1989) found that the longer patients live with uncertainty, the more likely they are to appraise it as an opportunity. Considering that participants were newly "diagnosed" in the present study, this might explain the absence of the appraisal of opportunity. Future research is encouraged to identify factors that could foster the appraisal of opportunity, so that patients can experience positive emotions and form more positive behavioural intentions.

Another possible reason for uncertainty not being appraised as an opportunity could be that the appraisal scale used was not able to successfully capture the positive potential of uncertainty as operationalized in this study. Although Mishel and Sorenson (1991) suggested the conceptual similarity of appraisal of challenge and opportunity, according to their definition the appraisal of challenge entails potential gain or growth, while in the context of the present study, positive appraisal might only indicate less loss (no news is good news) rather than actual gain. Therefore, the items in the appraisal of challenge (e.g., Is this going to have a positive impact on me?) scale might have been unable to capture the type of positivity that could be derived from the stimuli used. However, iteratively removing items and re-testing the hypotheses did not produce any different results, indicating the robustness of our findings. To better capture the nature of opportunity appraisal, future research is encouraged to develop more specific measurements, especially for the health-related contexts.

Moderating Role of Regulatory Focus. This study sought to explore the potential moderating role of regulatory focus, however, no significant interaction effect was found between regulatory focus and uncertainty on either appraisal of danger or appraisal of opportunity. The hypothesis that regulatory focus could be a potential moderator was based on the assumption that people consider possible outcomes of a situation differently – some individuals focus on the positive side and some on the negative side (Higgins, 1998; Pennington & Roese, 2003). A possible explanation for the non-significant results could be that the experimental materials in this study did not make a clear distinction between the positive and negative valence of the possible outcomes described. In the conversations, "high blood pressure" was used to indicate a relatively positive outcome while "cancer screening" ought to imply a negative outcome. However, even though with different seriousness levels, the two outcomes are both illnesses and "high blood pressure" may not have sufficiently addressed as something, relatively, positive. Chances are that participants perceived the two possibilities both as negative, and therefore appraised uncertainty as a high danger regardless of their regulatory focus. This assumption is supported by previous research suggesting that the effect of regulatory focus is associated with the overall valence (i.e. positive vs. negative valence) of the message (Yi & Baumgartner, 2009). To better test for the effect of this potential moderator, future research could consider including a pilot study to ensure a clear distinction between the positive and negative valence of the message.

Another individual difference that might influence the effects of vague language is eHealth literacy (i.e., the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem, Norman &

Skinner, 2006). eHealth literacy might strengthen the association between vague language and uncertainty, as it may amplify users' perception of the complexity of the information. Indeed, it has been shown that people with low health literacy are more likely to experience health-related uncertainty in clinical settings (Reynolds, 2018), but more research is needed to examine the role of eHealth literacy in an online consultation setting.

Limitations

The present study sheds some light on the relationship between vague language and uncertainty and its consequences, however, there are several limitations that warrant consideration in the interpretation of the findings.

The first limitation lies in the setting of the online experiment. Participants were asked to imagine the symptom and the consultation, while results showed that the majority of them had not had such experiences before. This approach could be problematic considering the fact that it is difficult to imagine unfamiliar situations. A study among family caregivers of cancer patients depicted that caregivers generally cannot accurately imagine patients' situation and tend to overestimate their symptom experiences even though they have daily interpersonal interactions (Lobchuk & Vorauer, 2003). One can assume that in the present study, participants' imagination of the experimental scenarios and their perspective taking of the patients might not have been accurate, which may have influenced subsequent measures. Thus, future research would need to be conducted among real patients to avoid the inaccuracy of perspective taking.

Secondly, due to the cross-sectional nature of this study, intentions were measured instead of actual behaviours, which could be problematic considering that individuals do not always translate their intentions into action. A meta-analysis by Rhodes and de Bruijn (2013), for instance, yielded an overall 46% intention-behaviour discordance with regard to physical activity. Future studies are, therefore, recommended to consider longitudinal designs and use measures which would allow researchers to better capture actual behavioural outcomes, such as diaries or real-life observations (Garber et al., 2004; Minnis & Padian, 2001).

Moreover, uncertainty was measured with a scale adapted from Mishel Uncertainty in Illness Scale (Hagen et al., 2015; Mishel, 1990); the original instrument was designed to assess uncertainty in community-dwelling chronically ill adults who have been or are currently receiving treatment. The present study had, however, a slightly different context in that participants were in the diagnostic process and were not yet receiving treatment. Although the results showed that the scale had a Cronbach's α of .63, indicating an acceptable reliability level, chances are that the scale in this study did not sufficiently grasp the uncertainty in diagnosis. Considering that uncertainty could occur at any time in a health-related scenario, measurements that apply to more situations (e.g. diagnosis, pre-, post-, and during treatment) are needed in future research.

Implications

Earlier research argued that vague language is often used as a sender strategy to make the information more understandable or to ease tension in conversations (Trappes-Lomax, 2007; Varttala, 1999). However, findings of this study depict that vague language may arouse negative feelings such as fear and anxiety in patients through increased levels of uncertainty and perceived

danger. For health communication practice, this implies that the use of vague language could be problematic. Illness-related negative emotions are related to poor physical functioning (Swindells et al., 1999), decreased emotional well-being (Karademas et al., 2011), and lower quality of life (Shen et al., 2006). Therefore, based on the results presented, healthcare providers are advised to refrain from using vague language during an online consultation session.

Moreover, descriptive analyses showed that participants in the precise condition also reported a moderate to high level of uncertainty ($M = 3.21$, $SD = 0.74$). In other words, all participants who engaged in the virtual consultation experienced a certain degree of uncertainty. Keeping in mind that uncertainty had only negative consequences, this result should highlight the need for post-consultation service to cope with uncertainty and avoid any unfavourable outcomes. For example, many studies have demonstrated that adequate information provision is an important factor that helps reducing health-related uncertainty (Lemaire, 2004; Lemaire & Lenz, 1995; Sheer & Cline, 1995). Therefore, after an online medical consultation, healthcare providers are advised to provide further information that may enhance the patient's knowledge and, thus, reduce uncertainty.

A further implication is drawn in the light of the rapid development of Artificial Intelligence (AI) powered chatbots designed for various health-related purposes such as psychiatric counseling (Oh et al., 2017), smoking cessation (Perski et al., 2019), symptom monitoring (Meyer et al., 2020), and diagnosing (Jungmann et al., 2019). Human-chatbot communication and online text-based communication are similar in the way that they both rely on verbal language to convey information. Our results suggest that chatbots should avoid using vague language to prevent negative emotions. More generally, the notion that language use can have a profound impact on people may be informative to chatbot developers such that dialogues design should receive conscious attention, considering potential consequences.

Conclusion

This was one of the first studies examining health-related uncertainty from the perspective of verbal properties and as such provides some insights into the effects of communication on uncertainty, and patients' consequent emotions and behaviours. To conclude, our findings suggest that vague language in online medical consultation can induce uncertainty, and that people generally appraise such uncertainty as a danger and use negative affect to cope with it. These findings suggest that online healthcare providers should refrain from using vague language in communication with patients to avoid inducing uncertainty and subsequent negative feelings. Future work is needed to validate these findings in longitudinal studies with objective behavioural measures and to explore factors that could foster appraisal of opportunity and thus the positive consequences of uncertainty.

Acknowledgements

Eline Smit was supported by the Innovational Research Incentives Scheme Veni from NWO-MaGW (Netherlands Organization for Scientific Research - Division for the Social Sciences; project number 451-15-028).

References

Adolphs, S., Atkins, S., & Harvey, K. (2007). Caught between professional requirements and interpersonal needs: Vague language in healthcare contexts. In J. Cutting (Ed.) *Vague Language Explored* (pp. 62-78). Palgrave Macmillan.

Albert, S., Shevchik, G., Paone, S., & Martich, G. (2011). Internet-Based medical visit and diagnosis for common medical problems: Experience of first user cohort. *Telemedicine and E-Health*, *17*(4), 304-308. https://doi.org/10.1089/tmj.2010.0156

Al-Mahdi, I., Gray, K., & Lederman, R. (2015). Online medical consultation: A review of literature and practice. *Proceedings of the 8th Australasian Workshop on Health Informatics and Knowledge Management*. Australia, *164*, 97-100.

Babrow, A. S. (1992). Communication and problematic integration: Understanding diverging probability and value, ambiguity, ambivalence, and impossibility. *Communication Theory, 2,* 95–130. https://doi.org/10.1111/j.1468-2885.1992.tb00031.x

Bailey, D., Wallace, M., & Mishel, M. H. (2007). Watching, waiting and uncertainty in prostate cancer. *Journal of Clinical Nursing*, *16*(4), 734-741. https://doi.org/10.1111/j.1365-2702.2005.01545.x

Bailey, J., & Nielsen, B. (1993). Uncertainty and appraisal of uncertainty in women with rheumatoid arthritis. *Orthopaedic Nursing*, *12*(2), 63-67. https://doi.org/10.1097/00006416-199303000-00011

Bento, A. I., Nguyen, T., Wing, C., Lozano-Rojas, F., Ahn, Y. Y., & Simon, K. (2020). Evidence from internet search data shows information-seeking responses to news of local COVID-19 cases. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(21), 11220–11222. https://doi.org/10.1073/pnas.2005335117

Berger, C. R., & Bradac, J. J. (1982). *Language and social knowledge: Uncertainty in interpersonal relationships*. Arnold.

Berger, C. R., & Calabrese, R. (1975). Some explorations in initial interaction and beyond: Toward a developmental theory of interpersonal communication. *Human Communication Research*, *1*(2), 99-112. https://doi.org/10.1111/j.1468-2958.1975.tb00258.x

Bokolo Anthony Jnr. (2020). Use of telemedicine and virtual care for remote treatment in response to COVID-19 pandemic. *Journal Of Medical Systems, 44*(7). https://doi.org/10.1007/s10916-020-01596-5

Bordia, P., Hunt, E., Paulsen, N., Tourish, D., & DiFonzo, N. (2004). Uncertainty during organizational change: Is it all about control?. *European Journal of Work and Organizational Psychology*, *13*(3), 345-365. https://doi.org/10.1080/13594320444000128

Bradley, G., Sparks, B., & Nesdale, D. (2001). Doctor communication style and patient outcomes: Gender and age as moderators. *Journal of Applied Social Psychology*, *31*(8), 1749-1773. https://doi.org/10.1111/j.1559-1816.2001.tb02749.x

Brashers, D. (2001). Communication and uncertainty management. *Journal of Communication*, *51*(3), 477-497. https://doi.org/10.1093/joc/51.3.477

Brashers, D., Neidig, J., Haas, S., Dobbs, L., Cardillo, L., & Russell, J. (2000). Communication in the management of uncertainty: The case of persons living with HIV or AIDS. *Communication Monographs*, *67*(1), 63-84. https://doi.org/10.1080/03637750009376495

Brashers, D., Neidig, J., Russell, J., Cardillo, L., Haas, S., Dobbs, L., Garland, G., McCartney, B., & Nemeth, S. (2003). The Medical, personal, and social causes of uncertainty in HIV illness. *Issues in Mental Health Nursing*, *24*(5), 497-522. https://doi.org/10.1080/01612840305292

Calvin, R., & Lane, P. (1999). Perioperative uncertainty and state anxiety of orthopaedic surgical patients. *Orthopaedic Nursing*, *18*(6), 61-66. https://doi.org/10.1097/00006416-199911000-00011

Carter, R., & McCarthy, M. (2006). *Cambridge grammar of English: A comprehensive guide spoken and written English grammar usage.* Cambridge University Press.

Channell, J. (1994). *Vague language*. Oxford University Press.

Cuan-Baltazar, J., Muñoz-Perez, M., Robledo-Vega, C., Pérez-Zepeda, M., & Soto-Vega, E. (2020). Misinformation of COVID-19 on the Internet: Infodemiology study. *JMIR Public Health And Surveillance*, *6*(2), e18444. https://doi.org/10.2196/18444

Cutting, J. (Eds.). (2007). V*ague language explored*. Palgrave Macmillan.

Dadds, M. R., Perrin, S., & Yule, W. (1998). Social desirability and self-reported anxiety in children: An analysis of the RCMAS lie scale. *Journal of Abnormal Child Psychology, 26*(4), 311. https://doi.org/10.1023/A:1022610702439

Deldar, K., Marouzi, P., & Assadi, R. (2011). Teleconsultation via the web: an analysis of the type of questions that Iranian patients ask. *Journal Of Telemedicine And Telecare, 17*(6), 324-327. https://doi.org/10.1258/jtt.2011.101206

Deloitte Centre for Health Solutions. (2020, September). Digital transformation: Shaping the future of European healthcare. https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/public-sector/deloitte-nl-shaping-the-future-of-european-healthcare.pdf

De Graves, S., & Aranda, S. (2008). Living with hope and fear-The uncertainty of childhood cancer after relapse. *Cancer Nursing*, *31*(4), 292-301. https://doi.org/10.1097/01.ncc.0000305745.41582.73

Dicianno, B., Parmanto, B., Fairman, A., Crytzer, T., Yu, D., Pramana, G., Coughenour, D., & Petrazzi, A. (2014). Perspectives on the evolution of mobile (mHealth) technologies and application to rehabilitation. *Physical Therapy*, *95*(3), 397-405. https://doi.org/10.2522/ptj.20130534

Ebright, P., & Lyon, B. (2002). Understanding hope and factors that enhance hope in women with breast cancer. *Oncology Nursing Forum*, *29*(3), 561-568. https://doi.org/10.1188/02.onf.561-568

Elving, W. (2005). The role of communication in organizational change. *Corporate Communications: An International Journal*, *10*(2), 129-138. https://doi.org/10.1108/13563280510596943

European Commission. (2014). European citizens' digital health literacy. https://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_404_en.pdf

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191. https://doi.org/10.3758/BF03193146

Flynn, D., Gregory, P., Makki, H., & Gabbay, M. (2009). Expectations and experiences of eHealth in primary care: A qualitative practice-based investigation. *International Journal of Medical Informatics*, *78*(9), 588-604. https://doi.org/10.1016/j.ijmedinf.2009.03.008

Folkman, S., Schaefer, C., & Lazarus, R. S. (1979). Cognitive processes as mediators of stress and coping. In V. Hamilton & D. M. Warburton (Eds.), *Human stress and cognition, An information processing approach* (pp.265-298). John Wiley and Sons.

Förster, J., Grant, H., Idson, L., & Higgins, E. (2001). Success/failure feedback, expectancies, and approach/avoidance motivation: How regulatory focus moderates classic relations. *Journal of Experimental Social Psychology*, *37*(3), 253-260. https://doi.org/10.1006/jesp.2000.1455

Garber, M., Nau, D., Erickson, S., Aikens, J., & Lawrence, J. (2004). The concordance of self-report with other measures of medication adherence: A summary of the literature. *Medical Care*, *42*(7), 649-652. https://doi.org/10.1097/01.mlr.0000129496.05898.02

Grant, H., & Higgins, E. (2003). Optimism, promotion pride, and prevention pride as predictors of quality of life. *Personality and Social Psychology Bulletin*, *29*(12), 1521-1532. https://doi.org/10.1177/0146167203256919

Greco, V., & Roger, D. (2003). Uncertainty, stress, and health. *Personality and Individual Differences*, *34*(6), 1057-1068. https://doi.org/10.1016/s0191-8869(02)00091-0

Gudykunst, W. B. (1993). Toward a theory of effective interpersonal and intergroup communication: An anxiety/uncertainty management (AUM) perspective. In R. L. Wiseman & J. Koester (Eds.), *International and intercultural communication annual, Vol. 17, 1993. Intercultural communication competence* (pp. 33-71). Sage Publications, Inc.

Hagen, K., Aas, T., Lode, K., Gjerde, J., Lien, E., Kvaløy, J., … Lind, R. (2015). Illness uncertainty in breast cancer patients: Validation of the 5-item short form of the Mishel Uncertainty in Illness Scale. *European Journal of Oncology Nursing*, *19*(2), 113-119. https://doi.org/10.1016/j.ejon.2014.10.009

Halamish, V., Liberman, N., Higgins, E., & Idson, L. (2008). Regulatory focus effects on discounting over uncertainty for losses vs. gains. *Journal of Economic Psychology*, *29*(5), 654-666. https://doi.org/10.1016/j.joep.2007.09.002

Han, P., Williams, A., Haskins, A., Gutheil, C., Lucas, F., Klein, W., & Mazor, K. (2014). Individual differences in aversion to ambiguity regarding medical tests and treatments: Association with cancer screening cognitions. *Cancer Epidemiology Biomarkers & Prevention*, *23*(12), 2916-2923. https://doi.org/10.1158/1055-9965.epi-14-0872

Hau, Y., Kim, J., Hur, J., & Chang, M. (2020). How about actively using telemedicine during the COVID-19 pandemic?. *Journal Of Medical Systems*, *44*(6). https://doi.org/10.1007/s10916-020-01580-z

Hayes, A. F. (2013). *Methodology in the social sciences. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach.* The Guilford Press.

Hazlett, A., Molden, D., & Sackett, A. (2011). Hoping for the best or preparing for the worst? Regulatory focus and preferences for optimism and pessimism in predicting personal outcomes. *Social Cognition*, *29*(1), 74-96. https://doi.org/10.1521/soco.2011.29.1.74

Hébert, J., Peterson, K., Hurley, T., Stoddard, A., Cohen, N., Field, A., & Sorensen, G. (2001). The effect of social desirability trait on self-reported dietary measures among multi-ethnic female health center employees. *Annals of Epidemiology*, *11*(6), 417-427. https://doi.org/10.1016/s1047-2797(01)00212-5

Herman, J., Stevens, M., Bird, A., Mendenhall, M., & Oddou, G. (2010). The tolerance for ambiguity scale: Towards a more refined measure for international management research. *International Journal of Intercultural Relations*, *34*(1), 58-65. https://doi.org/10.1016/j.ijintrel.2009.09.004

Higgins, E. (1998). Promotion and prevention: Regulatory focus as a motivational principle. *Advances in Experimental Social Psychology, 30*, 1–46. https://doi.org/10.1016/S0065-2601(08)60381-0

Higgins, E., Friedman, R., Harlow, R., Idson, L., Ayduk, O., & Taylor, A. (2001). Achievement orientations from subjective histories of success: Promotion pride versus prevention pride. *European Journal of Social Psychology*, *31*(1), 3-23. https://doi.org/10.1002/ejsp.27

Hillen, M., Gutheil, C., Strout, T., Smets, E., & Han, P. (2017). Tolerance of uncertainty: Conceptual analysis, integrative model, and implications for healthcare. *Social Science & Medicine, 180*, 62-75. https://doi.org/10.1016/j.socscimed.2017.03.024

Hilton, B. (1989). The relationship of uncertainty, control, commitment, and threat of recurrence to coping strategies used by women diagnosed with breast cancer. *Journal of Behavioral Medicine*, *12*(1), 39-54. https://doi.org/10.1007/bf00844748

Ioannidis, J. (2020). Coronavirus disease 2019: the harms of exaggerated information and non-evidence-based measures. *European Journal Of Clinical Investigation*, e13223. https://doi.org/10.1111/eci.13223

Jerusalem, M., Schwarzer, R. (1992). Self-efficacy as a resource factor in stress appraisal processes. In R. Schwarzer (Ed.), *Self-efficacy: Thought control of action* (pp.195-213). Taylor & Fancis.

Jung, C., & Padman, R. (2014). Virtualized healthcare delivery: Understanding users and their usage patterns of online medical consultations. *International Journal of Medical Informatics*, *83*(12), 901-914. https://doi.org/10.1016/j.ijmedinf.2014.08.004

Jung, C., & Padman, R. (2015) Disruptive digital innovation in healthcare delivery: The case for patient portals and online clinical consultations. In: R. Agarwal, W. Selen, G. Roos, & R. Green (Eds). *The Handbook of Service Innovation*. Springer

Jungmann, S., Klan, T., Kuhn, S., & Jungmann, F. (2019). Accuracy of a chatbot (Ada) in the diagnosis of mental disorders: Comparative case study with lay and expert users. *JMIR Formative Research, 3*(4), e13863. https://doi.org/10.2196/13863

Kang, Y. (2003). Testing the mediating effect of appraisal in the model of uncertainty in illness study. *Journal of Korean Academy of Nursing*, *33*(8), 1127. https://doi.org/10.4040/jkan.2003.33.8.1127

Kang, Y. (2008). Role of health locus of control between uncertainty and uncertainty appraisal among patients with atrial fibrillation. *Western Journal of Nursing Research*, *31*(2), 187-200. https://doi.org/10.1177/0193945908326063

Karademas, E., Tsalikou, C., & Tallarou, M. (2011). The impact of emotion regulation and illness-focused coping strategies on the relation of illness-related negative emotions to subjective health. *Journal of Health Psychology*, *16*(3), 510-519. https://doi.org/10.1177/1359105310392093

Kazer, M., Bailey Jr, D., Chipman, J., Psutka, S., Hardy, J., & Hembroff, L., Regan, M., Dunn, R., Crociani, C., & Sandra, M. G. (2012). Uncertainty and perception of danger among patients undergoing treatment for prostate cancer. *BJU International*, *111*, E84-E91. https://doi.org/10.1111/j.1464-410x.2012.11439.x

Kennedy, P., Evans, M., & Sandhu, N. (2008). Psychological adjustment to spinal cord injury: The contribution of coping, hope and cognitive appraisals. *Psychology, Health & Medicine*, *14*(1), 17-33. https://doi.org/10.1080/13548500802001801

Klesges, L., Baranowski, T., Beech, B., Cullen, K., Murray, D., Rochon, J., & Pratt, C. (2004). Social desirability bias in self-reported dietary, physical activity and weight concerns measures in 8- to 10-year-old African-American girls: results from the Girls health Enrichment Multisite Studies (GEMS). *Preventive Medicine*, *38*, 78-87. https://doi.org/10.1016/j.ypmed.2003.07.003

Klinar, I., Balažin, A., Baršić, B., & Tiljak, H. (2011). Identification of general characteristics, motivation, and satisfaction of internet-based medical consultation service users in Croatia. *Croatian Medical Journal*, *52*(4), 557-565. https://doi.org/10.3325/cmj.2011.52.557

Knobloch, L., & Carpenter-Theune, K. (2004). Topic avoidance in developing romantic relationships: Associations with intimacy and relational uncertainty. *Communication Research*, *31*(2), 173-205. https://doi.org/10.1177/0093650203261516

Kramer, M. W. (1999). Motivation to reduce uncertainty: A reconceptualization of uncertainty reduction theory. *Management Communication Quarterly, 13,* 305–316. https://doi.org/10.1177/0893318999132007

Kummervold, P., Chronaki, C., Lausen, B., Prokosch, H., Rasmussen, J., Santana, S., Staniszewski, A., & Wangberg, S.C. (2008). eHealth trends in Europe 2005-2007: A population-based survey. *Journal of Medical Internet Research*, *10*(4), e42. https://doi.org/10.2196/jmir.1023

Labiris, G., Coertzen, I., Katsikas, A., Karydis, A., & Petounis, A. (2002). An eight-year study of Internet-based remote medical counselling. *Journal Of Telemedicine And Telecare, 8*(4), 222-225. https://doi.org/10.1258/135763302320272194

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer Publishing.

Lemaire, G. (2004). More than just menstrual cramps: Symptoms and uncertainty among women with endometriosis. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, *33*(1), 71-79. https://doi.org/10.1177/0884217503261085

Lemaire, G., & Lenz, E. (1995). Perceived uncertainty about menopause in women attending an educational program. *International Journal of Nursing Studies*, *32*(1), 39-48. https://doi.org/10.1016/0020-7489(94)00028-i

Liao, M., Chen, M., Chen, S., & Chen, P. (2008). Uncertainty and anxiety during the diagnostic period for women with suspected breast cancer. *Cancer Nursing*, *31*(4), 274-283. https://doi.org/10.1097/01.ncc.0000305744.64452.fe

Lin, C., Wittevrongel, L., Moore, L., Beaty, B., & Ross, S. (2005). An Internet-based patient-provider communication system: Randomized controlled trial. *Journal of Medical Internet Research*, *7*(4), e47. https://doi.org/10.2196/jmir.7.4.e47

Linedale, E., Chur-Hansen, A., Mikocka-Walus, A., Gibson, P., & Andrews, J. (2016). Uncertain diagnostic language affects further studies, endoscopies, and repeat consultations for patients with functional gastrointestinal disorders. *Clinical Gastroenterology and Hepatology*, *14*(12), 1735-1741.e1. https://doi.org/10.1016/j.cgh.2016.06.030

Lobchuk, M., & Vorauer, J. (2003). Family caregiver perspective-taking and accuracy in estimating cancer patient symptom experiences. *Social Science & Medicine*, *57*(12), 2379-2384. https://doi.org/10.1016/s0277-9536(03)00132-1

Lu, H., Shaw, B., & Gustafson, D. (2011). Online health consultation: Examining uses of an interactive cancer communication tool by low-income women with breast cancer. *International Journal of Medical Informatics*, *80*(7), 518-528. https://doi.org/10.1016/j.ijmedinf.2011.03.011

Lucas, B., Elliot, B., & Landman, T. (2020). *Online information search during COVID-19*. http://arxiv.org/abs/2004.07183

McCormick, K., Naimark, B., & Tate, R. (2006). Uncertainty, symptom distress, anxiety, and functional status in patients awaiting coronary artery bypass surgery. *Heart & Lung*, *35*(1), 34-45. https://doi.org/10.1016/j.hrtlng.2005.08.002

Meyer, A., Giardina, T., Spitzmueller, C., Shahid, U., Scott, T., & Singh, H. (2020). Patient perspectives on the usefulness of an artificial intelligence–assisted symptom checker: Cross-Sectional survey study. *Journal of Medical Internet Research, 22*(1), e14679.

Middleton, A., LaVoie, N., & Brown, L. (2012). Sources of uncertainty in type 2 diabetes: Explication and implications for health communication theory and clinical practice. *Health Communication*, *27*(6), 591-601. https://doi.org/10.1080/10410236.2011.618435

Milcent, C. (2018). *Healthcare reform in China: From violence to digital healthcare.* Springer.

Minnis, A., & Padian, N. (2001). Reliability of adolescents' self-reported sexual behavior: A comparison of two diary methodologies. *Journal of Adolescent Health*, *28*(5), 394-403. https://doi.org/10.1016/s1054-139x(00)00218-4

Mishel, M. H. (1984). Perceived uncertainty and stress in illness. *Research in Nursing and Health, 7*, 163-171

Mishel, M. H. (1988). Uncertainty in illness. *Image: The Journal of Nursing Scholarship, 20*(4), 225-232. https://doi.org/10.1111/j.1547-5069.1988.tb00082.x

Mishel, M. H. (1990). Reconceptualization of the uncertainty in illness theory. *Image: Journal of Nursing Scholarship*, *22*, 256-262.

Mishel, M.H., & Sorenson, D. (1991). Uncertainty in gynecological cancer: a test of the mediating functions of mastery and coping. *Nursing Research*, *40*(3), 167-171. https://doi.org/10.1097/00006199-199105000-00010

Molden, D., & Higgins, E. (2004). Categorization under uncertainty: Resolving vagueness and ambiguity with eager versus vigilant strategies. *Social Cognition*, *22*(2), 248-277. https://doi.org/10.1521/soco.22.2.248.35461

Nijland, N., van Gemert-Pijnen, J., Boer, H., Steehouder, M., & Seydel, E. (2009). Increasing the use of e-consultation in primary care: Results of an online survey among non-users of e-consultation. *International Journal of Medical Informatics*, *78*(10), 688-703. https://doi.org/10.1016/j.ijmedinf.2009.06.002

Norman, C., & Skinner, H. (2006). eHealth literacy: Essential skills for consumer health in a networked world. *Journal Of Medical Internet Research, 8*(2), e9.

Oh, K. J., Lee, D., Ko, B., & Choi, H. J. (2017). A chatbot for psychiatric counseling in mental healthcare service based on emotional dialogue analysis and sentence generation. *Proceedings - 18th IEEE International Conference on Mobile Data Management, MDM 2017*, 371–376. https://doi.org/10.1109/MDM.2017.64

Peacock, E. J., & Wong, P. T. (1990). The stress appraisal measure (SAM): a multidimensional approach to cognitive appraisal. *Stress Medicine, 6*, 227-236.

Pennington, G., & Roese, N. (2003). Regulatory focus and temporal distance. *Journal of Experimental Social Psychology*, *39*(6), 563-576. https://doi.org/10.1016/s0022-1031(03)00058-1

Perski, O., Crane, D., Beard, E., & Brown, J. (2019). Does the addition of a supportive chatbot promote user engagement with a smoking cessation app? An experimental study. *Digital Health, 5*, 1-13.

Rains, S., & Tukachinsky, R. (2014). An examination of the relationships among uncertainty, appraisal, and information-seeking behavior proposed in uncertainty management theory. *Health Communication*, *30*(4), 339-349. https://doi.org/10.1080/10410236.2013.858285

Research2Guidance. (2017). mHealth app economics 2017 - Current status and future trends in mobile health. https://research2guidance.com/product/mhealth-economics-2017-current-status-and-future-trends-in-mobile-health/

Reynolds, R. (2018). *Uncertainty in illness and health literacy in pancreatic cancer patients (Doctoral dissertation)*. https://digitalcommons.library.tmc.edu/uthson_etd/29/

Rhodes, R., & de Bruijn, G. (2013). How big is the physical activity intention-behaviour gap? A meta-analysis using the action control framework. *British Journal of Health Psychology*, *18*(2), 296-309. https://doi.org/10.1111/bjhp.12032

Roseman, I. J. (2001). A model of appraisal in emotional system: Integrating theory, research and applications. In K. R. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research*. Oxford University Press.

Rowland-Morin, P., & Carroll, J. (1990). Verbal communication skills and patient satisfaction: A study of doctor-patient interviews. *Evaluation & The Health Professions*, *13*(2), 168-185. https://doi.org/10.1177/016327879001300202

Schoenberg, N., & Drew, E. (2002). Articulating silences: Experiential and biomedical constructions of hypertension symptomatology. *Medical Anthropology Quarterly*, *16*(4), 458-475. https://doi.org/10.1525/maq.2002.16.4.458

Sheer, V., & Cline, R. (1995). Testing a model of perceived information adequacy and uncertainty reduction in physician-patient interactions. *Journal of Applied Communication Research*, *23*(1), 44-59. https://doi.org/10.1080/00909889509365413

Shen, B., Myers, H., & McCreary, C. (2006). Psychosocial predictors of cardiac rehabilitation quality-of-life outcomes. *Journal of Psychosomatic Research*, *60*(1), 3-11. https://doi.org/10.1016/j.jpsychores.2005.06.069

Stephan, W., Stephan, C., & Gudykunst, W. (1999). Anxiety in intergroup relations: a comparison of anxiety/uncertainty management theory and integrated threat theory. *International Journal of Intercultural Relations*, *23*(4), 613-628. https://doi.org/10.1016/s0147-1767(99)00012-7

Strout, T., Hillen, M., Gutheil, C., Anderson, E., Hutchinson, R., Ward, H., Kay, H., Mill, G., & Han, P. (2018). Tolerance of uncertainty: A systematic review of health and healthcare-related outcomes. *Patient Education and Counseling*, *101*(9), 1518-1537. https://doi.org/10.1016/j.pec.2018.03.030

Swindells, S., Mohr, J., Justis, J., Berman, S., Squier, C., Wagener, M., & Singh, N. (1999). Quality of life in patients with human immunodeficiency virus infection: impact of social support, coping style and hopelessness. *International Journal of STD and AIDS*, *10*(6), 383-391. https://doi.org/10.1258/0956462991914302

Trappes-Lomax, H. (2007). Vague language as a means of self-protective avoidance: Tension management in conference talks. In J. Cutting (Ed.), *Vague Language Explored.* Palgrave Macmillan.

Tseng, M., & Zhang, G. (2018). Pragmeme, adaptability, and elasticity in online medical consultations. *Journal of Pragmatics*, *137*, 40-56. https://doi.org/10.1016/j.pragma.2018.09.004

Umefjord, G., Petersson, G., & Hamberg, K. (2003). Reasons for consulting a doctor on the Internet: Web survey of users of an Ask the Doctor service. *Journal Of Medical Internet Research, 5*(4), e26. https://doi.org/10.2196/jmir.5.4.e26

Varttala, T. (1999). Remarks on the communicative functions of hedging in popular scientific and specialist research articles on medicine. *English for Specific Purposes*, *18*(2), 177-200. https://doi.org/10.1016/s0889-4906(98)00007-6

Whitten, P., Buis, L., & Love, B. (2007). Physician-patient e-visit programs. *Disease Management & Health Outcomes*, *15*(4), 207-214. https://doi.org/10.2165/00115677-200715040-00002

Wineman, M., Schwetz, K., Zeller, R., & Cyphert, J. (2003). Longitudinal analysis of illness uncertainty, coping, hopefulness, and mood during participation in a clinical drug trial. *Journal of Neuroscience Nursing*, *35*(2), 100-106. https://doi.org/10.1097/01376517-200304000-00006

Wonghongkul, T., Dechaprom, N., Phumivichuvate, L., & Losawatkul, S. (2006). Uncertainty appraisal coping and quality of life in breast cancer survivors. *Cancer Nursing*, *29*(3), 250-257. https://doi.org/10.1097/00002820-200605000-00014

Wonghongkul, T., Moore, S., Musil, C., Schneider, S., & Deimling, G. (2000). The influence of uncertainty in illness, stress appraisal, and hope on coping in survivors of breast cancer. *Cancer Nursing*, *23*(6), 422-429. https://doi.org/10.1097/00002820-200012000-00004

Ybarra, M., & Suman, M. (2006). Help seeking behavior and the Internet: A national survey. *International Journal of Medical Informatics*, *75*(1), 29-41. https://doi.org/10.1016/j.ijmedinf.2005.07.029

Yi, S., & Baumgartner, H. (2009). Regulatory focus and message framing: A test of three accounts. *Motivation and Emotion*, *33*(4), 435-443. https://doi.org/10.1007/s11031-009-9148-y

Zacher, H., & de Lange, A. (2011). Relations between chronic regulatory focus and future time perspective: Results of a cross-lagged structural equation model. *Personality and Individual Differences*, *50*(8), 1255-1260. https://doi.org/10.1016/j.paid.2011.02.020

Zapf, B., Carpenter, R., & Snyder, G. (1981). Ulcerating tumor of tonsil and neck, mass as Occurrence of acute myelocytic leukemia. *Otolaryngology–Head and Neck Surgery*, *89*(4), 560-563. https://doi.org/10.1177/019459988108900410

Zhang, Y. (2017). Uncertainty in illness: Theory review, application, and extension. *Oncology Nursing Forum, 44*(6), 645-649. https://doi.org/10.1188/17.onf.645-649

Zhu, W., & Li, J. (2013). A pragmatic study on the functions of vague language in commercial advertising. *English Language Teaching, 6*(6), 103-112. https://doi.org/10.5539/elt.v6n6p103

Author Contributions

Conceptualization (main idea, theory): Linwei He & Eline Smit
Funding acquisition: Not applicable
Project administration: Linwei He & Eline Smit
Methodology (design, operationalization): Linwei He & Eline Smit
Data collection: Linwei He
Data analysis: Linwei He
Writing – original draft: Linwei He
Writing – review & editing: Eline Smit

Author Biographies

Linwei He is a PhD candidate in the Department of Communication and Cognition at Tilburg University. Her research focuses on health communication and emerging technologies such as chatbots. At the core of her research interest is the question of how to engage users with technologies that promote healthy behaviors such as smoking cessation.

Eline Smit, PhD is an Assistant Professor in the Department of Communication Science at the University of Amsterdam. Her research focusses on innovative digital health communication strategies, with a special focus on computer-tailoring and the exploration of novel computer-tailoring strategies, such as mode and message frame tailoring. Dr. Smit has an extensive track record of peer-reviewed articles and has successfully obtained multiple grants for research projects in the digital health communication field.