The effects of lexical and discourse-based hedging in news stories of cancer screening and treatment on cancer-related behavioral beliefs and trust towards cancer scientists

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Abstract

Hedging, a way to convey scientific uncertainty, could manifest in two different ways: lexical hedging (expression of uncertainty through linguistic elements such as "might," "may," and "likely") and discourse-based hedging (expression of uncertainty through disclosing experimental weaknesses, lack of generalizability of study results, and so forth). Previous studies in cancer communication documented some positive effects of hedging on variables pertaining to cancer prevention and control, but they focused on discourse-based hedging. To assess and compare the effects of the two different types of hedging on people's cancer-related behavioral beliefs and trust towards cancer scientists, an online survey experiment was conducted. No significant effects of hedging on beliefs or trust were found. The associations among variables of interests, including behavioral beliefs, trust, attitude, and behavioral intention, were examined, and the potential moderating role of research literacy was explored. Implications of the study's results are discussed.

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Introduction

In 2020, it is expected that more than 1.8 million people will be diagnosed with cancer in the US, and 606,520 Americans will die of cancer in the same year, meaning that there will be 1660 deaths because of cancer per day (American Cancer Society, 2020). Cancer clinical trials are considered pivotal in developing cutting-edge treatments from research labs to cancer clinics to combat the disease (American Cancer Society, 2020). Therefore, a huge number of clinical trials sponsored by different entities are going on in the US. For example, currently there are around 800 NCI-supported clinical trials for breast cancer available to breast cancer patients across the whole country (National Cancer Institute, 2020). Cancer screening, which is an important component of early cancer detection, is also important to combat cancer (National Cancer Institute, 2018). For instance, the American Cancer Society (2021) recommends that those aged 45 and up should receive regular screening for colorectal cancer.

Despite the institutional efforts of implementing cancer clinical trials and promoting cancer screening services, for most people, the decision whether to get enrolled in clinical trials or to receive cancer screening procedures is, in the end, an individual one. And such a decision normally begins with getting exposed to relevant information. News media tend to be one of the most dominant channels to disseminate such information. For example, Niederdeppe et al. (2007) reported that around 81% of the participants in his study sought or scanned cancer-related information from news media like newspapers or magazines, which echoed Kelly et al (2010).'s finding that news media was the dominant source that people resorted to for cancer-related

information. More importantly, the lay public's understanding and perceptions towards medical science such as cancer clinical trials is, to some extent, influenced by mainstream news media (Kotwani, 2007).

Despite the importance of news media in disseminating cancer information and shaping the public's opinions, news media's coverage of cancer-related topics is not flawless. Many scholars criticized that news coverage of cancer research including clinical trials are rarely hedged—according to The Dictionary by Merriam-Webster (n.d.), hedge means "to evade the risk of commitment especially by leaving open a way of retreat". Hence, many news reporters have not always been successful in communicating the degree of uncertainty in cancer research clearly to the public. (Brody, 1999; Russell, 1999). Such a phenomenon can also be seen in news stories covering broader topics such as medical research. For example, a content analysis conducted by Dumas-Mallet, Smith, Boraud, Gonon (2018) revealed that only 21% of the news stories regarding biomedical research stressed that the results of the research had to be confirmed by replication. In terms of health-related guidelines, Sumner et al. (2016) found only 14% of news stories regarding health recommendations include caveats or limitations.

Does hedging actually matter, and how does hedging manifest in news stories or other content? First, there exists some empirical evidence suggesting that including limitations in news stories about cancer research could favorably influence variables related to cancer control and prevention, including trust towards medical professionals and the credibility of reporters (Jensen, 2008; Jensen et al., 2011). Second, hedging could

manifest in two different ways: lexical hedging (expression of uncertainty through linguistic elements such as “might,” “may,” “possibly,” and “likely”) and discourse-based hedging (expression of uncertainty through disclosing experimental weaknesses, limitations of theoretical frameworks, and so forth). However, previous research, especially in the context of cancer communication, has mainly focused on the effects of discourse-based hedging. Hence, the primary purpose of this study is to understand and compare effects of the two different types of hedging in news stories related to cancer clinical trials and cancer screening on the public’s cancer-related behavioral beliefs and trust towards cancer scientists. Also, because these two cognitive responses could influence attitudes and behavioral intentions among the public, exploring these potential downstream impacts is a secondary purpose of this study.

Cancer clinical trials may sound irrelevant when it comes to the general population. However, it is estimated that the lifetime risk of developing invasive cancer in the US is nearly 41% for men and 38% for women (American Cancer Society, 2020). This means that cancer is not a rare disease anymore for the public. For the success of clinical trials, participation rate matters. Specifically, a clinical trial with a higher rate of enrollment could deliver treatment advances at a relatively quick rate, which will be ultimately beneficial to the general population (Unger, Cook, Tai, & Bleyer, 2014).

As for cancer screening, it is naturally more relevant to the general population, since early detection of cancer could lead to better treatment results such as increased survival rate. For example, in 2015, the mortality rates of cancer were 26% lower compared to those in 1990, and such a downward trend should be, at least partially,

attributed to cancer screening and early detection (Byers, Wender, Jemal, Baskies, Ward, & Brawley, 2016). Treating early-stage cancer is also more affordable. Kakushadze, Raghubanshi, & Yu (2017) estimated that in the US, the national annual treatment cost-savings, due to early cancer detection, could be more than 10 billion dollars. In a nutshell, high levels of participation in cancer screening services among the general population is a necessity to achieve desired public health results (Duffy, Myles, Maroni, & Mohammad, 2017).

To understand and compare effects of the two different types of hedging in news stories related to cancer clinical trials and cancer screening, I conducted an online survey experiment administered through CloundResearch, Participants were recruited through MTurk. I chose MTurk instead of a participant pool on campus because of the access to a more diverse and heterogeneous population. In the following sections, I reviewed relevant literature and discussed theoretical framework for this study. Then I addressed the research design, stimuli development and modification, experimental procedure, measurement of variables of interest, analytical procedure, results, discussion, and conclusion, both for the pilot study and the main study.

Theoretically speaking, this study will contribute to our understanding of hedging in cancer communication in the following ways. First, I investigate whether both discourse-based and lexical hedging could lead to more positive cognitive outcomes including behavioral beliefs and trust, compared to the control condition (no hedging). Second, I test whether such effects of hedging are consistent across two different and important cancer topics, cancer clinical trials and colonoscopy. Doing so will increase the

generalizability of study findings and enable stronger theoretical claims. Third, I explore the possible downstream impacts of the two cognitive responses, behavioral beliefs and trust, on the public's attitudes and behavioral intentions towards cancer clinical trials and cancer screening, which might provide a foundation for a more rigorous future analysis (i.e., path analysis).

Practically speaking, this study could serve as a guidance to reporters who cover science and health stories. Specifically, communicators and public health professionals will get a better sense of whether they should convey scientific uncertainty to the public (i.e., use hedging language or not), and, if so, how they should convey such uncertainty (i.e., via lexical hedging or discourse-based hedging strategies). By implementing such strategies, communicators and public health professionals could desirably influence the general public's ultimate behaviors towards clinical trials and cancer screening procedures.

Literature Review

Hedging and Uncertainty

Hedging is a strategy used by writers including reporters in order to signal tentativeness or caution when delivering information (Crismore & Kopple, 1988). Hyland (1996) argued that hedging is important for scientific writing because through hedged language, writers could clearly express caution towards their propositions and express their anticipation of possible objections to their statements. Therefore, hedged language is frequently used in journal articles.

Hedging can be expressed in different ways. A content analysis conducted by Hyland (1996) revealed that there are mainly two ways to express hedging, lexical hedges and strategic hedges or discourse-based hedges. Lexical hedges express uncertainty through linguistic elements including modal verbs (might, could, perhaps) and epistemic adjectives (possible, likely), while strategic hedges express tentativeness through disclosing experimental weakness, limitation of the theoretical framework, and so forth (Hyland, 1996). The ways in which hedging can be expressed influenced, at least in part, how I manipulated the stimuli materials in this study, which will be addressed in a more detailed way in the following section.

The relationship between hedging and uncertainty is a blurry or subtle one. To clarify the relationship between the two concepts, we should first understand in a general way what uncertainty is. Walker et al. (2003) defined uncertainty as being "any deviation from the unachievable ideal of completely deterministic knowledge of the relevant system" (p. 5). Portrayals of uncertainty in the context of science may add shades of

ambiguity to the findings, results, hypotheses, and interpretation of stated claims (Gustafson & Rice, 2020). Conceptual clarity of uncertainty also necessitates further distinction of different types of uncertainty. Gustafson & Rice (2020) pointed out that there are mainly four types of uncertainty: deficient uncertainty, technical uncertainty, consensus uncertainty, and scientific uncertainty. The four types of uncertainty, respectively, focus on a gap in current knowledge; a range or probability of a scientific claim; disagreement among multiple parties towards any particular theories, findings or statements; and the inherent tentativeness of current scientific knowledge (Gustafson & Rice, 2020).

Based on the conceptualization of hedging and uncertainty, it is clear that caveats or hedging could be a useful tool to communicate uncertainty in many contexts. Conversely, argued by Stocking (1999), when covering science, reporters could make science sound more certain by removing limitations and caveats, emphasizing the results instead of the research process, and other tactics. This echoes the argument made by Ratcliff, Jensen, Christy, Crossley, & Krakow (2020) that uncertainty in health-related news stories could be expressed through the inclusion of hedging language. However, the existence of four different types of uncertainty means that hedging is not the only tool used by writers to express uncertainty. Based on the conceptualization above, lexical hedging tends to communicate technical uncertainty, since both care about probability, while discourse-based hedging tends to capture deficient uncertainty, since both emphasize the current knowledge gap. As for consensus uncertainty, it is mainly expressed through the presence of conflicting information. Such corresponding

relationships will also help us to better understand the effects of lexical and discourse-based hedging.

Conceptualizing the Effects of Hedging on Primary Outcomes: Cancer-Related Behavioral Beliefs and Trust

Comparing effects of two types of hedging: evidence from multiple fields

The effects of lexical hedging on people's cognitions and perceptions have been studied by scholars from multiple disciplines not related to cancer communication, and somewhat conflicting results were documented. For example, Blankenship & Holtgraves (2005), two social psychologists focusing on the relationship between language and social psychology such as the effects of persuasive messages on attitude change, found that a message advocating comprehensive exams in school with lexical hedges generated negative perceptions towards the message's soundness and reasoning, as well as towards the message source's trustworthiness and expertise. Such negative effects tended to be even more profound among those more motivated to process the message (Blankenship & Holtgraves, 2005). Also in social psychology, Durik, Britt, Reynolds, & Storey (2008) found that in a communication calling for comprehensive exams in a university, colloquial lexical hedges (kind of, sort of) led to negative evaluation of the arguments, while professional lexical hedges (probably, possibly) did not. Therefore, research conducted by social psychologists in the context of education suggested that the effects of

lexical hedging could be influenced by many factors such as the specific type of lexical hedging and participants' motivation to process the message.

In the field of English and Linguistics, Crismore and Vande Kopple (1997) reported a significant and positive relationship between increased lexical hedging and perceived believability of the author among high school students. However, a further investigation conducted by educational psychologists revealed that the type of lexical hedging also matters. When being exposed to messages containing attribution shields (information on who said what, such as "at least to my knowledge"), participants decided to evaluate the arguments more positively, while plausibility shields (probably, possibly) had no effects on message evaluation (Thiebach, Mayweg-Paus, Jucks, 2015).

Such conflicting and complex effects of lexical hedging warrants a theoretical understanding of how lexical hedging works. As mentioned above, the effects of lexical hedging may depend on which subtype of lexical hedges is being investigated (Thiebach, Mayweg-Paus, Juck, 2015; Durik, Britt, Reynolds, & Storey ,2008). Apart from the specific types of hedging, scholars have tried to understand the mechanism from the perspective of message relevance to individuals. Durik, Britt, Reynolds & Storey (2008) argued that participants seeing the topic of the message as more relevant to them tended to be more motivated and more able to process the message deeply, which, in turn, increased the chances of documenting effects of lexical hedges. However, if the participants had few experiences dealing with lexical hedges, the effects of lexical hedges may be absent (Thiebach, Mayweg-Paus, Jucks, 2015). These both echoed the explanation of Blankenship & Holtgraves (2005) that hedges seemed to operate through

the central route, which, as indicated in the Elaboration Likelihood Model, means that the participants tend to devote much cognitive and mental energy to process information, particularly arguments, and come up with their own thoughts that are resistant to counterarguing (Petty & Cacioppo, 1986).

Compared to lexical hedging, the effects of discourse-based hedging have been addressed in the specific context of cancer communication, and the documented results seem to be relatively consistent. For example, after being exposed to news stories with discourse-based hedging, participants reported less fatalism towards cancer, were more resistant to nutrition backlash, and expressed more trust in medical professionals (Jensen et al., 2011). An association was also found between hedging attributed to the primary scientist responsible for the research and increased trustworthiness towards scientists and reporters (Jensen, 2008). It is worth noting that these positive effects were recorded among college students, which might be too homogeneous and thus constrained in generalizability to the broader general population. In contrast, another study conducted by Jensen, Pokharel, Scherr, King, Brown, & Jones (2011) documented somewhat more diverse effects of discourse-based hedging on a rather heterogeneous adult population. Specifically, the disclosure condition (news story containing limitations, attributed to the scientists involved in the study) resulted in less prevention-focused fatalism towards cancer and less nutrition backlash compared to the dueling condition (news story containing limitations, attributed to scientists unaffiliated with the study) (Jensen, Pokharel, Scherr, King, Brown, & Jones, 2011). However, in spite of the diversity of the effects of discoursed-based hedging in a rather heterogeneous adult population, it is fair to say that discourse-based hedging generally produces consistently positive effects,

because compared to the disclosure condition, the dueling condition, in which an unaffiliated researcher talks about limitations in the news story, is somewhat conflict-driven. In other words, people may view it as conflicting information, which normally produces unfavorable outcomes (Nagler, 2014). Therefore, it is still safe to say that discourse-based hedging generally generates positive cognitive responses.

Given the intertwined relationship between hedging and uncertainty, it is also necessary to review and compare the effects of lexical and discourse-based hedging from the perspective of the uncertainty that they try to capture. As argued earlier, lexical hedging mainly reflects technical uncertainty. The effects of technical uncertainty on cognitions, such as risk perceptions, and trust in the context of public science communication were either positive or null (Gustafson & Rice, 2020). For discourse-based hedging, it mainly captures deficient uncertainty. The effects of deficient uncertainty, as pointed out by Gustafson & Rice (2020), were pretty much mixed, including positive, negative, and null effects. Note that such diverse effects of discourse-based hedging were documented in a broad context of public science communication, while in the context of cancer communication, the effects of discourse-based hedging tended to be generally positive (Jensen, 2008; Jensen et al., 2011; Jensen, Pokharel, Scherr, King, Brown, & Jones, 2011).

Considering my primary interests in the effects of hedging on behavioral beliefs and trust (the two primary outcomes in this study), I will, in the following two sections, discuss conceptualizations of these cognitive responses and the expected effects of hedging on them.

The effects of hedging in cancer-related news stories on cancer-related behavioral beliefs

The first primary outcome to be examined in this study is behavioral beliefs towards participating in a cancer clinical trial after a cancer diagnosis and receiving colonoscopy when it is recommended. According to the reasoned action approach (Fishbein & Ajzen, 2010), behavioral beliefs refer to a subjective assessment of the likelihood that carrying out a certain behavior will result in certain favorable and unfavorable consequences (Yzer, 2012).

Could behavioral beliefs related to cancer arise from exposure to hedging in news coverage about cancer? Since there are two types of hedging, we must consider the effects of them separately. For discourse-based hedging, in the context of cancer communication, positive effects on beliefs directly related to cancer have been found, as reviewed earlier. For instance, Jensen et al. (2011) reported that discourse-based hedging in news stories led to two cancer-related beliefs including less fatalism towards cancer and more resistance to nutrition backlash. For lexical hedging, to our knowledge there has been no study investigating its effects in the context of cancer communication. But research from the broader field of public science communication suggests that its effects on cognitive outcomes are either positive (Crismore and Vande Kopple, 1997) or null (Thiebach, Mayweg-Paus, Jucks, 2015), suggesting no clear direction for the influence of lexical hedging compared to that of discourse-based hedging.

The effects of hedging in cancer-related news stories on trust

From classical times to the present, the investigation of persuasive effectiveness and social influence has included the image of the message source among message receivers (McCroskey & Teven, 1999), and such an image was named by Aristotle as the source's ethos (Cooper, 1932), or source's credibility (Hovland, Janis, & Kelly, 1953). Aristotle argued that ethos was composed of three elements: intelligence, goodwill, and character (McCroskey & Teven, 1999). Similarly, Hovland, Janis, & Kelly (1953) envisioned source credibility as consisting of three aspects: expertness, intentional towards the receiver, and trustworthiness.

Another concept that is similar to the source's credibility is trust—another primary outcome to be examined in this study. The interweaving between the concepts of credibility and trust makes it tricky to distinguish between the two concepts. Some researchers argued that the two concepts should not be treated as the same. For instance, Tseng and Fogg (1999) indicated that credibility can be viewed as synonymous with "believability," while trust can be interpreted as "dependability,"

However, the conceptualization of trust by other researchers suggests that both concepts of trust and source credibility might capture some similar elements. For example, as pointed out by Levi (1998), trust in institutions can only happen when agents or people behind the institution are perceived to be "competent and credible, and likely to act in the interests of those being asked to trust institutions"(p. 3). The three aspects proposed by Levi (1998) are very similar to those elements of ethos (McCroskey & Teven, 1999) or source credibility (Hovland, Janis, Kelly, 1953), with competence

corresponding to expertness or intelligence, credibility corresponding to trustworthiness or character, and the likelihood to act in the interests of trustors corresponding to goodwill or intention towards message receivers. In essence, the degree of trust somebody is willing to put into the message source is similar to the concept of source's credibility or ethos (Giffin, 1967). Hence, the current research will use trust and source credibility interchangeably.

Note that when it comes to empirical studies, the element of goodwill of the concept of trust or source credibility has been ignored by researchers in many fields including cancer communication (Jensen, 2008). This was justified by a factor analysis conducted by McCroskey & Young years ago (1981), which revealed that the three theoretical dimensions of trust, namely competence, character, and intention (or goodwill), collapsed to two, namely competence and character, when it came to empirically based perceptions, since a perception of the source's goodwill might be subsumed under the other factors. However, further and more recent research by McCroskey & Teven (1999) suggested that this shift might be a product of misanalysis and/or misinterpretation of data. Specifically, after analyzing 390 participants' responses to questionnaires about one of ten communication sources, including political figures, public figures, and interpersonal contacts, it was clear that goodwill, once discarded, should be treated as one of the three dimensions forming the concept of trust or source credibility (McCroskey & Teven, 1999). Although Jensen (2008) conceptualized credibility as a two-dimension concept (competence and trustworthiness) in his research examining the effects of hedging in cancer communication, he acknowledged that treating credibility as a three-aspect concept might offer a more nuanced measure.

Hence, in this study, the concept of trust or credibility will be conceptualized and operationalized as a three-dimension concept, which is consistent with the theoretical tradition of Aristotle. However, unlike Jensen's study (2008), this study will not examine trust towards medical professionals such as physicians due to the content of our stimuli materials, in which medical research studying the effectiveness and uncertainty of cancer clinical trials and colonoscopy will be addressed. Such topics are more related to cancer researchers or scientists rather than practicing physicians. Hence, I will focus on trust towards cancer scientists rather than physicians.

Similar to behavioral beliefs, in the context of cancer communication, the effects of discourse-based hedging on trust were relatively consistent compared to the effects of lexical hedging. For example, exposure to discourse-based hedging in cancer news stories generally resulted in increased trustworthiness towards medical professionals (Jensen et al., 2011) and towards scientists and reporters (Jensen, 2008). In contrast, the effects of lexical hedging on trust were found to be negative (Blankenship & Holtgraves, 2005), positive (Crismore and Vande Kopple; 1997), and even absent (Thiebach, Mayweg-Paus, Jucks, 2015)—although again none of these lexical hedging studies were conducted in the cancer communication context.

Hence, the generally positive effects of discourse-based hedging and mixed effects of lexical hedging on several cognitive outcomes including behavioral beliefs and trust indicate that there is no clear direction when comparing 1) the effects of lexical hedging and no-hedging (control condition), and 2) the effects of lexical hedging and discourse-based hedging on the primary outcomes in this study (behavioral beliefs and

trust). Conversely, a clear direction may emerge when studying the differences of the effects of discourse-based hedging and no-hedging on such variables. To this end, we propose the following research questions and hypotheses:

H1: Compared to the no hedging condition, discourse-based hedging in news stories will produce more positive behavioral beliefs towards participating in cancer clinical trials and receiving cancer screening services (H1a), and higher levels of trust towards cancer scientists (H1b).

RQ1: Compared to the no-hedging condition, will lexical hedging in news stories produce more positive behavioral beliefs towards participating in cancer clinical trials and receiving cancer screening services (RQ1a), and higher levels of trust towards cancer scientists (RQ1b)?

RQ2: Compared to the lexical hedging condition, will discourse-based hedging in news stories produce more positive behavioral beliefs towards participating in cancer clinical trials and receiving cancer screening services (RQ2a), and higher levels of trust towards cancer scientists (RQ2b)?

Conceptualizing the Potential Influence of the Primary Cognitive Responses on Secondary Attitudinal and Behavioral Intentional Responses

From behavioral beliefs and trust to attitude

When it comes to the conceptualization of attitude, different scholars have defined attitudes from different perspectives, but they are not without commonality. Specifically, Gawronski (2007), after examining the definitions of the concept by many different

scholars, argued that the most essential element of attitude as a concept is evaluation. For example, Eagly and Chaiken (1993) viewed attitude as a psychological tendency or inclination that people would hold or achieve after evaluating or assessing a particular entity. In other words, attitude could be a kind of sentiment, such as some degree of approval or disapproval, favor or disfavor, or others (Eagly & Chaiken, 1993). The entity, which is the target of attitude, could be abstract or concrete, as argued by Albarracin, Sunderrajan, Lohmann, Chan and Jiang (2018). The entity could be a person, a product, a news story, a policy, the government, a behavior, and so forth (Albarracin, Sunderrajan, Lohmann, Chan, & Jiang, 2018).

Moreover, according to Fishbein & Ajzen (2010), attitude is composed of two aspects: instrumental and experiential aspects. Instrumental attitude emphasizes cognitions and beliefs regarding whether performing a certain behavior will result in benefits or harms or will be wise or foolish, while experiential attitude refers to people's emotional and affective responses to the idea of performing the behavior, such as feeling pleasant or not (Fishbein & Ajzen, 2010).

Based on the conceptualizations above, it is evident that attitude is normally considered as a very global and abstract perception with many underlying specific beliefs regarding performing a behavior (Yzer, 2012). According to the reasoned action approach (Fishbein & Ajzen, 2010), the specific cognitive responses that can determine attitude are behavioral beliefs, which refer to the subjective assessment of the likelihood that carrying out a certain behavior will result in certain favorable and unfavorable consequences (Yzer, 2012).

Another variable that could influence attitude is trust. Specifically, trust towards cancer scientists might influence people's attitude towards cancer clinical trials and colonoscopy, and some studies have shown that such effects also might operate through perceived benefits and risks. For instance, both Siegrist (1999) and Tanka (2004) demonstrated that trust could affect the general public's acceptance of gene technology through influencing people's perceived risks and benefits of the technology. Similarly, using structural equation modeling, Li & Chen (2007) reported that trust towards scientists, researchers, and institutions performing gene manipulation could lead to more perceived benefits and less perceived risks towards genetically-modified food, and these perceptions could influence people's general attitudes towards GM food. In the specific context of cancer communication, trust towards health care providers served as a significant predictor of positive attitudes towards clinical trials (Yang, McCombas, Gay, Leonard, Dannenberg, & Dillon, 2009). The authors of this study did not empirically investigate the possible mechanism or mediators of the effects of trust on physicians, but they argued that cancer patients with greater optimistic feelings were less reluctant to consider cancer clinical trials (Yang, McCombas, Gay, Leonard, Dannenberg, & Dillon, 2009). This argument was consistent with the main hypothesis of the broaden-and-build theory of positive emotions which states that positive affect or emotions could widen one's array of thoughts and broaden one's momentary thought-action repertoires (Fredrickson, 2001). And the optimistic feelings might, at least partially, come from their beliefs that the benefits of cancer clinical trials may outweigh the risks.

From attitude to behavioral intention

Another potential downstream outcome to be explored in this study is behavioral intention to participate in cancer clinical trials after cancer diagnosis and to get screened for colorectal cancer (e.g. through colonoscopy) when it is recommended. Based on the reasoned action approach, one of the predictors of behavioral intention can be attitude (Yzer, 2012), or specifically in this study, the general population's attitude towards participation in cancer clinical trials after a cancer diagnosis and receiving colonoscopy when it is recommended.

From trust to behavioral intention

Trust in physicians and scientists also could influence people's behavioral intentions to participate in clinical trials (Sood et al., 2009), and the importance of trust also matters when it comes to cancer screening, with distrust towards physicians being considered as a barrier to the uptake of some certain cancer screening services (Yang, Matthews, & Hillemeier, 2011). But what is the theoretical mechanism connecting trust and behavioral intentions? Again research points to the central role of perceived risks and benefits: Studies have found that trust towards researchers, scientists, and institutions could generate perceived risks and benefits towards GM food (Li & Chen) and gene technology (Tanaka, 2004; Siegrist, 1999), and both perceived risks and benefits were demonstrated to be important determinants of behavioral intentions in multiple contexts such as smoking (Parsons, Siegel, Cousins, 1997), online shopping behaviors (Bhatti,

Rehman, 2019), and quit smoking (McKee, O'Malley, Salovey, Krishnan-Sarin, & Mazure, 2004).

Taken together, we propose the following secondary hypotheses:

H2: Behavioral beliefs towards cancer clinical trials and cancer screening (H2a) and trust towards cancer scientists (H2b) will be positively associated with the general public's attitude towards trials and screening.

H3: The general public's attitudes towards cancer clinical trials and cancer screening will be positively associated with their behavioral intentions to participate in a cancer clinical trial after cancer diagnosis and get screened for colorectal cancer (e.g., with a colonoscopy) when it is recommended.

H4: The general public's trust towards cancer scientists will be positively associated with their behavioral intentions to participate in a cancer clinical trial after cancer diagnosis and get screened for colorectal cancer (e.g., with a colonoscopy) when it is recommended.

Exploring the Moderating Role of Research Literacy

Many social contextual factors may moderate the effects of media messages on health outcomes (Viswanath & Emmons, 2006). One of these factors might be research literacy, the conceptualization of which has been studied by many scholars. For example, Isler et al. (2013) developed a model for conceptualization of research literacy, where it is composed of mainly five elements: knowledge of research concepts, cognitive capacity to

weigh decisions to participate in research, attitudes towards research, high motivation to explore multiple research options, and participation in research (Isler et al., 2013). However, Isler et al. (2013)'s model for research literacy may be too broad, since it captures many aspects.

Nagler (2010) and Powell (2016) approached the concept from a narrower perspective. For instance, Powell (2016) defined research literacy as people's capacity to acquire, process, and comprehend research-related information with a purpose of weighing the pros and cons and making an informed decision regarding whether to participate in the research. Nagler (2010), examining the concept in the context of diet and nutrition, argued that research literacy should be composed of three aspects: 1) understanding of research methodology; 2) understanding of the challenges of diet and nutrition research; and 3) understanding of the process of scientific discovery. Hence, regarding the conceptualization of research literacy, both Nagler (2010) and Powell (2016) tried to focus on mainly people's understanding of scientific research, including its processes and difficulties. And this aspect of research literacy is what I am ultimately interested in; hence, based on previous work, I conceptualize research literacy as an individual's capability to appreciate both the challenging process of scientific research and the unavoidable limitations of many scientific discoveries.

In actuality, research literacy may not be equally distributed across the population. Powell (2016) found research literacy is associated with many factors including race, age, income, education level, and health literacy. Hence, given the diversity of the general population, cancer-related information may not be processed and

interpreted in a homogenous way. For instance, in the context of discourse-based hedging, Jenson, Pokharel, Scherr, King, Brown, & Jones (2018) reported that when facing higher levels of uncertainty conveyed by discourse-based hedging, those with a 12th grade education or less showed greater backlash compared to those with higher education levels.

It would be ideal to examine the moderating role of research literacy in a systematic way, but this would require a larger sample size than is feasible for this thesis project. Therefore, this study will only conduct some exploratory research to understand whether the effects of hedging might be different across individuals with different levels of research literacy, thereby offering hypothesis generating information for future work.

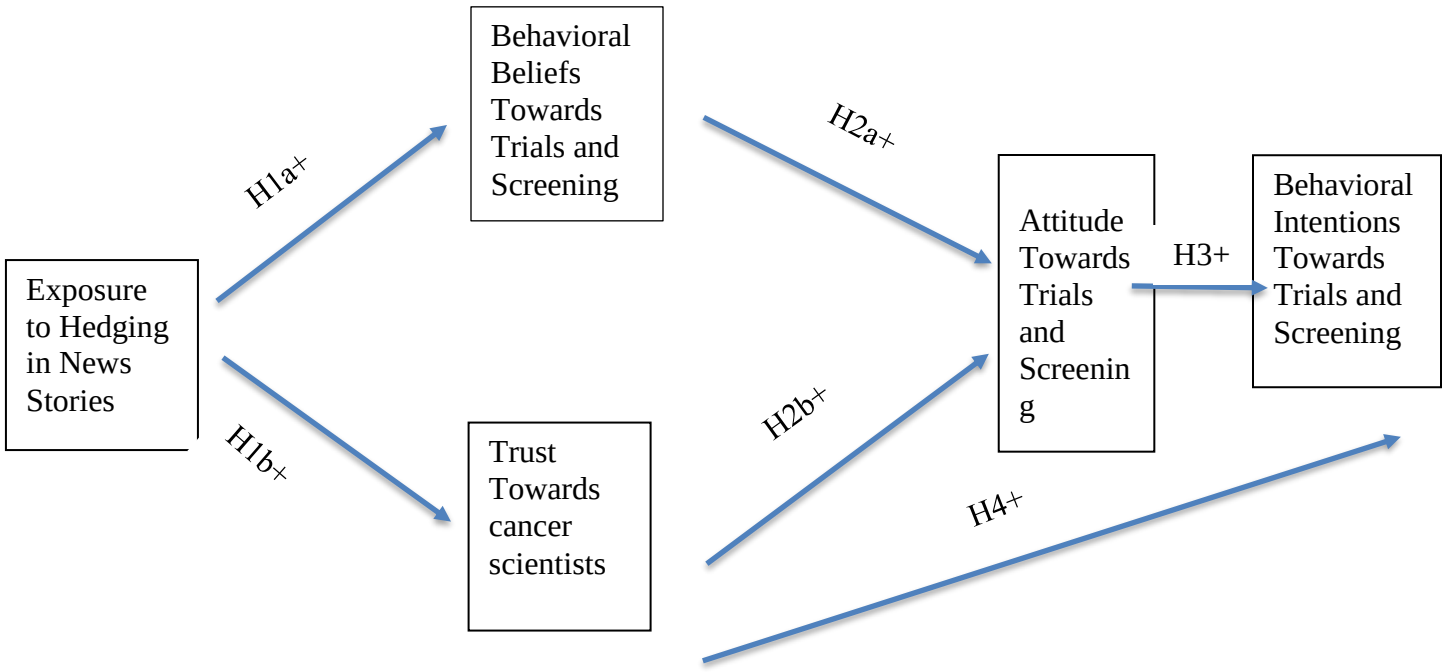

Figure 1. Conceptual model depicting the effects of exposure to hedging in news stories

Pilot study

Method

Research design

The main purpose of the pilot study was to determine whether the stimuli were successfully manipulating hedging. There were three conditions (lexical hedging, discourse-based hedging, and no hedging) in the pilot study, and each condition included two news stories representing two different topics, respectively (cancer clinical trial, and colonoscopy).

Experiment Procedure

The main purpose of the pilot study was to make sure that participants noticed the uncertainty conveyed by hedging. The subject pool operated by Hubbard School of Journalism and Mass Communication at the University of Minnesota was used to recruit a sample of 81 participants for the pilot study. The study included the following steps: 1) I informed participants of the purpose of the study: to test the public's reactions to cancer-related information; and 2) participants were randomly assigned to read two news stories that were both strategically hedged, lexically hedged, or not hedged at all. The two stories represented two cancer topics (cancer clinical trial and colonoscopy), respectively. The order of topics was randomly rotated. After exposure to each of the two news stories, participants were instructed to answers questions measuring whether and the extent to which the news stories conveyed any scientific uncertainty, and whether the stories were easy to understand.

Stimuli development

To develop stimuli materials for this study, I extracted several news stories covering cancer clinical trials and cancer screening (colonoscopy) from Factiva. The stories served as a pool to further generate stimuli materials. Then, through synthesizing and consolidating relevant information from the pool, I came up with two news stories, respectively, related to a cancer clinical trial and colonoscopy. Finally, I edited the two news stories to produce six stimuli materials representing six conditions (Table 1).

Table 1

Manipulation tactics across the six conditions

	Cancer clinical trial	Colonoscopy
No hedging	Control condition without scientific uncertainty conveyed	Control condition without scientific uncertainty conveyed
Lexical hedging	Conveyed scientific uncertainty through linguistic elements such as "might", "could", and "possibly".	Conveyed scientific uncertainty through linguistic elements such as "might", "could", and "possibly".
Discourse-based hedging	Conveyed scientific uncertainty through disclosing study limitations in several aspects such as experiment design and results generalizability.	Conveyed scientific uncertainty through disclosing study limitations in several aspects such as experiment design and results generalizability.

To ensure validity, there were no visible differences in terms of format across all six news stories. For instance, they were stripped of the name of the news organization since simply mentioning it could influence people's attitudes, perceptions, and intentions. Also, the font size and typeface remained the same across six conditions. There were no substantial differences in word counts across the six conditions (Table 2).

Table 2

Word counts of the six stimuli materials

	Cancer clinical trial	Colonoscopy
No hedging	302	294
Lexical hedging	324	318
Discourse-based hedging	361	368

Measurement

Uncertainty

Adopted from the scale used by Jensen (2008), uncertainty was assessed in two ways. First, uncertainty was assessed through a 7-point Likert scale where 1= strongly disagree and 7 = strongly agree with three items, including "The news story conveyed many uncertainties regarding the study", "The news story described many limitations of the study", and "The news story suggested that the findings of the study might not be certain."

In each condition (lexical hedging, discourse-based hedging, or no hedging), every participant was exposed to two news stories covering two cancer topics (cancer clinical trial and colonoscopy). After the exposure, they answered two sets of questions measuring perceived uncertainty of each story, respectively. Consequently, two variables were created to represent the mean scores of all the items measuring perceived uncertainty of the clinical trial story (M = 3.79, SD = 1.43) and of the colonoscopy story (M = 3.75, SD = 1.53). Reliability was strong, with Cronbach's Alpha being 0.87 for the clinical trial story scale and 0.89 for the colonoscopy story scale.

Second, uncertainty was also measured through a slider marker. Participants were asked to indicate how much uncertainty they noticed in the news story they just read on the slider marker ranging from 0 (no uncertainty) to 100 (lots of uncertainty). Similarly, two variables were created to represent the mean score of uncertainty for the clinical trial story (*M* =40.46, *SD* = 27.19) and the colonoscopy story (*M* = 43.31, *SD* = 28.85).

Readability

Readability was measured through a 7-point Likert scale where 1 = strongly disagree and 7 = strongly agree with the following four items adopted from Nagler, Yzer, and Rothman (2019), including "The news story is easy to understand", "the news story is poorly written", "The news story uses plain English", "The news story uses lots of jargon". Two variables were created to represent the mean scores of all the items measuring readability of the clinical trial story (*M* = 3.29, *SD* = 1.07) and the colonoscopy story (*M* = 5.18, *SD* = 1.00). Reliability was acceptable, with Cronbach's Alpha being 0.72 for the clinical trial story scale and 0.71 for the colonoscopy story scale.

Analytical approach

To achieve the main purpose of the study (i.e., to check whether participants noticed the uncertainty conveyed by hedging), first, I averaged the scores of uncertainty that participants indicted on the 1-7 Likert scale and on the slider scale (0-100), and came up with the mean scores of perceived uncertainty for the six story conditions. Second, for each story topic (cancer clinical trial or colonoscopy), I compared the mean scores of perceived uncertainty of the two hedging conditions (lexical hedging and discourse-based hedging) with the control condition (no hedging).

Moreover, to make sure that there would not be many differences in readability across stories covering the same topic with different hedging strategies, I also averaged the scores of readability measured by 1-7 Likert scale to generate the mean readability scores of the six story conditions; second, I compared the mean readability scores of the stories covering the same cancer topic with different hedging tactics.

Results

After deleting 6 responses that were not fully completed (progress was not 100%), there were 67 valid responses subject to further analysis, and they were evenly distributed among the three hedging conditions (no-hedging condition: n =23; lexical hedging condition: n = 22; discourse-based hedging condition: n = 22).

The uncertainty scores varied across different hedging conditions as shown in Table 3 and Table 4; hence the manipulation was generally successful. Based on the results, discourse-based hedging stories had the highest uncertainty stores regardless of measurement method (Likert Scale or Slider) or topic (clinical trial or colonoscopy). No hedging stories had the lowest uncertainty scores. Lexical hedging stories were in the middle. Moreover, when comparing two stories with different topics (clinical trials and colonoscopy) and the same hedging condition (no hedging, lexical hedging, or discourse-based hedging), there were not many differences in the uncertainty score.

In spite of the largely successful manipulation, the difference of perceived uncertainty score between the clinical trial story with lexical hedging (M = 3.29) and the clinical trial with no-hedging (M = 3.26) was trivial, suggesting that the lexical hedging story featuring a cancer clinical trial might need revision to boost its perceived uncertainty.

Table 3

Uncertainty score measured by 7-point Likert scale across different hedging conditions in the context of clinical trial and colonoscopy

	Clinical Trials *M (SD)*	Colonoscopy *M (SD)*
Discourse-Based Hedging	4.85 (.99)	4.55 (1.29)
Lexical Hedging	3.29 (1.39)	3.56 (1.57)
No Hedging	3.26 (1.29)	3.17 (1.42)

Table 4

Uncertainty score measured by slider scale (0-100) across different hedging conditions in the context of clinical trial and colonoscopy

	Clinical Trials *M(SD)*	Colonoscopy *M(SD)*
Discourse-Based Hedging	53.10 (21.07)	55.86 (26.85)
Lexical Hedging	37.86 (31.45)	43.82 (33.65)
No Hedging	31.30 (24.54)	30.83 (20.17)

I also tested the stimuli materials' readability. There were not many differences in terms of readability across stories covering the same topic with different hedging strategies, as shown in Table 5. However, when comparing the readability scores between clinical trial stories and colonoscopy stories with the same type of hedging strategy, there

were notable differences. Given that the main purpose of this study is comparing the effects of different types of hedging under the same topic (i.e., colonoscopy story with lexical hedging vs. colonoscopy story with no hedging) rather than across topics (i.e., colonoscopy story with lexical hedging vs. clinical trial story with lexical hedging), the differences might not be worth addressing further.

Table 5

Readability score measured 7-point Likert scale across different hedging conditions in the context of clinical trial and colonoscopy

	Clinical Trials *M(SD)*	Colonoscopy *M(SD)*
Discourse-Based Hedging	3.56 (1.18)	5.15 (0.92)
Lexical Hedging	3.23 (0.95)	5.17 (0.91)
No Hedging	3.06 (1.04)	5.25 (1.19)

Conclusion and discussion

The pilot study revealed that the manipulations were generally successful, with uncertainty scores varying in expected ways and readability scores remaining similar across different hedging conditions under the same story topic. However, as noted above, the gap in perceived uncertainty level between the clinical trial story with lexical hedging (M = 3.29) and the clinical trial story with no-hedging (M = 3.26) was too small. Hence, to strengthen the uncertainty score, I revisited the story covering clinical trial with lexical hedging strategies and slightly tweaked it by adding more lexical hedging-related language elements (e.g., "**about 38%** of the patients").

The notable differences in readability level across the stories covering different cancer topics with the same hedging strategy, although not meaningful in this study, might be due to two reasons. First, the clinical trial stories might pose more challenges for participants to understand due to the complicated yet necessary description of the drug's mechanism of action (MOA), namely the bio-chemical mechanism about how the newly developed drug works. Second, the difference might be explained by measurement. When developing the scale measuring the readability scores of colonoscopy stories, I reversed the 7-point Likert scale so that 1 corresponded to strongly agree, and 7 corresponded to strongly disagree, while in the scale for clinical trial stories, 1 meant strongly disagree and 7 meant strongly agree. However, participants might not have noticed this change. In other words, when they chose 5 as the readability score for the colonoscopy story, I am not sure whether they had "somewhat agree" in mind or "somewhat disagree" in mind. These two possibilities notwithstanding, given the main purpose of the study as mentioned above, no overhaul of the stimuli materials was deemed necessary.

Main Study

Method

Research design

A survey experiment was employed to test the hypothesis and answer the research questions of this study. This required embedding an experimental design in a survey, and randomly assigning research participants to control and treatment conditions (Gaines, Kuklinski, & Quirk, 2006). In this way, cause-effect relationships would be revealed and established through comparing the responses of participants in treatment groups to the responses of those in the control groups (Gaines, Kuklinski, & Quirk, 2006). In this study, I compared (a) the effects of two hedging conditions and the no-hedging condition and (b) the effects of discourse-based hedging and lexical hedging. Hence, a survey experiment design is appropriate.

Since we focused on the effects of news stories containing discourse-based hedging, lexical hedging, and no hedging in the context of two main topics (cancer clinical trials and cancer screening), the main study is a 2 (cancer topic: clinical trial, colonoscopy)*3 (types of hedging: none, lexical, discourse-based) study design with a total of 6 conditions.

Experiment Procedure for the main study

A sample of 576 U.S. adults were recruited through CloudResearch, which is a "wrapper" of Mechanical Turk (Mturk), to participate in the main study. Upon approval from the University of Minnesota Institutional Review Board, participants were invited to participate in the survey experiment and provided a link to access the study. The data

collection procedure was composed of the following steps: 1) participants were shown an information sheet containing some basic information about the study including the study purpose, procedures, and contact information of the researchers; they were also given an option to exit the study; 2) participants who agreed to participate were randomly assigned to one of the six conditions; 3) after exposure to the stimulus materials, participants were instructed to answer questions measuring their cognitive, attitudinal, and behavioral intentional responses; 4) participants were asked about the characteristics of the stimulus materials, which served as manipulation check; and 5) participants were asked several demographic questions, such as age, gender, and education level.

Based on the story topic that participants were exposed to, the specific questions gauging their behavioral beliefs, attitudes, and behavioral intentions were slightly different, which was achieved through Qualtrics programming. For instance, participants reading the story about cancer clinical trials would respond to questions assessing their behavioral beliefs, attitudes, and behavioral intentions towards the topic (i.e., cancer clinical trial), and the same applied to those exposed the story about colonoscopy. Other questions, including trust towards cancer researchers, perceived uncertainty level of the story (manipulation check), and demographic information, were the same for all participants.

Also through Qualtrics programing, I ensured that the questions gauging behavioral beliefs and trust towards cancer scientists would always be the first two appearing in the survey questionnaire, since they were the primary outcomes of the main study. Items in each question matrix were displayed in random order, and the slider scales

were either anchored at 0 (the starting point) or 100 (the ending point) and were randomly displayed to participants.

Measurement

Primary outcome: Behavioral beliefs towards cancer clinical trials and cancer screening (colonoscopy)

Behavioral beliefs refer to the subjective assessment regarding the probability that a behavior will generate a desired or undesired outcome or consequence (Yzer, 2012). Ideally speaking, to identify the behavioral beliefs underpinning a behavior, open-ended questions, which allow the participants to come up with all advantages and disadvantages of performing the behavior, would be used to elicit the beliefs (Yzer, 2012). However, since some studies have been done by other scholars to investigate the behavioral/outcome beliefs of participating in cancer clinical trials and cancer screening (colonoscopy), I drew upon the results of previous studies, along with the definition of behavioral beliefs, to develop my own measurement.

For example, some salient behavioral beliefs regarding participation in cancer clinical trials among cancer patients, including “benefit future patients”, “help others”, “help my own disease”, “get better medical treatment,” “time commitment,” “side effects”, and “inconvenience”, were identified by Sutherland, da Cunha, Lockwood, & Till (1996) and Yang et al. (2010) through semi-structured interview and questionnaires. As for colonoscopy as a cancer screening tool, based on the studies conducted by James, Campell & Hudson (2002), Liljegren et al. (2004) and Bleiker et al. (2005), several behavioral beliefs regarding the advantages and disadvantages of receiving colonoscopy,

such as “early detection of cancer”, “will worry less”, “better control over health”, and “ physical discomfort from the procedure”, were extracted.

Hence, to measure behavioral beliefs regarding participation in cancer clinical trials, we asked: “If I were to participate in a cancer clinical trial someday after cancer diagnosis, it would…” The following beliefs collected from previous literature were listed, and participants rated them on a 7-point Likert scale (where 1 = strongly disagree, and 7= strongly agree): “provide me with better medical treatment”, “benefit future patients”, “help medical research”, “expose me to potential side effects”, “take a lot of time”, and “be inconvenient”.

To assess behavioral beliefs regarding receiving colonoscopy as a cancer screening procedure, we asked: “If I were to get screened for colorectal cancer (e.g., with a colonoscopy) when it is recommended for me, it would…” The following beliefs collected from previous literature were listed, and participants rated them on a 7-point Likert scale (where 1 = strongly disagree, and 7 = strongly agree): “detect my cancer early”, “reduce my worry about getting colorectal cancer”, “provide me with control over my health”, “expose me to physical discomfort”, “expose me to physical discomfort or pain”, and “cost me money for the procedure without getting meaningful information.”

Negative behavioral beliefs of cancer clinical trials and colonoscopy were recoded so that a higher score would represent a higher level of belief positivity score. To get a sense of participants’ overall belief positivity level, two new variables counting the number of positive beliefs that participants agreed with (somewhat agree, agree, and strongly agree) were created in the context of clinical trial (*M* = 2.84, *SD* = 0.82, *Min* =

0.00, *Max* = 6.00) and colonoscopy (*M* = 2.71, *SD* = 0.84, *Min* = 0.00, *Max* = 5.00), respectively.

Primary outcome: Trust towards cancer scientists

Adopted from the scale used by McCroskey & Young (1999), trust towards cancer scientists was assessed on a 7-point semantic differential scale, on which participants were asked: "In my opinion, cancer researchers or cancer scientists"… "are unintelligent/are intelligent", "are untrained/are trained", "are incompetent/are competent", "don't care about the public/do care about the public", "don't have the public's interests at heart/do have the public's interests at heart", "are self-centered/are not self-centered", "are untrustworthy/are trustworthy", "are unethical/are ethical", "are dishonest/are honest". All the three factors or aspects of trust were captured by the 9 items. Specifically, the first three items focused on competence, the second three captured goodwill, and the last three emphasized on trustworthiness (McCroskey & Young, 1999). A 9-item scale demonstrated reliability, with Cronbach's Alpha = 0.86. A variable was constructed through calculating the mean score of all the items measuring trust (*M* = 5.55, *SD* = 0.90).

Secondary outcome: Attitude towards cancer clinical trials and cancer screening (colonoscopy)

Both instrumental attitude and experiential attitude were measured based on the conceptualizations of the two kinds of attitude proposed by Fishbein & Ajzen (2010), and the measurements items proposed by Gray (2015). For instrumental attitude, I asked participants: "If I were to participate in a cancer clinical trial someday after cancer diagnosis/If I were to get screened for colorectal cancer (e.g., with colonoscopy) when it

is recommended for me, it would be"… "good/bad", "wise/foolish", "beneficial/harmful", "valuable/worthless" on a 7-point semantic differential scale. As for experiential attitude, participants responded to: "If I were to participate in a cancer clinical trial someday after cancer diagnosis/If I were to get screened for colorectal cancer (e.g., with colonoscopy) when it is recommended for me, it would be"… "enjoyable/unenjoyable", "stressful/relaxing", "pleasant/unpleasant" on a 7-point semantic differential scale. Some of the items were recoded so that a higher score would represent a more positive attitude. There was good evidence of reliability (Cronbach's Alpha = 0.78 for attitudes towards cancer clinical trials; Cronbach's Alpha = 0.81 for attitudes towards colonoscopy). Two variables were created to represent the mean scores of all the items measuring attitude towards cancer clinical trials (M = 4.13, SD = 1.20) and attitude towards colonoscopy (M = 4.12, SD = 1.31)

Secondary outcome: Behavioral intentions

Behavioral intentions were assessed directly through a 7-point Likert scale where 1 = very unlikely, and 7 = very likely with the item adapted from Gray (2012): "How likely is it that you will participant in a cancer clinical trial someday after cancer diagnosis" (M = 5.73, SD = 1,19) and "How likely is it that you will get screened for colorectal cancer (e.g., with a colonoscopy) when it is recommended for you? " (M = 4.12, SD = 0.87). Based on the story topic that participants were assigned to, they responded to one of the questions above.

Exploratory moderator: Research Literacy

Based on the definitions proposed by Nagler (2010) and Powell (2016), research literacy was measured on a 4-point Likert scale where 1 = no understanding at all, and 4

= clear understanding, with the following questions: “Some news stories use specific terminologies. For each term below, indicate your level of understanding of what it means: 1) Scientific study; 2) Clinical trials (or randomized clinical trials); 3) causal effect relationship (as opposed to association); 4) the difference between random assignment and random sampling.” Note that the first three items were developed by Nagler (2010), while the fourth item was developed by myself. The four items went through a reliability test, and the Cronbach’s Alpha was 0.49. Based on the SPSS output, deleting any one of the four items would not boost the reliability score; given the exploratory nature of this analysis, I decided to keep all the four items despite the weak reliability score. A new variable was created to represent the mean scores of all the items measuring research literacy (M = 3.12, SD = 0.47).

Manipulation check

The exact measurement of uncertainty in the pilot study was used for manipulation check in the main study. Based on the topic (cancer clinical trials or colonoscopy as a screening procedure), participants were asked to indicate how much they agree or disagree on a 7-point Likert scale, where 1 = strongly disagree and 7= strongly agree, with the following statements: 1) The news story conveyed many uncertainties regarding the study; 2) The news story described many limitations of the study; 3) The news story suggested that the findings of the study might not be certain. Reliability test of the three items were performed (Cronbach’s Alpha = 0.77). A new variable was created to represent the mean scores of all the items measuring perceived uncertainty (M = 5.27, SD = 1.14).

Analytical approach

Before conducting any data analysis, I cleaned the dataset so that only valid responses would be included for further analysis. I performed reliability tests of relevant scales in this study; a manipulation check was also conducted to make sure that the stimuli materials manipulated uncertainty as expected. Then, to get a clear picture of the demographics of participants, I performed descriptive analysis of participants' age, gender, race and education level; I also conducted descriptive analysis to 1) check the distribution of the six conditions and 2) understand the data distribution of relevant variables including research literacy, behavioral beliefs, trust, attitude, and behavioral intention. A one-way ANOVA test was conducted to compare the effects of different hedging conditions on behavioral beliefs towards cancer clinical trials and colonoscopy (discourse-based hedging vs. no hedging—H1a; lexical hedging vs. no hedging—RQ1a; discourse-based hedging vs. lexical hedging—RQ2a). A two-way ANOVA test was conducted to compare the effects of different hedging conditions on trust towards cancer scientists (discourse-based hedging vs. no hedging--H1b; lexical hedging vs. no hedging--RQ1b; discourse-based hedging vs. lexical hedging--RQ2b). To test the correlations between behavioral beliefs and attitudes (H2a), trust and attitudes (H2b), attitudes and behavioral intentions (H3), and trust and behavioral intentions (H4), bivariate and partial correlation tests were conducted. The potential moderating role of research literacy was examined through comparing the mean scores of behavioral beliefs and trust towards cancer scientists of participants with relatively high versus low research literacy scores in the three hedging conditions (lexical hedging, discourse-based hedging, and no hedging). SPSS was used for main study data analysis.

Power analysis

The sample size of 576 participants was informed by a power analysis conducted on GPower 3.1. I chose F-test as the test family, and ANOVA: Fixed effects, omnibus, one-way as the statistical test. In the input parameters, the effect size was set as 0.15, α error probability was 0.05, power was 0.8, and number of groups was 6.

Results

Participants' characteristics and condition distributions

The research data downloaded from Qualtrics, where participants' answers to the survey questionnaire were recorded, revealed 588 responses, although the study was set up on CloudResearch to recruit a sample of 576 participants from Mturk. This discrepancy might be due to a variety of reasons, including duplicate responses from the same participant and the failure of participants to submit the correct completion code.

After data cleaning, there were 572 respondents in total. Males represented 66.4% (*n* = 378) of the participants, while females only accounted for 33.2% (*n*=189). One participant preferred not to disclose his/her gender, and another one selected "Other" as their gender identity. Another three participants were declared as missing since they skipped the question measuring their gender identity. As for age, most participants were between 25-44 years old, and they accounted for 83.2% of the 572 respondents. Both the Mean and Median score of the age were between 35-44 years old. Participants reported their race as 73.8% White (*n*=422), 22% Black or African American (*n*=126), 3.3% Asian (*n*= 19), and 0.7% American Indian or Alaska Native (*n*=4), and 0.2% Other (*n*=1). Among the 572 participants, 41.2% (*n* = 234) identified them as Hispanic or Latino. In

addition, 79.1% of participants (*n*=451) have completed education of college level, and 10.7% (*n*=61) have completed some college or technical school. Only 10.2% (*n* = 38) have never received any form of higher education. More information about participants' demographics is shown in Table 6.

Table 6

Demographics characteristics of the sample

	Frequency	*Percentage*
Gender		
Male	378	66.4
Female	189	33.2
Prefer not to say	1	.2
Other	1	.2
Age		
16-24	20	3.5
25-34	265	46.4
35-44	210	36.8
Over 50	70	12.3
Prefer not to say	6	1.1
Race		
White	424	73.8
Black or African American	126	22.0
Asian	19	3.3
American Indian or Alaska Native	4	.7
Other	1	.2
Hispanic or Latino		
Yes	234	41.2
No	334	58.8
Education		
Never attended school	5	.9
Elementary	6	1.1
Some high school	9	1.6
High school graduate	38	6.6
Some college or technical school	61	10.7
College graduate	451	79.1

Since the main study was a 2 (cancer topic: clinical trial, colonoscopy)*3 (types of hedging: none, lexical, discourse-based) study design, the participants were randomly assigned to one of the six conditions. Specific condition distribution is shown in Table 7.

Table 7

Condition distributions

	Frequency	*Percentage*
Clinical trial without hedging	95	16.6
Clinical trial with lexical hedging	99	17.3
Clinical trial with discourse-based Hedging	94	16.4
Colonoscopy without Hedging	92	16.1
Colonoscopy with lexical hedging	95	16.6
Colonoscopy with discourse-based Hedging	97	17.0

Manipulation check

Manipulation was successful, as participants noticed more uncertainty in the lexical and discourse-based hedging conditions compared to no-hedging conditions regardless of the topic (cancer clinical trial or colonoscopy) or measurement (slider scale or Likert scale), as shown in Table 8 and Table 9.

However, note that although the means went in the expected directions, the difference between hedging and no-hedging conditions were not very big. The successful yet weak manipulation might negatively influence the chance in finding significant effects, which would be address further in the discussion section.

Table 8

Perceived uncertainty level across the six conditions measured by 7-point Likert scale

	Cancer clinical trial *M (SD)*	Colonoscopy *M (SD)*
No hedging	5.05 (1.21)	5.22 (1.41)
Lexical hedging	5.16 (1.19)	5.36 (1.14)
Discourse-based hedging	5.45 (0.84)	5.38 (0.95)

Table 9

Perceived uncertainty level across the six conditions measured by 0-100 slider scale

	Cancer clinical trial *M (SD)*	Colonoscopy *M (SD)*
No hedging	62.31 (25.33)	63.35 (25.62)
Lexical hedging	66.03 (24.31)	69.17 (24.14)
Discourse-based hedging	71.43 (19.68)	68.27 (25.21)

Primary analysis: The effects of different types of hedging on behavioral beliefs and trust

The purpose of H1a, RQ1a and RQ2a was to compare the effects of different types of hedging on behavioral beliefs in the context of cancer clinical trials and colonoscopy. One-way ANOVA tests were performed. As shown in Table 10 and Table 11, the test showed no significant differences among three different hedging conditions in

terms of their effects on behavioral beliefs towards cancer clinical trials ($F(2,285) = .48$, $p = .95$) and colonoscopy ($F(2,281) = .77$ $p = .93$). Hence, H1a was not supported.

The purpose of H1b, RQ1b and RQ2b was to compare the effects of different types of hedging on trust towards cancer scientists in the context of cancer clinical trials and colonoscopy. Since there were two factors (cancer topic and hedging condition), two-way ANOVA tests were conducted. The main effects of hedging conditions (no-hedging, lexical hedging, and discourse-based hedging) yielded an F ratio of $F(2, 566) = .361$, $p = .70$, indicating that there were no significant differences among the effects of hedging conditions on trust towards cancer scientists. Therefore, H1b was not supported.

Table 10

Means and 95% CI of outcomes variables by hedging conditions in the context of cancer clinical trial

	Behavioral belief	Trust
No hedging	2.83[a]	5.53[a]
	[2.64, 3.02]	[5.35, 5.71]
Lexical hedging	2.83[a]	5.47[a]
	[2.66, 3.00]	[5.30, 5.64]
Discourse-based	2.86[a]	5.47[a]
hedging	[2.73, 3.00]	[5.28, 5.66]

Note: Means that share the same subscript are not significantly different, p > .05

Table 11

Means and 95% CI of outcomes variables by hedging conditions in the context of colonoscopy

	Behavioral belief	Trust
No hedging	2.68[a]	5.53[a]
	[2.50, 2.87]	[5.34, 5.73]
Lexical hedging	2.72[a]	5.56[a]
	[2.56, 2.87]	[5.38, 5.74]
Discourse-based	2.73[a]	5.71[a]
hedging	[2.56, 2.91]	[5.53, 5.90]

Note: Means that share the same subscript are not significantly different, p > .05

Secondary analysis: The association among behavioral beliefs, attitude, trust, and behavioral intention

H2a focused on the association between agreement with behavioral beliefs and attitudes towards cancer clinical trials and screening. A correlation test was conducted, and there were weak yet significantly positive correlations between belief positivity score and attitudes towards cancer clinical trials (r = .26, $p < .001$) and towards colonoscopy (r = .15, $p = .01$), as shown in Table 12 and Table 13.In other words, the more belief positivity participants reported, the more positive attitudes they held towards cancer clinical trials and colonoscopy.

Partial correlations were run to assess the relationship between belief positivity score and attitudes whilst controlling for age, gender, race, and education. There was a weak yet significantly positive correlation between behavioral belief positivity and attitudes towards cancer clinical trials after controlling for age ($r = .25$, $p < .001$), gender ($r = .25$, $p < .001$), race ($r = .26$, $p < .001$), and education ($r = .27$, $p < .001$). The weak but significantly positively relationship held as well in the context of colonoscopy after controlling for age ($r = .15$, $p = .01$), gender ($r = .16$, $p = .008$), race ($r = .15$, $p = .01$) and education (($r = .16$, $p = .008$). Therefore, age, gender, race and education all had little influence over the relationship between behavioral beliefs and attitudes towards cancer clinical trials and screening. H2a was supported.

H2b examined the association between trust towards cancer scientists and the general public's attitudes towards cancer clinical trials and colonoscopy. As shown in Table 12, there was a weak but significantly positive relationship between trust towards cancer scientists and attitudes towards colonoscopy ($r = .16$, $p = .008$), suggesting that the more trust people had in cancer scientists, the more positive their attitudes were towards colonoscopy. In the context of cancer clinical trials, although there was also a weak and positive relationship between trust and attitude, the relationship was not significant ($r = .05$, $p = .42$), as shown in Table 13.

To investigate the relationship between trust and attitudes in both the context of cancer clinical trials and colonoscopy whilst controlling for age, gender, race, and education a partial correlation test was performed. In the context of colonoscopy, there was a weak but significantly positive relationship between trust towards cancer scientists and attitudes towards colonoscopy, after controlling for age ($r = .15$, $p = .01$), gender (r

= .16, p = .008), race (r = .14, p = .02), and education (r = .14, p = .02). A nonsignificant positive relationship was found between trust towards cancer scientists and attitudes towards cancer clinical trials after controlling for age (r = .03, p = .61), race (r = .05, p = .43), gender (r = .05, p = .44), and education (r = .06, p = .31). Hence, age, race, education and gender had little influence on the relationship between trust towards cancer scientists and attitude towards cancer clinical trials and colonoscopy. H2b was partially supported.

H3 was meant to test the association between attitudes towards cancer clinical trials and colonoscopy and behavioral intentions. As displayed in Table 12, there was a weak but significantly positive relationship between attitudes towards cancer clinical trials and behavioral intention (r = .27, p < .001), suggesting that the more positive attitudes people had towards cancer clinical trials, the more likely they would intend to participate in a trial after cancer diagnosis. This relationship also held after controlling for age (r = .26, p < .001), gender (r = .28, p < .001), race (r = .27, p < .001), and education (r = .27, p < .001). In spite of a weak positive relationship between attitudes and behavioral intention in the context of colonoscopy, this relationship was not significant (r = .07, p = .022), as displayed in Table 13, and this was also true after controlling for age (r = 08, p = .19), race (r = .08, p = 0.19), gender (r = .08, p = .17), and education ((r = .09, p =.15). H3 was partially supported.

The purpose of H4 was to investigation the relationship between trust towards cancer scientists and behavioral intentions. Correlation tests were performed, and revealed a moderate and significantly positive relationship between trust towards cancer scientists and behavioral intention among the participants to participate in a clinical trial

after diagnosis (r = .38, p < .001), and the intention to receive colonoscopy after being recommended (r = .32, p < .001), as shown in Table 12 and Table 13 respectively. Hence, the more trust people had in cancer scientists, the higher behavioral intention they reported. The relationship also held in the context of clinical trials when controlling for age (r = .37, p < .001), gender (r = .38, p < .001), race (r =.38, p < .001), and education (r = .38, p < .001), and in the context of colonoscopy after controlling for age (r = .33, p < .001), gender (r = .32, p < .001) race (r = .33, p < .001), and education (r = .33, p < .001). Therefore, the demographics (age, gender, education and race) exerted little influence over the relationship between trust and behavioral intention. H4 was fully supported.

Table 12

Intercorrelations between behavioral beliefs, trust, attitudes and behavioral intention in the context of cancer clinical trials

	Behavioral beliefs	Trust towards cancer scientists	Attitudes towards cancer clinical trial	Behavioral intention
Behavioral beliefs	1	.35**	.26**	.27**
Trust towards cancer scientists		1	.05	.38**
Attitudes towards cancer clinical trial			1	.27**
Behavioral intention				1

**. Correlation is significant at the 0.01 level, p < 0.01

Table 13

Intercorrelations between behavioral beliefs, trust, attitudes and behavioral intention in the context of colonoscopy

	Behavioral beliefs	Trust towards cancer scientists	Attitudes towards colonoscopy	Behavioral intention
Behavioral beliefs	1	.40**	.15**	.22**
Trust towards cancer scientists		1	.16**	.32**
Attitudes towards cancer colonoscopy			1	.07
Behavioral intention				1

**. Correlation is significant at the 0.01 level, $p < 0.01$

Exploring the potential moderating role of research literacy

The median score of research literacy among participants was 3, which would serve as the cut point between relatively low research literacy (those whose average research literacy score was equal or less than 3) and relatively high research literacy (those whose average research literacy score was more than 3).

The exploratory analysis does not strongly suggest a potential moderating role of research literacy on the effects of different types of hedging on behavioral beliefs positivity and trust, regardless of cancer topic. As shown in Table 14 – Table 17, in both the context of cancer clinical trials and colonoscopy, those with higher research literacy

scores on average reported more belief positivity and possessed higher level of trust towards cancer scientists, regardless of hedging conditions.

Table 14

Behavioral beliefs positivity score in the context of cancer clinical trial among participants of lower and higher research literacy across three hedging conditions (n=288)

	Lower research literacy *M (SD)*	Higher research literacy *M (SD)*
No hedging	2.61 (.96)	3.12 (.81)
Lexical hedging	2.70 (.89)	3.00 (.79)
Discourse-based hedging	2.69 (.91)	3.00 (.40)

Table 15

Behavioral beliefs positivity score in the context of colonoscopy among participants of lower and higher research literacy across three hedging conditions (n = 283)

	Lower research literacy *M (SD)*	Higher research literacy *M (SD)*
No hedging	2.42 (.99)	2.95 (.64)
Lexical hedging	2.49 (.92)	2.98 (.40)
Discourse-based hedging	2.66 (.89)	2.80 (.96)

Table 16

Trust towards cancer scientists across among participants of lower and higher research literacy across three hedging conditions in the context of cancer clinical trial (n = 288)

	Lower research literacy *M (SD)*	Higher research literacy *M (SD)*
No hedging	5.25 (.87)	5.91 (.77)
Lexical hedging	5.05 (.72)	6.01 (.72)
Discourse-based hedging	5.07 (.76)	5.78 (.95)

Table 17

Trust towards cancer scientists across among participants of lower and higher research literacy across three hedging conditions in the context of colonoscopy (n=283)

	Lower research literacy *M (SD)*	Higher research literacy *M (SD)*
No hedging	5.04 (.89)	6.04 (.66)
Lexical hedging	5.20 (.88)	5.98 (.69)
Discourse-based hedging	5.36 (.99)	6.06 (.63)

Discussion

Discussion

The primary goal of this study was to investigate the effects of different types of hedging, including lexical hedging and discourse-based, on two cognitive responses among the general public. Specifically, I compared the effects of lexical hedging and discourse-based hedging, lexical hedging and no-hedging, and discourse-based hedging and no-hedging on the two primary outcomes, namely cancer-related behavioral beliefs and trust in cancer scientists. The results suggested no significant effects on the two primary cognitive outcomes across three different hedging conditions (no-hedging, lexical hedging, and discourse-based hedging), regardless of cancer topic. Findings are therefore inconsistent with Jensen's (2011) study, which revealed some positive and desirable effects of discourse-based hedging on participants' perceptions including cancer fatalism and nutrition backlash.

It might make sense to explain the lack of significant results in this study from the perspective of psychological distance and the construal level theory. According to Pizzi, Marzocchi, Orsingher & Zammit (2015), construal level theory (CLT) argues that depending on the perceived distance between an individual and an event or object, people might generate different mental representation of the event or object. In other words, with greater psychological distance from an object, people might be more likely to construe it in abstract and decontextualized details (high-level construal), while with smaller social distance, people might construe it in concrete and contextualized details (low-level construal) (Liberman, Trope, McCrea, & Sherman, 2007). Therefore, CLT is highly related to psychological distance, an egocentric assessment or experience of the different

ways in which one object or event might be removed the self in the here and now (Trope & Liberman, 2010). Specifically, psychological distance has four dimensions including temporal distance, spatial distance, social distance, and hypotheticality (Liberman, Trope, & Stephan, 2007).

In the context of health communication and media effects, some researchers found that psychological distance might moderate the effectiveness of health messages in influencing people's cognitive responses. For instance, Kim (2019) reported that an advertisement framed by high-level construal terms was more persuasive for a psychologically distant disease (bronchitis) compared to psychologically proximal disease (flu), while an advertisement with low-level construal terms tended to more persuasive for a psychological proximal disease (flu) than for a psychologically distant disease (bronchitis). In the context of cancer communication, this pattern also held, with low-level construal messages being more effective in people feeling psychologically close towards cancer (e.g. cancer family history, more knowledge of cancer, personal experience of cancer, etc.) and vice versa (Kim, 2019).

Hence, a consistency between message framing (low-level construal vs. high-level construal) and people's perceived psychological disease towards an object might be the prerequisite for a health message to have some kind of influence on cognitive responses. The stimuli materials in this study addressed many concrete and detailed aspects of cancer clinical trials and colonoscopy, such as how the newly developed drug worked, potential side effects brought on by the drug, and some concrete limitations of the research featured in the stories. Based on a detailed list of high vs. low-level construal examples proposed by Soderberg, Callahan, Kochersberg, Amit & Ledgerwood (2015),

low-level construal can be characterized by concrete details rather than abstract gestalts. Hence, I argue here that this study's stimuli materials are filled with low-construal terms.

However, cancer, as an object, might have great psychological distance from our participants. According to the statistics from NCI'S Surveillance, Epidemiology, and End Results (SEER) program, the median age of receiving a cancer diagnosis is 66 years old (National Cancer Institute, 2020), while around 83% of the participants in this study are between 25-44 years old. As for cancer screening procedures such as colonoscopy, it is recommended that people with average risk of colorectal cancer should start screening at age 45 (American Cancer Society, 2021). In short, it makes sense to argue that most participants in this study may have little knowledge or personal experience with cancer and are more likely to construe cancer in an abstract way. Consequently, it is possible that they might not resonate with the concrete details about cancer clinical trials and colonoscopy in my stimuli materials, making the news stories less effective in influencing their cognitions including behavioral beliefs and trust towards cancer scientists.

From the point of methodology, the lack of significant effects could also be attributed to the successful yet weak manipulation of stimuli materials. Although the average perceived uncertainty scores in the lexical and discourse-based hedging conditions were higher compared to that of no-hedging conditions regardless of the topic (cancer clinical trial or colonoscopy) or measurement (Likert scale or slider), the difference were not very big. Such a weak manipulation might at least partially contribute to the null finding in the current study.

The correlations among behavioral beliefs, trust, attitude, and behavioral intentions were tested. The empirical evidence in this study supported the positive association between behavioral beliefs positivity score and attitude. Note that in this study, I calculated the number of behavioral belief items that participants agreed with, be it agree, "somewhat agree", or "strongly agree". Hence, the more positive behavioral beliefs held, the more positive attitudes they seemed to possess towards cancer clinical trials and colonoscopy.

The positive correlation between trust towards cancer scientists and attitude was only significant in the context of colonoscopy. This might come from the experimental nature of clinical trial. In the area of oncology, the overall probability of success for clinical trials is only 3.4%, the lowest among several therapeutic areas (Wong, Siah, & Lo, 2018). Hence, even with high level of trust towards cancer scientists and researchers, it might be hard for people to form a positive attitude towards cancer clinical trials due to the high rate of failure.

The positive correlation between attitude and behavioral intention was only supported in the context of cancer clinical trial. I would explain this from the angle of involvement, which could be activated when a product or service is perceived as pivotal and essential in meeting important needs, goals, and values (Vermeir & Verbeke, 2005). In context of sustainable food consumption, Vermeir & Verbeke (2005) found that people with higher level of involvement in sustainability possessed higher level of intention to purchase sustainable foods. Informed by this theory, I argue that participants might attach greater importance to cancer clinical trials, meaning that they consider cancer clinical trials as instrumental in curing or controlling cancer after getting a diagnosis, which

might connect attitude and behavioral intention. In contrast, colonoscopy might be attached little value since it is essentially a screening service, or a part of routine check-up rather than a treatment procedure. Therefore, even with positive attitude towards colonoscopy, people might still not intend to receive it.

Limitation and future directions

This study's results should be considered with several limitations in mind. First, the conceptual model in this study suggested a route through which hedging could eventually lead to behavioral intentions towards cancer clinical trial and colonoscopy. However, instead of performing a path analysis testing the mediating role of several variables including behavioral beliefs, trust, and attitude, I only tested the correlation among those variables. The results of the correlation analysis were generally exploratory. Hence, further work on hedging might consider path analysis to investigate indirect pathways among variables, such as whether hedging could ultimately influence people's behavioral intentions through some cognitive responses such as behavioral beliefs, trust, and attitude. Second, the results of this study may not be highly generalizable. The sample was largely young, highly educated, and possessed higher levels of research literacy. Such a convenience sample is not representative of the broader US general population. Further research should recruit a more representative sample of participants. Third, the examination of the moderating role of research literacy in this study was only exploratory in nature due to sample size constraints. Moreover, the low reliability of research literacy scale dealt a further blow to the rigor of the exploratory analysis. Further research should strive to create a highly reliable scale to measure research literacy, and

conduct a formal moderation analysis to critically investigate the potential moderating role of research literacy.

Conclusion

In sum, this study tested and compared different types of hedging on behavioral beliefs and trust towards cancer scientists in two cancer contexts, cancer clinical trial and colonoscopy. The central hypothesis was not supported, and analyses suggested that hedging did not influence these primary outcomes as observed in prior work. However, this should not invalidate the use of hedging language to communicate uncertainty in news stories, since the current study did not reveal any negative effects of hedging on the two important cognitive outcomes, and some other studies in cancer communication did indicate positive effects of hedging on cognitions. Also, given the dearth of empirical studies assessing effects of lexical hedging in cancer communication, further work might continue this line of investigation. For instance, further analysis could examine the effects of different types of hedging such as attribution shields (information on who said what, such as “at least to my understanding”) and plausibility shields (probably, perhaps) in the context of cancer communication.

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Appendix A: Study information sheet – pilot study

INFORMATION SHEET FOR RESEARCH

You are invited to be in a research study of understanding how the public respond the public health information. You were selected as a possible participant because you are a MTurk worker who are eligible to participate. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by Dr. Rebekah Nagler (the PI) and Le Wang (the student researcher) in the Hubbard School of Journalism & Mass Communication at the University of Minnesota.

Procedures:

If you agree to be in this study, we would ask you to do the following things:
You will be exposed to two news story. Please note that depends on your past health experiences, some of the news stories might contain information that could be upsetting. After reading each of the story, you will answer a few questions gauging your responses to the news story. The survey will take around 10 minutes.

Confidentiality:

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota or MTurk, which is operated by Amazon. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researchers conducting this study are: Dr. Rebekah Nagler and Le Wang. You may ask any questions you have now. If you have questions later, you are encouraged to contact them at School of Journalism and Mass Communication, Room 111 Murphy Hall, 0371A (campus delivery code), 206 Church St SE, Minneapolis, Minnesota, 55455; 612-25-9388; nagle026@umn.edu

This research has been reviewed and approved by an IRB within the Human Research Protections Program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll

Free: 1-888-224-8636) or go to z.umn.edu/participants. You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

Do you consent to the terms above?

Yes
No

Appendix B: Survey instruments – pilot study

Thank you for agreeing to participate in this study. We'd like to invite you to read two news stories separately and then answer the questions that follow. Please note that you will not be able to go back to the story after proceeding.

Q1. Based on the new stories you just read, how much do you agree with the following statements?

	Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
The news story conveyed many uncertainties regarding the study conducted							
The news story described many limitations of the study conducted							
The news story suggested that the findings of the study might not be certain							

Q2. How much uncertainty did you notice in the news stories you read. Mark on the following scale ranging from 0 (none) – 100 (a lot).

Q3. Based on the new story you just read, how much do you agree with the following statements

	Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree

The news story is easy to understand							
The news story is poorly written							
The news story uses plain English							
The news story uses lots of jargon							

Thank you for participating in the study. Please be aware that the news stories you read were edited for the purposes of scientific research. We are interested in the effects of hedging, which can convey scientific uncertainty, on people's attitudinal, cognitive, and behavioral outcomes. Therefore, some people read real news stories that were modified to underscore scientific uncertainty through different hedging strategies, and the amount of scientific uncertainty might have been overstated. If you have any questions about this study, please feel free to contact the Principal Investigator, Dr. Rebekah Nagler, at 111 Murphy Hall, 206 Church Street SE, Minneapolis, MN, 55455; (612) 625-9388; or nagle026@umn.edu, or you could reach out to the Institutional Review Board (IRB) of the University of Minnesota, at Suite 350-2, McNamara Alumni Center, 200 SE Oak St, Minneapolis, MN, 55455; (612)-626-5645, or irb@umn.edu.

This ends the survey. Thanks again for your participation!

Appendix C: Information sheet– main study

INFORMATION SHEET FOR RESEARCH

You are invited to be in a research study of understanding how the public respond the public health information. You were selected as a possible participant because you are a MTurk worker who are eligible to participate. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by Dr. Rebekah Nagler (the PI) and Le Wang (the student researcher) in the Hubbard School of Journalism & Mass Communication at the University of Minnesota.

Procedures:

If you agree to be in this study, we would ask you to do the following things:
You will be exposed to one news story. Please note that depends on your past health experiences, some of the news stories might contain information that could be upsetting. After reading the story, you will answer a few questions gauging your responses to the news story.. Then, you will be asked to answer a few questions regarding your background. The survey will take around 8-10 minutes

Confidentiality:

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota or MTurk, which is operated by Amazon. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researchers conducting this study are: Dr. Rebekah Nagler and Le Wang. You may ask any questions you have now. If you have questions later, you are encouraged to contact them at School of Journalism and Mass Communication, Room 111 Murphy Hall, 0371A (campus delivery code), 206 Church St SE, Minneapolis, Minnesota, 55455; 612-25-9388; nagle026@umn.edu

This research has been reviewed and approved by an IRB within the Human Research Protections Program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll

Free: 1-888-224-8636) or go to z.umn.edu/participants. You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

Do you consent to the terms above?

Yes
No

Appendix D: Survey instrument– main study-clinical trial story

Thank you for agreeing to participate in this study regarding public's responses to cancer information. We'd like to ask you to read the following health news story and then answer the questions that follow. Please note that you will not be able to go back to the story after proceeding.

[INSERT RANDOMLY ASSIGNED NEWS STORY HERE]

Here, we would like to ask you some questions about your perceptions of cancer scientists or researchers. Please indicate your impression of cancer scientists or researchers below.

Q1. In my opinion, cancer researchers or scientists…

	1	**2**	**3**	**4**	**5**	**6**	**7**	
Are unintelligent								Are intelligent
Are untrained								Are trained
Are incompetent								Are competent
Don't care about the public								Do care about the public
Don't have the public's interests at heart								Do have the public's interests at heart
Are self-centered								Are not self-centered
Are untrustworthy								Are trustworthy
Are unethical								Are ethical
Are dishonest								Are honesty

Now, we'd like to ask you some questions about your perceptions of cancer clinical trials. Please note that one would only participate in cancer clinical trials if diagnosed with cancer since these trials are designed to test new ways of treating cancer.

Q2. If I were to participate in a cancer clinical trial after cancer diagnosis, it would…

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Provide me with better medical treatment							
Benefit future cancer patients							
Help medical research							
Expose me to potential side effects							
Take a lot of time							
Be inconvenient							

Q3. If I were to participate in a cancer clinical trial someday after cancer diagnosis, it would be

	1	2	3	4	5	6	7	
Bad								Good
Wise								Foolish
Beneficial								Harmful
Valuable								Worthless
Enjoyable								Unenjoyable
Stressful								Relaxing
Pleasant								Unpleasant

Q4. How likely is it that you will participant in a cancer clinical trial someday after cancer diagnosis

	1	2	3	4	5	6	7	
Very unlikely								**Very likely**

Now, we are going to ask you some questions about the news story you just read.

Q5. Based on the news story you just read, how much do you agree with the following statements

	Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
The news story conveyed many uncertainties regarding the study							
The news story described many limitations of the study							
The news story suggested that the findings of the study might not be certain							

Q6. How much uncertainty did you notice in the news story you read. Please indicate using the following sliding scale, ranging from 0 (none) – 100 (a lot).

Before concluding the survey, we would like to ask some questions about yourself.

Q7: What is your age?

Under 15
16-24
25-34

35-44
Over 50
Prefer not to say

Q8: How would you describe your gender?

Male
Female
Other (with a blank entry field for the participant to self-identify)
Prefer not to answer

Q9: Are you Hispanic or Latino?

Yes
No
Don't know/not sure

Q10. What is your race? Do you consider yourself…(Select one or more.)

White
Black or African American
Asian
Native Hawaiian or other Pacific Islander
American Indian or Alaska Native
Other (with a blank entry field for the participant to self-identify).

Q11. What is the highest grade or year of school you have completed?

Never attended school or only attended kingergarten
Grades 1 through 8 (elementary)
Grades 9 through 11 (some high school)
Grades 12 or GED (high school graduate)
College 1 year to 3 years (some college or technical school)
College 4 years or more (college graduate)

Q12. Some news stories use specific terminologies. For each term below, indicate your understanding of what it means:

	No understanding at all	Superficial understanding	Moderate understanding	Clear understanding
Scientific study				
Clinical trials (or randomized controlled trials)				
Cause-effect relationship (as opposed to association)				
The difference between random assignment and random sampling				

Thank you for participating in the study. Please be aware that the news story you read was edited for the purposes of scientific research. We are interested in the effects of hedging, which can convey scientific uncertainty, on people's attitudinal, cognitive, and behavioral outcomes. Therefore, some people read real news stories that were modified to underscore scientific uncertainty through different hedging strategies, and the amount of scientific uncertainty might have been overstated. If you have any questions about this study, please feel free to contact the Principal Investigator, Dr. Rebekah Nagler, at 111 Murphy Hall, 206 Church Street SE, Minneapolis, MN, 55455; (612) 625-9388; or nagle026@umn.edu, or you could reach out to the Institutional Review Board (IRB) of the University of Minnesota, at Suite 350-2,McNamara Alumni Center, 200 SE Oak St, Minneapolis, MN, 55455; (612)-626-5645, or irb@umn.edu.
This ends the survey. Thanks again for your participation!

Appendix E: Survey instrument– main study-colonoscopy story

Thank you for agreeing to participate in this study regarding public's responses to cancer information. We'd like to ask you to read the following health news story and then answer the questions that follow. Please note that you will not be able to go back to the story after proceeding.

[INSERT RANDOMLY ASSIGNED NEWS STORY HERE]

Here, we would like to ask you some questions about your perceptions of cancer scientists or researchers. Please indicate your impression of cancer scientists or researchers below.

Q1. In my opinion, cancer researchers or scientists…

	1	**2**	**3**	**4**	**5**	**6**	**7**	
Are unintelligent								Are intelligent
Are untrained								Are trained
Are incompetent								Are competent
Don't care about the public								Do care about the public
Don't have the public's interests at heart								Do have the public's interests at heart
Are self-centered								Are not self-centered
Are untrustworthy								Are trustworthy
Are unethical								Are ethical
Are dishonest								Are honesty

Now we'd like to ask you some questions about your perceptions of colonoscopy.

Q2. If I were to get screened for colorectal cancer (e.g., with a colonoscopy) when it is recommended for me, it would…

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Detect my cancer early							
Reduce my worry about getting colorectal cancer							
Provide me with control over my health							
Expose me to physical discomfort or pain							
Cost me money for the procedure without getting meaningful information							

Q3. If I were to get screened for colorectal cancer (e.g., with a colonoscopy) when it is recommended for me, it would be

	1	2	3	4	5	6	7	
Bad								Good
Wise								Foolish
Beneficial								Harmful
Valuable								Worthless
Enjoyable								Unenjoyable
Stressful								Relaxing
Pleasant								Unpleasant

Q4. How likely is it that you will get screened for colorectal cancer (e.g., with a colonoscopy)
when it is recommended for you?

	1	2	3	4	5	6	7	
Very unlikely								Very likely

Now, we are going to ask you some questions about the news story you just read.

Q5. Based on the news story you just read, how much do you agree with the following statements

	Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
The news story conveyed many uncertainties regarding the study							
The news story described many limitations of the study							
The news story suggested that the findings of the study might not be certain							

Q6. How much uncertainty did you notice in the news story you read. Please indicate using the following sliding scale, ranging from 0 (none) – 100 (a lot).

Before concluding the survey, we would like to ask some questions about yourself.

Q7: What is your age?

Under 15
16-24
25-34
35-44
Over 50
Prefer not to say

Q8: How would you describe your gender?

Male
Female
Other (with a blank entry field for the participant to self-identify)
Prefer not to answer

Q9: Are you Hispanic or Latino?

Yes
No
Don't know/not sure

Q10. What is your race? Do you consider yourself…(Select one or more.)

White
Black or African American
Asian
Native Hawaiian or other Pacific Islander
American Indian or Alaska Native
Other (with a blank entry field for the participant to self-identify).

Q11. What is the highest grade or year of school you have completed?

Never attended school or only attended kingergarten
Grades 1 through 8 (elementary)
Grades 9 through 11 (some high school)
Grades 12 or GED (high school graduate)
College 1 year to 3 years (some college or technical school)
College 4 years or more (college graduate)

Q12. Some news stories use specific terminologies. For each term below, indicate your understanding of what it means:

	No understanding at all	Superficial understanding	Moderate understanding	Clear understanding
Scientific study				
Clinical trials (or randomized controlled trials)				
Cause-effect relationship (as opposed to association)				
The difference between random assignment and random sampling				

Thank you for participating in the study. Please be aware that the news story you read was edited for the purposes of scientific research. We are interested in the effects of hedging, which can convey scientific uncertainty, on people's attitudinal, cognitive, and behavioral outcomes. Therefore, some people read real news stories that were modified to underscore scientific uncertainty through different hedging strategies, and the amount of scientific uncertainty might have been overstated. If you have any questions about this study, please feel free to contact the Principal Investigator, Dr. Rebekah Nagler, at 111 Murphy Hall, 206 Church Street SE, Minneapolis, MN, 55455; (612) 625-9388; or nagle026@umn.edu, or you could reach out to the Institutional Review Board (IRB) of the University of Minnesota, at Suite 350-2,McNamara Alumni Center, 200 SE Oak St, Minneapolis, MN, 55455; (612)-626-5645, or irb@umn.edu.
This ends the survey. Thanks again for your participation!

Appendix F: Stimuli materials-Clinical trial

No hedging:

Merck Drug Show Promising Results in Treating Melanoma

CHICAGO—An experimental drug developed by Merck & Co. (MRK) shrank tumors in 38% of patients with advanced melanoma in a clinical trial, a promising result attracting attention here at the annual meeting of the American Society of Clinical Oncology.
The drug, which is called lambrolizumab, or MK-3475, works through disabling a brake and mobilizing the human body's immune system to fight cancer. The brake is a protein on immune system cells called programmed death 1 receptor, or PD-1. Cancer cells can use PD-1 as a shield against the immune system.

Results from the clinical trial conducted by Merck were published in the New England Journal of Medicine. Among 135 patients involved in the clinical trial, tumors shrank in 38 percent of patients overall , but the rate was 52% for patients who got the highest dose of the drug.
Only 13% of patients had notable side effects including fatigue, rash, and diarrhea. Such side effects would be considered tolerable by most patients, a researcher from Merck commented.

"This is the most impressive thing I've seen in melanoma," Dr. Antoni Ribas, a professor of medicine at the University of California, Los Angeles, and the senior author of the study, said in an interview. "We've never had something where we've had these rates of responses with such minimal side effects."
"Data from this clinical trial will be applicable to the broader clinical population with melanoma", said Dr. Erin Todd, a dermatologist at the department of dermatology at MD Anderson Cancer Center, who is not affiliated with the study. "And that's because the results are based on a group of patients that are diverse enough to represent the whole clinical population."
Merck also is studying the drug as a potential treatment for non-small cell lung cancer.

Lexical Hedging:

Merck Drug **Seems To** Show Promising Results in Treating Melanoma

CHICAGO—An experimental drug developed by Merck & Co. (MRK) shrank tumors in approximately 38% of patients with advanced melanoma in a clinical trial, a potentially promising result attracting attention here at the annual meeting of the American Society of Clinical Oncology.
The drug, which is called lambrolizumab, or MK-3475, **is suspected to** work through disabling a brake and **possibly mobilizing** the human body's immune system to fight cancer. The brake is a protein on immune system cells called programmed death 1 receptor, or PD-1. Cancer cells can use PD-1 as a shield against the immune system.

Results from the clinical trial conducted by Merck were published in the New England Journal of Medicine. Among 135 patients involved in the clinical trial, tumors shrank in about 38% of patients overall, but the rate was about 52% for patients who got the highest dose of the drug.
Approximately 13% of the patients had notable side effects, including fatigue, rash, and diarrhea. Such side effects **would probably be considered relatively tolerable** by **most** patients, a researcher from Merck **speculated.**

"This **appears to be** the most impressive thing I've seen in melanoma," Dr. Antoni Ribas, a professor of medicine at the University of California, Los Angeles and the senior author of the study, **suggested** in an interview. "**It seems like** we've **almost never had** something where we've had these rates of responses with such **relatively minimal side effects**."

"Data from this clinical trial **is likely to** be applicable to the broader clinical population with melanoma", **speculated** Dr. Erin Todd, a dermatologist at the department of dermatology at MD Anderson Cancer Center, who is not affiliated with the study. "And that's because the results are based on a group of patients that **seems to be diverse enough** to represent the whole clinical population."
Merck also is studying the drug as a potential treatment for non-small cell lung cancer.

Discourse based hedging:

Merck Drug Show Promising Results in Treating Melanoma. But Researchers **Voice Their Concerns**

CHICAGO—An experimental drug developed by Merck & Co. (MRK) shrank tumors in 38% of patients with advanced melanoma in a clinical trial, a promising result attracting attention here at the annual meeting of the American Society of Clinical Oncology.

The drug, which is called lambrolizumab, or MK-3475, works through disabling a brake and mobilizing the human body's immune system to fight cancer. The brake is a protein on immune system cells called programmed death 1 receptor, or PD-1. Cancer cells can use PD-1 as a shield against the immune system.

Results from the clinical trial conducted by Merck were published in the New England Journal of Medicine. Among 135 patients involved in the clinical trial, tumors shrank in 38% of patients overall , but the rate was 52% for patients who got the highest dose of the drug.

Only 13% of the patients had notable side effects, including fatigue, rash, and diarrhea. Yet one limitation is that we lack data on whether these side effects will be tolerable by cancer patients , a researcher from Merck cautioned.

"Although this is the most impressive thing I've seen in melanoma, there are caveats to note," Dr. Antoni Ribas, a professor of medicine at the University of California, Los Angeles and the senior author of the study, said in an interview. **"This was still an early-stage study; more testing is needed to know whether the drug will succeed in future investigations. For example, patients have not been followed long enough to determine the drug's long-term effects."**

The generalizability of the study is also a big concern. **"Data from this clinical trial will not be applicable to the broader clinical population with melanoma",** said Dr. Erin Todd, a dermatologist at the department of dermatology at MD Anderson Cancer Center, who is not affiliated with the study. "And that's due to a flaw in the research design. **The results are based on a group of patients that are not diverse enough to represent the whole clinical population."**

Merck also is studying the drug as a potential treatment for non-small cell lung cancer.

Appendix G: Stimuli materials-colonoscopy

No hedging:

Colonoscopy Proven as Effective Test to Save Lives

CHICAGO— Colonoscopy is an effective tool to slash colon cancer deaths, according to the largest study of the procedure so far.

Colonoscopy is considered the gold standard for colon cancer screening and is used in millions of people every year. The new study shows that for every one-percent increase in colonoscopy use, the risk of death from colon cancer dropped three percent.

The reduced death rate is due to the accuracy of colonoscopy. During a colonoscopy exam, the doctor inserts a slim, flexible tube into the rectum. A camera at the tip of the tube allows the doctor to identify and remove abnormal cell clumps before they turn into a cancer tumor. The study also finds evidence to show that colonoscopy is better than other screening methods, such as a stool test.

Dr. David F. Rex, professor of medicine at the University of Toronto, followed more than 2.4 million people for about 15 years, who were between 50 and 90 years old at the outset of the study and did not have colon cancer. By 2006, about 1 in 100 had died from the disease.

Over the same period, as colonoscopy rates nearly quadrupled, the risk of dying from colon cancer tapered steadily, even after accounting for factors such as income and age.

Moreover, Dr. Robert Smith, American Cancer Society Vice President for Cancer Screening, commented through email, “The results of this study are promising. The study has shown that the cause-effect relationship between colonoscopy and reduced colon cancer death rates is clear.”

Dr. Allen King of Minnesota Gastroenterology PA, also said it was established by now that colonoscopy reduces colon cancer death rates.

“There are enough studies out there to cement the idea,” he said.

Lexical hedging:

Colonoscopy **Seems to be** an Effective Test to Save Lives

CHICAGO— Colonoscopy **is arguably** an effective tool to slash colon cancer deaths, according to the largest study of the procedure so far.

Colonoscopy **is presumed to be** a gold standard for colon cancer screening and **is likely** used in millions of people every year. The new study **suggests** that for every one-percent increase in colonoscopy use, the risk of death from colon cancer seemed to drop by **approximately three** percent.

The reduced death rate **may be** due to the relative accuracy of colonoscopy. During a colonoscopy exam, the doctor inserts a slim, flexible tube into the rectum. A camera at the tip of the tube may allow the doctor to identify and perhaps remove abnormal cell clumps before they turn into a cancer tumor. The study also finds evidence to show that colonoscopy is **somewhat better** than other screening methods, such as a stool test.

Dr. David F. Rex, professor of medicine at the University of Toronto followed more than 2.4 million people for about 15 years, who were between 50 and 90 years old at the outset of the study and did not have colon cancer. By 2006, about 1 in 100 had died from the disease.

Over the same period, as colonoscopy rates **nearly quadrupled,** the risk of dying from colon cancer tapered **fairly steadily**, even after accounting for factors such as income and age.

However, Dr. Robert Smith, American Cancer Society Vice President for Cancer Screening, cautioned through email, "The results of this study **could be** compelling, **but time will tell.** The study **appears to** show that the cause-effect relationship between colonoscopy and reduced colon cancer death rates is clear."

Dr. Allen King of Minnesota Gastroenterology PA, also said **it was not fully established** that colonoscopy reduces colon cancer death rates.

"There are likely **nearly enough** studies out there to cement the idea," he said.

Discourse-based hedging:

Colonoscopy Proven as Effective Test to Save Lives. But **experts question the evidence**

CHICAGO— Colonoscopy is an effective tool to slash colon cancer deaths, according to the largest study of the procedure so far.

Colonoscopy is considered the gold standard for colon cancer screening and is used in millions of people every year. The new study shows that for every one-percent increase in colonoscopy use, the risk of death from colon cancer dropped three percent.

The reduced death rate is due to the accuracy of colonoscopy. During a colonoscopy exam, the doctor inserts a slim, flexible tube into the rectum. A camera at the tip of the tube allows the doctor to identify and remove abnormal cell clumps before they turn into a cancer tumor. **However, other researchers pointed out that there is no evidence in this study to show that colonoscopy is better than other screening methods, such as a stool test.**

Dr. David F. Rex, professor of medicine at the University of Toronto followed more than 2.4 million people for about 15 years, who were between 50 and 90 years old at the outset of the study and did not have colon cancer. By 2006, about 1 in 100 had died from the disease.

Over the same period, as colonoscopy rates nearly quadrupled, the risk of dying from colon cancer tapered steadily, even after accounting for factors such as income and age.

However, Dr. Robert Smith, American Cancer Society Vice President for Cancer Screening commented through email, "Though this result of the study are compelling **, the cause-effect relationship between colonoscopy and reduced colon cancer death rates has never been tested. The observational data obtained in the study are, at best, useful in establishing the association between colonoscopy and reduced death rates. Investigating the effects of colonoscopy on death rates would require a so-called randomized controlled trial, in which participants are randomly assigned to either screening or no screening"**

Dr. Allen King of Minnesota Gastroenterology PA, also **said the cause-effect relationship between colonoscopy and reduced colon cancer death rates has not been established given the absence of a randomized controlled trial.**

"There are not enough studies out there to cement the idea," he said.