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NEWS COVERAGE OF CANCER RESEARCH

Does Disclosure of Scientific Uncertainty Enhance Credibility?

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The news media are recognized as an essential channel for communicating health research and recommendations to the public (Atkin & Wallack, 1990; Jensen, Krakow, John, & Liu, 2013; Johnson, 1997). News stories can educate lay audiences about methods for preventing a myriad of health risks, including cancer, which is the second leading cause of death among Americans (Siegel, Miller, & Jemal, 2015; Stryker, Moriarty, & Jensen, 2008). However, whether or not the public trusts a source of risk information can influence how they interpret and respond to the risks (Malka, Krosnick, & Langer, 2009; Priest, Bonfadelli, & Rusanen, 2003; Siegrist, Connor, & Keller, 2012).

Prior research in the context of health journalism has identified a connection between perceived credibility and hedging (Jensen, 2008). In general, *hedged* language is language that employs modifying devices (hedges) to make tentative statements. In a scientific context, hedging is more aptly described as the disclosure of scientific uncertainty (Hyland, 1996). It is customary for scientific research published in peer-reviewed journals to include a discussion of study limitations and caveats, and for inferences to be made cautiously (i.e., with language of restrained possibility such as "could," "perhaps," and "might"; Reyna, 1981; Schwartz, Woloshin, & Welch, 1999).

When reporting scientific research to the public, a journalist can choose how much uncertainty to include. Sometimes the inclusion of hedging language is at direct odds with other news values. For example, although accuracy is a strong marker of quality in newswriting (Dudo, Dahlstrom, & Brossard, 2007; Kovach & Rosenstiel, 2007), journalists are expected to present information simply and clearly to make it easier for audiences to understand (see Bender, Drager, Davenport, & Fedler, 2009). Further, journalists are expected to appeal to audiences by presenting engaging material (Groot Kormelink & Costera Meijer, 2015). This tension can lead to the omission of uncertainty for the sake of clarity, novelty, or sensation value.

Journalists also choose whether to include disclosures of scientific uncertainty from the primary scientists responsible for a study, or alternately to invite unaffiliated scientists to comment. Casting a balanced view by interviewing multiple sources is a key tenet in journalism (Bender et al., 2009). Yet attempts to create balance in science coverage are frequently made by soliciting the point of view of an outside scientist *in place of* disclosure from the primary scientist. This may create the appearance that the primary scientist failed to acknowledge the uncertainty, or that scientists are dueling about the findings, either of which could inadvertently impact perceived credibility.

The current study examines whether certain practices in journalism could be systematically lowering public perceptions of credibility with regard to cancer research reports. Though likely unintentional, this could lead to biased processing and, potentially, dismissal of health information that is important in helping the public avoid health risks. We model this study on a prior experiment by Jensen (2008), which found a link between disclosure of scientific uncertainty attributed to the primary scientist and increased trustworthiness ratings for both the journalist and the primary scientist. We aim to see if Jensen's (2008) earlier findings hold (a) with updated news credibility measures (Yale, Jensen, Carcioppolo, Sun, & Liu, 2015), (b) in a sample that is more representative of the general public, and (c) in a more current media environment. Additionally, we explore whether source and amount of uncertainty influence public support for scientific research in general.

Capturing Perceptions of Credibility

In order to navigate the plethora of risks—including health risks—inherent in modern society, people often select other social actors in whom to trust (Kohring & Matthes, 2007). These are usually expert systems (such as news media, industry, scientists, and government) that individuals deem suitable to act on their behalf. Here, trust replaces knowledge, and individuals choose

which information sources to trust based on certain criteria (Kohring & Matthes, 2007). *Credibility* is one such heuristic.

Operational definitions of credibility are complex and vary widely in the literature. Early trust and credibility research, which focused on communicators in general, identified two major subdimensions of credibility: *expertise* and *trustworthiness* (Hovland, Janis, & Kelley, 1959). Expertise was operationalized as believing an actor to be informed and intelligent, while trustworthiness reflected a belief that the actor was impartial and not intending to persuade (Hovland, Janis, & Kelley, 1959). McCroskey and Young (1981) proposed a refinement to these widely used measures of credibility, identifying three distinct factors that comprised expertise: being intelligent, competent, and an expert; and three distinct factors that comprised trustworthiness: being trustworthy, honest, and ethical.

News Credibility

In measuring perceived credibility of newspapers and TV news, Gaziano and McGrath (1986) grouped the following 12 items together as a single factor: fair, unbiased, tells the whole story, accurate, respects the privacy of people, looks out for the interests of people, is concerned about the well-being of the community, separates fact from opinion, can be trusted, is concerned about the public interest, is factual, and has well-trained reporters. Their rationale was that these concepts have typically been treated as indicators of credibility in past research.

Meyer (1988) outlined a simpler measure of credibility comprised of five items: fairness, accuracy, unbiased, can be trusted, and tells the whole story. While each of these essentially describes *believability*, according to Meyer, he argued that "[t]his redundancy provides a far more accurate measurement than could be made by one of these items alone" (p. 574). Meyer also suggested that community affiliation (e.g., being concerned about the well-being of the community and the public interest) is distinct from credibility and should be measured with a separate scale, though West (1994) later found that addition to be unreliable. West also noted that the Gaziano-McGrath measure appeared to have multiple underlying factors.

Abdulla Garrison, Salwen, Driscoll, and Casey (2005) used a variation of the Gaziano and McGrath (1986) scale, grouping the following 11 items into three main factors: balanced, accurate, fair, objective, reports the whole story (under the primary dimension of *balance*), honest, believable, trustworthy (under the primary dimension of *honesty*), and current, up-to-date, timely (under the primary dimension of *currency*). One major difference in Abdulla et al.'s modified credibility scale is the replacement of concepts related to intent toward the receiver (e.g., community affiliation, goodwill) with concepts related to currency. A 12th item, bias, was not included in Abdulla et al.'s final scale for newspaper credibility.

Recently, Yale and colleagues (2015) tested Abdulla et al.'s (2005) scale as a single second-order factor (all nine items combined), as opposed to examining the honesty, balance, and currency separately as three first-order factors. The new factor structure mitigated discriminant validity issues observed in the original scale, suggesting that when testing all three factors—balance, honesty, or currency—they should be tested as a single scale to measure credibility.

Some scholars distinguish between *source* credibility and *message* credibility with regard to evaluations of news. Kiousis (2001) suggested that source credibility focuses on communicator variables (e.g., the individual journalist, the news outlet) while message credibility focuses on message variables (e.g., the content of news article). A third level of credibility judgment is also evident: perceived credibility of the platform. For instance, Kiousis (2001) found credibility ratings to be higher for print news than online or TV news. However, Kiousis noted that to some extent these layers are intertwined in audiences' minds.

The terms "journalists" and "news media" are sometimes used interchangeably in the literature (Kohring & Matthes, 2007). Frequently when communication scholars refer to trust in news media, they are actually speaking about trust in sources, such as journalists (Jensen, 2008). After all, it is journalists who select topics and facts to report, are responsible for reporting the information accurately, and offer their assessment of the issue—key dimensions of news trust, according to Kohring and Matthes (2007). Yet Kiousis (2001) made the case that perceptions of credibility—across layers, from journalist to outlet to media platform—are likely intertwined. In the current study, we asked participants to judge the news article instead of the journalist. Our aim was to keep the focus of their assessment on the content of the article, rather than shifting their thoughts toward a judgment of the person who said it, in order to examine the effects of our message characteristic variables. However, it is plausible that credibility evaluations of the article transfer to evaluations of the journalist (and vice versa).

Scientist Credibility

Few attempts have been made to specifically measure perceived credibility of scientists. Examinations of trust in scientists and scientific institutions have typically been embedded within larger studies about public trust in expert institutions (e.g., scientists, industry, government, and nonprofits; see Malka, Krosnick, & Langer, 2009; Priest, Bonfadelli, & Rusanen, 2003; Siegrist, Connor, & Keller, 2012).

Earle and Siegrist (2006) proposed a general trust model that divides trust into morality-based and performance-based assessment, with the former influencing *social trust* and the latter influencing *perceived competence*. Siegrist, Connor, and Keller (2012) applied this to public trust

in scientists and industry, suggesting that public trust in these groups can be examined in terms of perceived shared values and perceived competence. They proposed a multidimensional scale with items to capture subdimensions of social trust (honesty, concern for public health and the environment) and subdimensions of confidence (related to competence). Given these measures, trust and confidence factors may be closely related to perceived credibility of scientists and industry; however, this was specific to an environmental risk context.

Priest, Bonfadelli, and Rusanen (2003) examined trust in scientists along with industry, government, and other social institutions. They operationalized trust as "doing a good job for society," arguing that the measure taps into a dimension of social trust (p. 754). Siegrist, Connor, and Keller (2012), on the other hand, reasoned that trust and confidence are related but distinct concepts; trust is based on value similarity (i.e., intentions toward society) while confidence (i.e., competence) is based on past performance. Both of these appear to mirror the traditional key subdimensions of credibility—trustworthiness and expertise—although intentions toward society may be more closely related to goodwill.

In a series of studies conducted during 1971–1975, McCroskey and colleagues identified several dimensions of source credibility, including competence, character, sociability, extroversion, and composure. McCroskey and Young (1981) evaluated multiple types of expert sources, including organizations, peers, public figures, the media, and instructors. Their dimensions pertained more to speech communication cases, where factors such as composure, sociability, and character could be evaluated. A later credibility scale developed by McCroskey examined credibility as it pertained to experts (McCroskey & Teven, 1999) and has been one of the most widely used scales to assess perceptions of credibility via the subdimensions of expertise and trustworthiness.

Sjöberg (2001, p. 189) argued that competence has two sides: "One is knowing, the other is knowing the limits of one's knowledge." He suggested the latter is a consideration when evaluating a source's trustworthiness. In a science context, this aspect of competence—knowing the limits of one's knowledge—could be measured by a scientist's willingness to disclose uncertainty about her research, and potentially is a measure that audiences use to gauge scientist credibility.

Uncertainty and Credibility

In scientific research, uncertainty describes how well something (for instance, a study finding or a conclusion) is known (Peters & Dunwoody, 2016). It is not fully understood how lay audiences process uncertainty, and a growing body of literature has sought to understand audience

reactions (Binder, Hillback, & Brossard, 2016; Guenther, Froehlich, & Ruhrman, 2015; Guenther & Ruhrman, 2016; Jensen et al., 2017; Kimmerle, Flemming, Feinkohl, & Cress, 2015; Niederdeppe et al., 2014; Post & Maier, 2016; Winter, Kramer, Rosner, & Neubaum, 2015). However, the concepts of uncertainty and credibility have previously been explored together (Jensen, 2008; Priest, Bonfadelli, & Rusanen, 2003), and there is reason to believe message characteristics—such as whether, and to what extent, uncertainty is disclosed—can influence perceived credibility (Hendriks, Kienhues, & Bromme, 2016a; Hendriks, Kienhues, & Bromme, 2016b).

Amount of Uncertainty

The inclusion of uncertainty in health news can take the form of hedging language, or presentation of the limitations and caveats of research findings. A common newswriting principle is streamlining word choice, or "cutting out the fat" (Bender et al., 2009, p. 99). For example, journalists are often instilled with a belief that most adverbs and adjectives are unnecessary (see Bender et al., 2009). Aiming for strong and simple phrasing could lead to the removal of hedging language.

Yet research suggests that scientific uncertainty may be appreciated by lay audiences as well as the scientific community. For example, after reading hedged news reports of cancer research, participants in one study were less fatalistic about cancer than their peers who read non-hedged reports (Jensen et al., 2011a). Fuller expressions of uncertainty may even serve as a heuristic for news consumers with lower quantitative literacy and/or lower scientific knowledge. As Schwartz, Woloshin, and Welch (1999, p. 128) explain, sensing that an article has incomplete or undisclosed data can give the impression of "an underlying attempt to persuade rather than inform." Perceived intention to persuade in turn can lower trust and credibility ratings (Hovland, Janis, & Kelley, 1959; Kohring & Matthes, 2007).

People have heuristics for assessing the credibility of information even when it is not fully understood (Chaiken & Maheswaran, 1994). Potentially, lay audiences evaluate the quality of scientific research claims in news articles by recognizing the inclusion (or omission) of ambivalent language, caution surrounding claims, and specific data to support conclusions. Indeed, a study by Dahlstrom, Dudo, and Brossard (2012) found that audiences give more weight to scientific stories about health risks when precise information is included, defined as "specificity of information about a risk's pervasiveness, potency, or effects" (p. 156).

Elimination of uncertainty can happen at many stages of the research communication process. Journalists may assume audiences prefer streamlined health information (Allan, 2011). Potentially, the belief is that powerful

(i.e., certain) language will enhance trust in the communicator or in health research in general, and thus promote positive health beliefs and behaviors. Yet, as Dorothy Nelkin (1996, p. 1601) wrote, "Scientists, eager to promote their latest breakthrough, contribute to hyperbole" as well. Scientists may speak in overly certain terms about their research out of a belief that it will enhance their credibility or increase support from the public and decision-makers for their work (Star, 1983). Public relations professionals may further remove uncertainty as the information goes from journal article to press release (Nelkin, 1996).

Attempts to present research in a saleable way may be misguided. Although powerful language appears to heighten credibility in other contexts, such as business (Ober, Zhao, Davis, & Alexander, 1999) and public speaking (see Hosman, 2002), the effect might not hold when presenting health and medical research (Jensen, 2008). In fact, scholars have argued that using powerless language in science communication is a demonstration of objectivity (Popper, 1934/2002), which could in turn reflect on scientists' credibility. Potentially, a similar pattern would hold for science journalists, as well.

In light of prior research, we predict the following about uncertainty in news coverage of scientific studies:

H1a: Cancer news reports that include a higher amount of scientific uncertainty will associate with greater perceived credibility of the *journalist*, compared with low-uncertainty coverage.

H1b: Cancer news reports that include a higher amount of uncertainty will associate with greater perceived credibility of the *scientist* leading the study, compared with low-uncertainty coverage.

Source of Uncertainty

When journalists do include uncertainty in reports of scientific research, it is often by way of a counter point of view from an expert or scientist unaffiliated with the study. Casting a "balanced" view is a basic principle of newswriting, and seeking outside commentary is a common and generally constructive practice in journalism (Bennett, 1996). However, whether news audiences associate this kind of balance with quality or credibility may be context dependent (Jensen, 2008). In science reporting, the balance frame may have unintended consequences, giving the impression that the original scientists behind the study are ignorant of—or even attempting to mask—limitations in their research (Jensen, 2008). Additionally, it may create the appearance that scientists in the scientific community are pitted against each other and lack accordance on health research, even when this is not the case (Allan, 2011).

Some have suggested that the news media incorporate fringe counter-perspectives for the sake of sensationalism or to force balance where none exists (Dixon & Clarke, 2013). Journalists have been accused of treating discussions of scientific breakthroughs like "football matches" and giving equal weight to opposing viewpoints without scrutinizing the evidence behind them (Allan, 2011, p. 773). Onora O'Neill (2004, p. 269) writes that news consumers hear about highly publicized cases of "scandals, dereliction, cover up and even corruption in medicine and biomedical research"—some of which is founded, she says, but most of it is not. This suggests an already existing, biased lens through which news audiences may be processing news reports about scientific discoveries (Chingching, 2015). The dueling frame—disclosures of scientific uncertainty from an outside source, instead of the primary scientist responsible for the study—could further impact perceptions of scientist credibility. Regardless of whether the aim is to create an appearance of conflict and heighten a story's sensation value or simply to employ a balanced frame, we predict that source attribution of uncertainty will impact credibility:

> H2a: Limitations disclosed by the primary scientist, as opposed to an outside scientist, will lead to greater perceived credibility of the *journalist*.
>
> H2b: Limitations disclosed by the primary scientist, as opposed to an outside scientist, will lead to greater perceived credibility of the primary *scientist*.

Potentially, amount of uncertainty and source attributions interact to influence credibility judgements. Jensen (2008) found a small but significant interaction between amount and source of uncertainty such that greater uncertainty, when attributed to the primary scientist, increased credibility ratings for the journalist and the scientist. In the current study, we test whether the same uncertainty amount source interaction emerges with updated credibility measures and a population more representative of the general public.

> H3a: A high amount of uncertainty attributed to the primary scientist, as opposed to an outside scientist, will lead to greater perceived credibility of the *journalist*.
>
> H3b: A high amount of uncertainty attributed to the primary scientist, as opposed to an outside scientist, will lead to greater perceived credibility of the *scientist*.

Support for Scientific Research

Both uncertainty and perceived credibility could be related to public support for science. First, past research has shown that the communication of scientific uncertainty is related to public engagement with science (Retzbach & Maier, 2015; Retzbach, Otto, & Maier, 2016). If uncertainty is related to engagement with science, then it stands to reason that it could also be connected to support for the scientific enterprise. Moreover, support for scientific research seems to be relatively high. As an illustration, the National Science Foundation administers a survey every two years to assess US public opinion about the federal funding of scientific research. The survey has found Americans to be generally supportive of scientific research; most recently, 83% of Americans agreed or strongly agreed that the federal government should support scientific research that advances the frontiers of knowledge, even if it does not bring immediate benefits (National Center for Science and Engineering Statistics, 2014). Given that the majority of the public likely hears about scientific research through the news, perceptions of credibility in news coverage of health research could influence public support for science. This has not previously been examined. Thus, we investigate the following:

> RQ1: Is there a relationship among how scientific uncertainty is disclosed in the news, perceived credibility, and support for science?

Method

Design

Participants were randomly assigned to one of 16 conditions in a 2 (uncertainty amount) × 2 (uncertainty source) × 4 (cancer news article) between-subjects experiment. The amount of uncertainty was either high or low. The source of uncertainty was either the primary scientist (the scientist responsible for the study described in the article) or an outside scientist (a scientist unaffiliated with the study). Four different news articles were manipulated on these variables. Individuals completed a pretest, read a single news article, and then completed a posttest. Participants were paid $10 for participating in the study.

Sample. Participants ($N = 880$) were recruited in seven shopping malls in the Midwest and randomly assigned to one of the 16 news article conditions. Jensen's (2008) initial study surveyed a convenience sample of college students and was considered to be a starting point for further research. Participants in the present study represent a greater diversity of educational backgrounds and thus may be more representative of the US population. Participants provided demographic information, including

age ($M = 35.92$, $SD = .16$; range: 18–84), sex (female: 66.10%), education (more than 12th grade: 53.30%), and race (83.2% Caucasian, 11.7% African American, 3.1% Hispanic, Latino, or Spanish Origin, 1.0% Asian or Pacific Islander, 1.8% American Indian or Native American, and 2.3% self-described as "other"; participants could check more than one category). The mean household income was $51,769 ($SD = $42,954).

Stimulus materials. All participants randomly received a news article on one of four cancer research topics embedded within a survey. Survey questions were the same for all participants. The article was manipulated to represent one of four possible uncertainty conditions: low-uncertainty/primary scientist disclosure, high-uncertainty/primary scientist disclosure, low-uncertainty/dueling disclosure, high-uncertainty/dueling disclosure. Disclosure refers to uncertainty addressed by the scientist affiliated with the study (the primary scientist), while dueling refers to uncertainty addressed by an unaffiliated scientist.

Stimulus articles were developed by Jensen (2008) and involved the manipulation of real news articles gathered from the Lexis Nexis database. Search parameters included: US news articles from major papers or Midwest regional sources that contained "cancer research" or "cancer study" in the headline, lead paragraph(s), or key terms (Jensen, 2008). Using a random number generator, four articles were selected from these search results for inclusion in the study: two articles pertaining to research about cancer treatments (nanobombs, lung cancer treatment) and two pertaining to research in cancer prevention (Mediterranean diet, lycopene pills). See appendix for the full stimulus materials.

Survey Measures

Journalist credibility. After reading the article, participants were asked to evaluate the journalist's credibility. Journalist credibility was treated as a single second-order factor measured by nine items (accurate, honest, believable, balanced, report the whole story, objective, up-to-date, current, and timely; $M = 3.47$, $SD = .60$, $\alpha = .88$) using a five-point scale ranging from *strongly disagree* to *strongly agree* (Yale et al., 2015). These nine items were originally argued to represent the first-order factors of honesty, balance, and currency, but discriminant validity issues suggest that—when used together in the same analysis—they should be combined into a single scale (Yale et al., 2015). In other words, researchers have the option to use a single measure of credibility (all nine items combined) or to investigate hypotheses about a single first-order factor separately (e.g., an analysis that just includes the items representing the first-order factor of honesty). The current study utilizes the full scale, and also tests hypotheses related to the honesty factor ($M = 3.57$, $SD = .65$, $\alpha = .80$).

Scientist credibility. Participants were also asked to evaluate the primary scientist in the article. Expert source credibility has two underlying dimensions: expertise (intelligent, expert, competent; $M = 3.65$, $SD = .68$, $\alpha = .83$) and trustworthiness (trustworthy, honest, ethical; $M = 3.48$, $SD = .68$, $\alpha = .83$). These six items were assessed on five-point scales ranging from *strongly disagree* to *strongly agree* (McCroskey & Teven, 1999). Although McCroskey and Teven (1999) proposed "goodwill" as a third dimension of credibility, Jensen (2008) argued that goodwill is a separate construct and did not include it in the credibility scale used in his 2008 study. It was not included in the present study.

Support for scientific research. Participants were also asked about level of support for scientific research in general. Specifically, they reported how much they agree with the following statement: "Even if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the Federal Government." Answers were given on a four-point scale ranging from *strongly disagree* to *strongly agree* ($M = 3.09$, $SD = .87$). This single-item measure comes from the Science and Engineering Indicators of the National Science Foundation, published by the National Center for Science and Engineering Statistics (NCSES, 2014).

Power analysis. G*Power was used to calculate power for the design (Faul, Erdfelder, Buchner, & Lang, 2009). Past studies have found small effects (Jensen, 2008; Jensen et al., 2011a). For a three-way ANOVA with 16 cells, the design was adequately powered (.84) to detect a small effect ($f = .10$). That said, researchers should be mindful of both Type I and Type II error when searching for small effects. Type I error is guarded against via replication. Type II error is countered by focusing on effect size rather than relying heavily on the p-value logic of null hypothesis testing.

Results

Five three-way ANOVAs were conducted to test hypotheses H1a–H3b and RQ1. Uncertainty and source were fixed factors and news article was treated as a random factor (per Jackson & Brashers, 1994). News article was treated as random as the variation on that factor (i.e., 4 random news articles) represents natural variability rather than specific levels of interest (Jackson & Brashers, 1994).

The first ANOVA included the single dimension journalist credibility measure from Yale and colleagues (2015) as the outcome variable to test H1a, H2a, and H3a. The small uncertainty × source interaction found in previous research manifested once again, $F(1, 3.15) = 6.44$, $p = .081$. No other factors or interactions were significant (see Table 8.1). Consistent with Jensen (2008), participants in the high uncertainty/primary scientist disclosure condition perceived journalists as more credible than did their peers

in the low uncertainty/primary scientist condition (size of the effect between conditions: $r = .10$; for means and standard deviations, see Table 8.2).

As a follow-up analysis, a second ANOVA was carried out using only the credibility items representing the subdimension of honesty. Using an older measure, Jensen (2008) found a significant uncertainty × source interaction for trustworthiness. Consistent with the first ANOVA and with Jensen (2008), the follow-up ANOVA revealed a small uncertainty × source interaction, $F(1, 3.18) = 7.58$, $p = .066$. Once again, the high uncertainty/primary scientist condition correlated with higher journalist honesty ratings compared to the low uncertainty/primary scientist condition (size of the effect between conditions: $r = .10$; for means and standard deviations, see Table 8.3).

H1b, H2b, and H3b postulated that high uncertainty disclosed by the primary scientist would also link with higher trustworthiness ratings for the primary scientist. The credibility of experts is thought to have two underlying dimensions: trustworthiness and expertise. Two ANOVAs were conducted, one with trustworthiness as an outcome and the other with expertise as an outcome. No significant main effects or interactions were observed (see Table 8.1).

Table 8.1 ANOVA Results by Outcome Variable

	Journalist's Credibility	*Journalist's Trustworthiness*	*Scientist's Trustworthiness*	*Scientist's Expertise*	*Support for Research*
Uncertainty	1.15	3.28	.00	1.25	.01
Source	.06	.02	.10	1.53	.69
Article	5.69†	4.35	.81	5.66**	4.06
Uncertainty × Source	6.44†	7.58†	.04	.15	.16

Note: *F*-ratios for all main effects and the uncertainty × source interaction.

†$p < .10$ **$p < .01$

Table 8.2 Uncertainty × Source Attribution Interaction on Journalist's Credibility

	Disclosure	*Dueling*
High Uncertainty	3.52 (.56)	3.47 (.52)
Low Uncertainty	3.41 (.62)	3.48 (.68)

Note: Means and standard deviations (in parentheses). Post-hoc tests reveal that high uncertainty disclosure is significantly different than low uncertainty disclosure ($p < .05$). No other means are significantly different.

Table 8.3 Uncertainty × Source Attribution Interaction on Journalist's Trustworthiness

	Disclosure	*Dueling*
High Uncertainty	3.63 (.62)	3.52 (.58)
Low Uncertainty	3.50 (.68)	3.56 (.72)

Note: Means and standard deviations (in parentheses). Post-hoc tests reveal that high uncertainty disclosure is significantly different than low uncertainty disclosure ($p < .05$). No other means are significantly different.

Using four different cancer news articles in the present experiment allowed us to generalize across articles. We were not interested in whether one topic generated more perceived credibility than another, but whether our factors would generalize above and beyond the variance that could be attributed to a particular article. The observed interaction in the high uncertainty by primary scientist condition occurred across all four articles.

RQ1 asked if uncertainty and source attribution were related to support for scientific research. No significant main effects or interactions were observed (see Table 8.1).

Discussion

Journalists are trusted as key translators of scientific research for the public. The news is an especially important avenue for educating people about cancer and other major health risks (Dudo, Dahlstrom, & Brossard, 2007; Jensen et al., 2013; Stryker et al., 2008). Yet current norms in news coverage of health research could systematically lower public trust in these reports. For example, journalists frequently minimize uncertainty when reporting scientific findings. They may alternatively disclose it in a dueling frame by soliciting comments from an outside source instead of the scientists responsible for the study (Jensen, 2008).

Using updated news credibility measures (Yale et al., 2015), the present experiment found that amount and source of uncertainty in cancer news articles significantly impacted audience perceptions of journalist credibility. Specifically, participants found the journalist more credible and trustworthy when the story contained a *higher* amount of uncertainty attributed to the *primary* scientist. The observed effect was small but significant and held across all four different cancer news articles. This suggests that the effect occurs systematically and was not due to features of a particular article or cancer topic.

The same conditions may affect credibility judgments for scientists, though it was not apparent in the current study. Jensen (2008) did find that high uncertainty disclosed by the primary scientist led to higher

credibility ratings of both the journalist and the scientist. Thus, our study only partially replicates Jensen's earlier findings. Potentially, source and amount of uncertainty did not impact scientist credibility in our study because there are better measures that should be used to assess lay perceptions of scientist credibility (e.g., a scale specific to scientists). There is also the possibility of a small drip effect. Media effects are typically modest and often conceptualized as cumulative (Jensen, Bernat, Wilson, & Goonwardene, 2011b). Thus, subtle effects that are imperceptible during a single exposure can produce larger effects over time. It could be that omitting uncertainty in scientific news coverage, or disclosing it by way of a dueling frame, steadily undercuts journalists' credibility.

Public Health Implications

Public understanding of health is in jeopardy when journalists present medical discoveries as being more definite than they actually are (Allan, 2011; Schwartz, Woloshin, & Welch, 1999; Thiebach, Mayweg-Paus, & Jucks, 2015). To do so can "convey a false sense of the magnitude and certainty of the benefits of interventions, engendering unrealistic expectations" (Schwartz, Woloshin, & Welch, 1999, p. 131). Unhedged depictions of health risks, meanwhile, can cause undue fear (Schwartz, Woloshin, & Welch, 1999) and lead to fatalistic beliefs (Jensen et al., 2011a).

Minimizing scientific uncertainty could also increase skepticism in science and medicine. Past research has suggested that streamlining (e.g., reducing the amount of uncertainty) may set up research-based recommendations for backlash or rejection (Jensen et al., 2013). Communicating in certain terms about health and medical discoveries may create public confusion and even controversy by making the findings from multiple studies appear contradictory. A survey for the World Cancer Research Fund (WCRF) found that more than half of respondents believed "scientists were always changing their minds" about cancer causes and preventive measures (BBC, 2009). Indeed, sometimes news outlets report, seemingly back to back, that the very same things can cause cancer and cure it (Anderson, Brossard, & Scheufele, 2010). These apparent extremes are likely, at times, to be the result of streamlined study conclusions and omitted caveats. Disclosure of uncertainty in a dueling frame could also be a cause.

In view of the results of this and prior studies, it seems that lay audiences have come to interpret unhedged research claims as an indicator that the journalist or the scientist is overstating study findings. This, in turn, could harm trust in these important sources of health information. Several scholars have noted that trust in sources of risk information influences how people respond to reported risks (Malka, Krosnick, & Langer, 2009; Priest, Bonfadelli, & Rusanen, 2003; Siegrist, Connor, & Keller, 2012).

In the Context of an Evolving Media Environment

Because the news media have a latent influence on audience perceptions (Arendt, 2010), it is vital to examine connections among health risk perceptions, trust in information sources (e.g., scientists and journalists), and norms in science reporting (Jensen, 2008; Dahlstrom, Dudo, & Brossard, 2012). The current study examined print news articles. Although newspapers have garnered higher trust ratings than other news platforms in past research (Kiousis, 2001), the majority of Americans (57%) prefer to get their news from TV, followed by 38% who prefer online; only 20% get most of their news in print, according to a Pew Research Survey (Mitchell, Gottfried, Barthel, & Shearer, 2016). Nonetheless, examining trust in print news remains important, and findings from our study likely pertain to audience trust in TV, radio, and online news domains. Kiousis (2001) suggested that layers of news credibility—the news content, the journalist, the outlet, and the media platform—are intertwined. News consumers' criteria for assessing credibility may be constant across platforms and judgements of credibility may permeate across news media layers.

Growing concerns about fake news—fictional news stories circulated online (Barthel, Mitchel, & Holcomb, 2016)—could heighten audience skepticism toward news media. Roughly two-thirds of US adults who responded to a Pew Research Center survey claimed that fake news has caused a great deal of confusion about current events (Barthel, Mitchel, & Holcomb, 2016). This could signal an era in which journalists must strive harder to win audience trust. Careful reporting of cancer and other health risk research is an important area for consideration.

Limitations and Future Directions

The current study had a number of limitations. First, the length of the articles could have influenced perceptions of credibility. Articles in the high uncertainty conditions were one or two paragraphs longer. Potentially, some readers make heuristic judgments that more information is more trustworthy (although, longer articles in the high uncertainty/dueling conditions did not increase journalist credibility ratings). Second, the study only examined the impact of exposure to a single news article. Given the small but consistent significant effect, and the possibility that true impacts of exposure manifest cumulatively, it may be worthwhile for media effects scholars to study the effects of uncertainty disclosure with longitudinal study designs. Research should also continue to investigate how norms in news coverage impact scientist credibility, especially given the observed effect on journalist credibility.

Conclusion

Despite its limitations, this study makes an important contribution to credibility measurements. It replicated one major finding from Jensen (2008) with a diverse US sample that may be more representative of the population. Our results add to those of Jensen (2008) to indicate that amount of scientific uncertainty and source attributions can influence public trust in journalists. The results of our study indicate that lay audiences recognize a certain degree of uncertainty is inherent in the scientific process and in turn place greater trust in hedged research reports (or the journalists who write them).

While media are not always "exaggerating risk, whipping up hysteria and distorting reality" (Kitzinger, 1999, p. 55), this may be the perception among audiences. To counter skepticism and unintentional biases, journalists may consider which reporting practices, such as including scientific uncertainty in research reports, will foster favorable credibility judgements for both journalists and potentially also scientists.

References

Abdulla, R., Garrison, B., Salwen, M., Driscoll, P., & Casey, D. (2005). Online news credibility. In M. Salwen, B. Garrison, & P. Driscoll (Eds.), *Online news and the public*. Mahwah, NJ: Lawrence Erlbaum Associates.

Allan, S. (2011). Introduction: Science journalism in a digital age. *Journalism: Theory, Practice and Criticism*, *12*(7), 771–777.

Anderson, A. A., Brossard, D., & Scheufele, D. A. (2010). The changing information environment for nanotechnology: Online audiences and content. *Journal of Nanoparticle Research*, *12*(4), 1083–1094.

Arendt, F. (2010). Cultivation effects of a newspaper on reality estimates and explicit and implicit attitudes. *Journal of Media Psychology*, *22*(4), 147–159.

Atkin, C. K., & Wallack, L. (1990). *Mass communication and public health: Complexities and conflicts* (Vol. 121). Newbury Park, CA: SAGE Publications.

Barthel M., Mitchel, A., & Holcomb, J. (2016). Many Americans believe fake news is sowing confusion. Pew Research Center. Available from www.journalism.org/2016/12/15/many-americans-believe-fake-news-is-sowing-confusion (accessed on March 23, 2017).

BBC (2009, May 24). Britons "wary over cancer advice." Available from http://news.bbc.co.uk/2/hi/health/8059223.stm (accessed on December 15, 2015).

Bender, J. R., Drager, M. W., Davenport, L., & Fedler, F. (2009). *Reporting for the media* (9th ed.). New York: Oxford University Press.

Bennett, W. L. (1996). An introduction to journalism norms and representations of politics. *Political Communication*, *13*, 373–384.

Binder, A. R., Hillback, E. D., & Brossard, D. (2016). Conflict or caveats? Effects of media portrayals of scientific uncertainty on audience perceptions of new technologies. *Risk Analysis*, *36*(4), 831–846.

Chaiken, S., & Maheswaran, D. (1994). Heuristic processing can bias systematic processing: Effects of source credibility, argument ambiguity, and task importance on attitude judgment. *Journal of Personality and Social Psychology*, *66*(3), 460–460.

Chingching, C. (2015). Motivated processing: How people perceive news covering novel or contradictory health research findings. *Science Communication*, *37*(5), 602–634.

Dahlstrom, M. F., Dudo, A., & Brossard, D. (2012). Precision of information, sensational information, and self-efficacy information as message-level variables affecting risk perceptions. *Risk Analysis*, *32*(1), 155–166.

Dixon, G. N., & Clarke, C. E. (2013). Heightening uncertainty around certain science: Media coverage, false balance, and the autism-vaccine controversy. *Science Communication*, *35*(3), 358–382.

Dudo, A. D., Dahlstrom, M. F., & Brossard, D. (2007). Reporting a potential pandemic: A risk-related assessment of avian influenza coverage in U.S. newspapers. *Science Communication*, *28*(4), 429–454.

Earle, T. C., & Siegrist, M. (2006). Morality information, performance information, and the distinction between trust and confidence. *Journal of Applied Social Psychology*, *36*(2), 383–416.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160.

Gaziano, C., & McGrath, K. (1986). Measuring the concept of credibility. *Journalism Quarterly*, *63*(3), 451–462.

Groot Kormelink, T., & Costera Meijer, I. (2015). Truthful or engaging? Surpassing the dilemma of reality versus storytelling in journalism. *Digital Journalism*, *3*(2), 158–174.

Guenther, L., Froehlich, K., & Ruhrman, G. (2015). (Un)Certainty in the news: Journalists' decisions on communicating the scientific evidence of nanotechnology. *Journalism & Mass Communication Quarterly*, *92*(1), 199–220.

Guenther, L., & Ruhrman, G. (2016). Scientific evidence and mass media: Investigating the journalistic intention to represent scientific uncertainty. *Public Understanding of Science*, *25*(8), 927–943.

Hendriks, F., Kienhues, D., & Bromme, R. (2016a). Disclose your flaws! Admission positively affects the perceived trustworthiness of an expert blogger. *Studies in Communication Science*, *16*(2), 124–131.

Hendriks, F., Kienhues, D., & Bromme, R. (2016b). Evoking vigilance: Would you (dis)trust a scientist who discusses ethical implications of research in a science blog? *Public Understanding of Science*, *25*(8), 992–1008.

Hosman, L. A. (2002). Language and persuasion. In J. P. Dillard & M. Pfau (Eds.), *The persuasion handbook: Developments in theory and practice*. Thousand Oaks, CA: SAGE Publications.

Hovland, C. I., Janis, I. L., & Kelley, H. (1959). *Communication and persuasion: Psychological studies of opinion change* (3rd ed.). New Haven, CT: Yale University Press.

Hyland, K. (1996). Writing without conviction? Hedging in science research articles. *Applied Linguistics*, *17*(4), 433–454.

Jackson, S., & Brashers, D. E. (1994). *Random factors in ANOVA*. Thousand Oaks, CA: SAGE Publications.

Jensen, J. D. (2008). Scientific uncertainty in news coverage of cancer research: Effects of hedging on scientists' and journalists' credibility. *Human Communication Research*, *34*(3), 347–369.

Jensen, J. D., Carcioppolo, N., King, A. J., Bernat, J. K., Davis, L., Yale, R., & Smith, J. (2011a). Including limitations in news coverage of cancer research: Effects of news hedging on fatalism, medical skepticism, patient trust, and backlash. *Journal of Health Communication*, *16*(5), 486–503.

Jensen, J. D., Bernat, J. K., Wilson, K., & Goonwardene, J. (2011b). The delay hypothesis: The manifestation of media effects over time. *Human Communication Research*, *37*, 509–528.

Jensen, J. D., Krakow, M., John, K. K., & Liu, M. (2013). Against conventional wisdom: When the public, the media, and medical practice collide. *BMC Medical Informatics and Decision Making*, *13* (Suppl 3), S4.

Jensen, J. D., Scherr, C. L., Brown, N., Jones, C., Christy, K., & Hurley, R. J. (2014). Public estimates of cancer frequency: Cancer incidence perceptions mirror distorted media depictions. *Journal of Health Communication*, *19*, 609–624.

Jensen, J. D., Pokharel, M., Scherr, C. L., King, A. J., Brown, N., & Jones, C. (2017). Communicating uncertain science to the public: How amount and source of uncertainty impact fatalism, backlash, and overload. *Risk Analysis*, *37*(1), 40–51.

Johnson, J. D. (1997). *Cancer-related information seeking*. Cresskill, NJ: Hampton Press.

Kimmerle, J., Flemming, D., Feinkohl, I., & Cress, U. (2015). How laypeople understand the tentativeness of medical research news in the media: An experimental study on the perception of information about deep brain stimulation. *Science Communication*, *37*(2), 173–189.

Kiousis, S. (2001). Public trust or mistrust? Perceptions of media credibility in the information age. *Mass Communication & Society*, *4*(4), 381–403.

Kitzinger, J. (1999). Researching risk and the media. *Health, Risk & Society*, *1*(1), 55–69.

Kohring, M., & Matthes, J. (2007). Trust in news media development and validation of a multidimensional scale. *Communication Research*, *34*(2), 231–252.

Kovach, B., & Rosenstiel, T. (2007). *The elements of journalism: What newspeople should know and the public should expect*. New York: Three Rivers Press.

Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis*, *29*(5), 633–647.

McCroskey, J. C., & Teven, J. J. (1999). Goodwill: A reexamination of the construct and its measurement. *Communications Monographs*, *66*(1), 90–103.

McCroskey, J. C., & Young, T. J. (1981). Ethos and credibility: The construct and its measurement after three decades. *Communication Studies*, *32*(1), 24–34.

Meyer, P. (1988). Defining and measuring credibility of newspapers: Developing an index. *Journalism & Mass Communication Quarterly*, *65*(3), 567–574.

Mitchell, A., Gottfried, J., Barthel, M., & Shearer, E. (2016). The modern news consumer: News attitudes and practices in the digital era. Pew Research Center. Available from www.journalism.org/2016/07/07/the-modern-news-consumer (accessed on March 23, 2017).

National Center for Science and Engineering Statistics (NCSES). (2014). *Science and Engineering Indicators*. Available from www.nsf.gov/statistics/seind14/index.cfm/chapter-7/c7s3.htm (accessed on December 14, 2015).

Nelkin, D. (1996). An uneasy relationship: The tensions between medicine and the media. *The Lancet*, *347*(9015), 1600–1603.

Niederdeppe, J., Lee, T., Robbins, R., Kim, H. K., Kresovich, A., Kirshenblat, D., Standridge, K., Clarke, C. E., Jensen, J. D., & Fowler, E. F. (2014). Content and effects of news stories about uncertain cancer causes and preventive behaviors. *Health Communication*, *29*, 332–346.

Ober, S., Zhao, J. J., Davis, R., & Alexander, M. W. (1999). Telling it like it is: The use of certainty in public business discourse. *Journal of Business Communication*, *36*(3), 280–296.

O'Neill, O. (2004). Accountability, trust and informed consent in medical practice and research. *Clinical Medicine*, *4*(3), 269–276.

Peters, H. P., & Dunwoody, S. (2016). Scientific uncertainty in media content: Introduction to this special issue. *Public Understanding of Science*, *25*(8), 893–908.

Popper, K. (2002). *The logic of scientific discovery*. New York: Routledge. (Originally published in 1934)

Post, S., & Maier, M. (2016). Stakeholders' rationales for representing uncertainties of biotechnological research. *Public Understanding of Science*, *25*(8), 944–960.

Priest, S. H., Bonfadelli, H., & Rusanen, M. (2003). The "trust gap" hypothesis: Predicting support for biotechnology across national cultures as a function of trust in actors. *Risk Analysis*, *23*(4), 751–766.

Retzbach, A., & Maier, M. (2015). Communicating scientific uncertainty: Media effects on public engagement with science. *Communication Research*, *42*(3), 429–456.

Retzbach, J., Otto, L., & Maier, M. (2016). Measuring the perceived uncertainty of scientific evidence and its relationship to engagement of science. *Public Understanding of Science*, *25*(6), 638–655.

Reyna, V. F. (1981). The language of possibility and probability: Effects of negation on meaning. *Memory & Cognition*, *9*(6), 642–650.

Schwartz, L. M., Woloshin, S., & Welch, H. G. (1999). Risk communication in clinical practice: Putting cancer in context. *Journal of the National Cancer Institute Monographs*, *25*(1), 124–133.

Siegel, R. L., Miller, K. D., & Jemal, A. (2015). Cancer statistics, 2015. *CA: A Cancer Journal for Clinicians*, *65*(1), 5–29.

Siegrist, M., Connor, M., & Keller, C. (2012). Trust, confidence, procedural fairness, outcome fairness, moral conviction, and the acceptance of GM field experiments. *Risk Analysis*, *32*(8), 1394–1403.

Sjöberg, L. (2001). Limits of knowledge and the limited importance of trust. *Risk Analysis*, *21*(1), 189–198.

Star, S. L. (1983). Simplification in scientific work: An example from neuroscience research. *Social Studies of Science*, *13*, 205–228.

Stryker, J. E., Moriarty, C. M., & Jensen, J. D. (2008). Effects of newspaper coverage on public knowledge about modifiable cancer risks. *Health Communication*, *23*(4), 380–390.

Thiebach, M., Mayweg-Paus, E., & Jucks, R. (2015). "Probably true" says the expert: How two types of lexical hedges influence students' evaluation of scientificness. *European Journal of Psychology of Education*, *30*(3), 369–384.

Yale, R. N., Jensen, J. D., Carcioppolo, N., Sun, Y., & Liu, M. (2015). Examining first- and second-order factor structures for news credibility. *Communication Methods and Measures*, *9*(3), 152–169.

West, M. D. (1994). Validating a scale for the measurement of credibility: A covariance structure modeling approach. *Journalism Quarterly*, *71*(1), 159–168.

Winter, S., Kramer, N. C., Rosner, L. & Neubaum, G. (2015). Don't keep it (too) simple: How textual representations of scientific uncertainty affect laypersons' attitudes. *Journal of Language and Social Psychology*, *34*(3), 251–272.