

DISSERTATION

CONFLICTING HEALTH-RELATED SCIENTIFIC EVIDENCE IN NEWS REPORTS:
EFFECTS OF PRESENTATION FORMAT AND HEDGING ON PERCEIVED ISSUE
UNCERTAINTY AND SOURCE CREDIBILITY

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In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

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Summer 2016

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ABSTRACT

CONFLICTING HEALTH-RELATED SCIENTIFIC EVIDENCE IN NEWS REPORTS: EFFECTS OF PRESENTATION FORMAT AND HEDGING ON PERCEIVED ISSUE UNCERTAINTY AND SOURCE CREDIBILITY

This study examined the effects of two journalistic practices in reporting conflicting health-related scientific evidence on journalists' and scientists' credibility and whether the effects were mediated by perceived issue uncertainty. The two practices examined were presentation format and hedging. When conflicting findings are reported, journalists can use either a one-article format, using one story to report the conflict, or a two-article format, using two stories with each story representing one side of the conflict. When conflicting findings are reported, journalists can use hedging (e.g., reporting the limitations of scientific studies) to present the conflicting information. An online experiment was conducted to examine the two journalistic practices' effects. Results include the following: 1) the one-article format was beneficial to journalists' competence, but detrimental to scientists' competence, as compared with the two-article format; 2) journalists' and scientists' credibility in the hedged news conditions did not differ from those in the non-hedged news conditions; and 3) perceived issue uncertainty did not mediate presentation format's or hedging's effects on journalists' or scientists' credibility. An exploratory follow-up mediation analysis found that perceived message believability mediated presentation format's effects on journalists' and scientists' credibility. Theoretical, practical, and methodological implications are discussed.

ACKNOWLEDGEMENTS

Writing a dissertation is like free diving, an activity you don't do unless you really want it because you leave behind your loved ones to do it. It is risky because not every diver is able to resurface despite systematic training from previous years; it is rewarding because divers get to explore their self-limits, physically and mentally. The successful dive is not solely this diver's time, toil, and tenacity, but also contribution of a great many people. I thank these people for preparing, propelling, and protecting me.

My advisor, Marilee Long. Thank you for reading my originally 200-to-300-page draft multiple times, offering advice that helped me improve my dissertation, inculcating attention to details in research and writing, having visions for ideas that initially seemed like they would not work sometime soon, and working with me while I was in China. I also want to thank you for writing recommendation letters for me in short notices and opening up your end-of-the-semester schedule for my defense. Your patience, wisdom, and work ethics helped me finish the dissertation and overcome many other hurdles. I hope that one day I would become as good an advisor to my students as you have been to me.

My committee members, Ashley Anderson, Gene Gloeckner, Rosa Mikeal Martey, and Lorann Stallones. Thank you for serving on my committee. Ashley, thank you also for sharing your experience and writing recommendation letters for me while I was on the job market; Gene, thank you for the method course, recommendation letters, coffee breaks, and a boat ride on a beautiful lake off campus; Rosa, thank you also for giving me opportunity to work on your research projects, acknowledging my ideas in the projects, and supporting my professional development by sponsoring me to go to an international conference; and Lorann, thank you also for the public health seminar course.

My JTC fellows also contributed to this dissertation. Michael Humphrey, thank you for creating stimulus materials for my experiment. Darrell Blair, Daniela Castillo, Heidi Huntington, Sejin (Sage) Kim, Joanna Larez, Danielle Stomberg, Neelam Sharma, Stephanie Train, and Rhema Zlaten. Thank you for introducing my study to your students, who enabled me to complete data collection.

I also want to thank JTC professors who inspired me with their courses/workshops and/or their conversations with me during the last five years. They are Katie Abrams, Joe Champ, Cindy Christen, Kirk Hallahan, Jangyul Robert Kim, Kris Kodrich, Greg Luft, Patrick Lee Plaisance, Donna Rouner, Pete Seel, Jamie Switzer, and Craig Trumbo.

This dissertation would not have been possible without Chuchang Chiu, Paola Malpezzi Price, and Mary Vogl for selecting me as a Fulbright FLTA to come to CSU in the first place. Thank you for believing in me and supporting me continuously over the years.

I thank my friends, Barbara, Phil, and Ufer, for shining the darkest moments of my “dive” with food, music, and hikes. I also learned a lot from you. I also want to thank TJ for being a loyal best friend, even when we were over 7,000 miles apart.

I am also thankful for CSU Rec Center’s pool. Swimming and occasional pool diving there made me stronger and more resilient to tackle the next obstacle the dissertation study had in store for me.

My bàba and m ā ma receive my deepest gratitude for their love and support. It is their many years of dedication that ensured me the education needed for the dissertation. This dissertation is dedicated to you.

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CHAPTER 1. INTRODUCTION

We all need health-related science to make effective decisions in our lives. Are the expected benefits of a medical procedure worth its risks? How should we regulate electronic cigarettes? Science is, potentially, the best source for evidence needed to answer these questions. Uncertainty often exists as part of scientific discoveries. Uncertain scientific evidence can present itself at least in two forms: conflicting findings and ambiguous findings.

This dissertation examines the effects of two journalistic practices used to report uncertain health-related scientific evidence on perceived issue uncertainty and credibility of journalists and scientists. The two practices examined were presentation format (one-article format vs. two-article format) and hedging (reporting study limitations vs. not reporting study limitations). When conflicting findings are reported, journalists can use either a balanced format, using one story to report the conflict, or use two article or stories to report the conflict with each story representing one side of the conflict. Hedging is one practice journalists use when they decide to report the limitations of scientific studies. When limitations are reported, scientific findings become ambiguous.

How people respond to news covering uncertain health-related information has implications for the public's understanding of science, trust in science and journalism, health-related behaviors, support for research, and risk perception (Binder, Hillback, & Brossard, 2015; Bromme & Goldman, 2014; Chang, 2015; Corbett & Durfee, 2004; Dixon & Clarke, 2013; Jensen, 2008; Jensen & Hurley, 2012; Kortenkamp & Basten, 2015; Nagler, 2014).

Studies suggest that people respond negatively to news covering conflicting findings. For example, people who reported greater media exposure to contradictory health messages for

topics such as red wine, fish, coffee, and vitamins/supplements experienced greater feelings of confusion and reported lower intention to comply with nutrition recommendations. These feelings of confusion, in turn, were associated with doubt in public health recommendations in general (Nagler, 2014). After exposure to news covering contradictory (as opposed to one-sided) research findings, people expressed higher uncertainty and more negative attitudes toward health research, which, in turn, reduced people's support for government funding for health research (Chang, 2015). More disconcertingly, mere exposure to news coverage of controversial health-related issues in general, regardless of whether it was in divergent or convergent form, provoked distrust in scientists (Jensen & Hurley, 2012).

The few studies on ambiguous scientific findings suggest that people respond positively to news containing ambiguous findings. For example, scientists and journalists were viewed as more trustworthy when news coverage of cancer research was hedged (i.e., study limitations were reported) and when the hedging was attributed to the scientists responsible for the research (as opposed to scientists unaffiliated with the research) (Jensen, 2008). People were less fatalistic about cancer and less prone to nutritional backlash after exposure to hedged news stories (Jensen, et al., 2011).

Past studies have examined how uncertain science should be reported in news stories. Corbett and Durfee (2004) examined whether adding contextual information in news reporting conflicting findings could influence people's perceived issue uncertainty. Dixon and colleagues (2015) examined whether an article can present conflicting views without causing misperceptions by including weight-of-evidence information. Kortenkamp and Basten (2015) examined whether discrediting one expert's viewpoint would minimize false perceptions of controversy. Dixon and Clarke (2013) examined responses to false-balanced news (vs. one-

sided). Chang (2015) also examined responses to news stories that cover contradictory (vs. one-sided) health research findings. Jensen and Hurley (2012) examined responses to news articles that were consistent (vs. contradictory). Binder and colleagues (2015) examined responses to news reporting conflicting and ambiguous expert opinions versus news reporting conflicting but precise expert opinions.

Past studies on hedging have focused on hedging's effects in various contexts. For example, a context where information overload about scientific studies exists (Jensen, 2008; Jensen et al., 2011), a context where interpretation statements of research results are involved (Durik et al., 2008), and a context where data statements of research results are involved (Durik et al., 2008). The present study extends this line of literature by examining hedging's effects on source credibility in a context where conflicting information occurs.

Informed by social and cognitive psychology literature (Allen, 1991; Bradac, Hemphill & Tardy, 1981; Smithson, 1999; Stadtler, Scharrer, Brummernhenrich, & Bromme, 2013) and empirical findings in science communication (Hmielowski, Feldman, Myers, & Maibach, 2013; Jensen & Hurley, 2012), the present study hypothesized the following: 1) message attributes (i.e., presentation format and hedging) have effects on source credibility; and 2) message attributes have indirect effects on source credibility via perceived issue uncertainty.

This dissertation intends to extend health and science communication literature in the following two aspects:

- examining effects of presentation format (one-article format vs. two-article format) on journalists' credibility and scientists' credibility; and
- examining the effects of hedging on journalists' credibility and scientists' credibility in a context where conflicting evidence occurs.

CHAPTER 2. LITERATURE REVIEW

This chapter consists of eight parts. First, I review conceptualization of uncertainty from relevant decision-making literature. Second, I define conflict, review origins of conflict in health-related information, prevalence of conflict in health-related news, and why health conflict matters; review empirical studies on news consumers' responses to conflicting health-related information; and conceptualize conflict presentation formats. Third, I conceptualize presentation format and review use of presentation format in news and effects of presentation format. Fourth, I conceptualize hedging, and review hedging in news media reports and empirical studies on news consumers' responses to hedged news coverage. Fifth, I review credibility literature. Sixth, I present theoretical frameworks about the two message attributes' direct and indirect effects on source credibility. Seventh, I present hypotheses. Eighth, I introduce potential covariates. Eighth, I introduce potential covariates.

2.1 Conceptualization of Uncertainty

In this section, I review the conceptualization of uncertainty from relevant decision-making literature. First, I provide an overview of uncertainty in various disciplines. Second, I review typologies of uncertainty from decision-making literature.

2.1.1 Uncertainty in Various Disciplines

Uncertainty has been approached in a variety of ways from various disciplines at different levels¹. At the individual level, scholars have addressed uncertainty in issues such as health risk (Frewer, Miles, Brennan, Kuznesof, Ness, & Ritson, 2002; Miles & Frewer, 2003; Powell, Dunwoody, Griffin, & Neuwirth, 2007), illness experience (Babrow, Kasch, & Ford, 1998; Brashers, 2001; Mishel, 1988), interpersonal communication (Berger, 1975; Weary, & Edwards, 1994; Brashers, 2001), insurance premium setting (Cabantous, 2007), and understanding of science (Corbett & Durfee, 2004; Dixon & Clarke, 2013; Jensen & Hurley, 2012; Retzbach, Retzbach, Maier, Otto, & Rahnke, 2013). At the organizational level, scholars have addressed uncertainty in issues such as organization management (Gifford, Bobbitt, & Slocum, 1979; Milliken, 1987) and emergency management (Handmer, 2008). At the societal level, scholars have addressed uncertainty in issues such as politics and policy making (Funtowicz & Ravetz, 1990; Linnerooth, 1984), national population forecasting (Keilman, 1990), and the impact of globalization on young adults' marriage and family behaviors (Blossfeld, Buchholz, & Hofäcker, 2006).

2.1.2 Typologies of Uncertainty

Uncertainty has been used both as a descriptor of the state of an issue or situation and as a descriptor of the state of a person who perceives himself/herself to be lacking in critical information about the issue or situation. The former implies that it is possible to characterize an issue or situation in terms of how objectively certain it is; the latter implies that uncertainty in an

¹For a multidisciplinary perspective of uncertainty, see **Uncertainty and risk: multidisciplinary perspectives** edited by Bammer and Smithson (2008).

issue or situation is inherently “in the eyes of the beholder” and thus should be studied as a perceptual phenomenon. The distinction between the two states can be illustrated by the example of a link between autism and vaccination. Epidemiological studies have found no evidence that there is a link between vaccines and autism (Plotkin, Gerber, & Offit, 2009; Taylor et al., 1999). However, some parents still feel uncertain about whether vaccinating their children will increase the likelihood of autism (Kennedy, LaVail, Nowak, Basket, & Landry, 2011). Similarly, while the long-term effects of e-cigarettes are not yet known (Polosa et al., 2011), people who have been using e-cigarettes to help them quit smoking may feel certain that this new product is safe.

The most cited conceptualizations of uncertainty in social science are from the literature in decision making theory in economics and psychology. Economist Frank H. Knight defines uncertainty as “un-measurable probability” which is distinctive from risk as “measurable probability” (Knight, 1921). Knight identifies a few situations where uncertainty occurs. For example, uncertainty occurs when a decision maker does not know the statistical frequencies of events relevant to his/her decision, or when probability is impossible to calculate ahead of time. Risk, however, applies to situations where we do not know the outcome of a given situation, but we can measure the odds. For Knight, uncertainty, on the other hand, applies to situations where we cannot know all the information we need to calculate the odds in the first place. In this sense, the definition of uncertainty adopted in economics is a narrow one.

Decision theory by psychologists adopts a broader definition of uncertainty. Smithson conceptualizes uncertainty as a type of ignorance (Smithson, 1989). In his taxonomy of ignorance (Figure 1), Smithson defines uncertainty as incompleteness of knowledge in degree and subdivides uncertainty into three categories: vagueness, ambiguity, and probability. In brief, vagueness refers to a range of possible values on a continuum; ambiguity refers to a finite

number of distinct possibilities; and probability refers to the laws of chance (Bammer & Smithson, 2008).

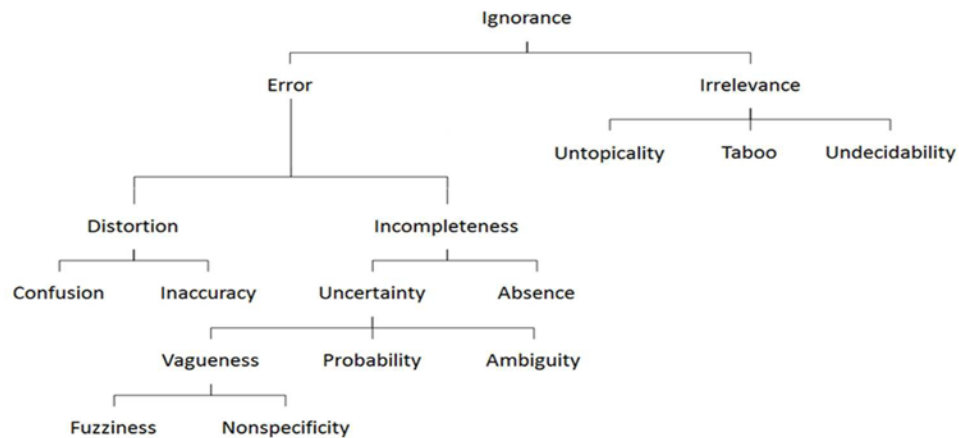


Figure 1. Smithson’s Typology of Ignorance (1989, p.18)

Vagueness, a multiplicity of possible values on a continuum, can be exemplified using an object whose color is blue (Smithson, 1989). An artist may distinguish between a warm blue and a cold blue; however, the exact place on the color continuum where this distinction occurs is not exact. Ambiguity, a finite number of possible states for a single object, is best demonstrated through a linguistic example (Smithson, 1989). To say that a food is hot does not clearly communicate whether "hot" refers to spiciness, temperature, the food being stolen, or the food being popular. Probability, the statistical likelihood of a future event, can be best illustrated by numerous tosses of a fair coin; the likely outcome is that half of the tosses will be heads and half will be tails (Smithson, 1989).

2.2 Conceptualization of Conflict as a Type of Uncertainty

In this section, I define conflict, present an example of conflict using two scientific studies, review why conflicting coverage occurs, review prevalence of scientific conflict in

health-related news, review why conflicting coverage matters, and review empirical studies on news consumers' responses to conflicting coverage.

2.2.1 Definition of Conflict

Conflict in this dissertation is conceptualized as one type of uncertainty. Uncertainty, according to Smithson's definition (1989), is incompleteness of knowledge regarding an issue or object. Smithson conceptualizes three types of uncertainty in his typology (1989): vagueness, probability, and ambiguity. Vagueness refers to a range of possible values of one state on a continuum. Vagueness uncertainty occurs when there is lack of specific knowledge. Probability refers to the laws of chance. Probability uncertainty occurs when there is lack of knowledge about the way an event happens when it is not planned or controlled. Ambiguity refers to a finite number of states. Ambiguity uncertainty occurs when there is lack of contextual knowledge to determine which of the finite states applies in a given situation. Ambiguity can be conflictive when two or more states cannot hold true simultaneously. For example, if one source informs me that coffee is good for my health and another source says coffee is bad for my health, then I will take this to be conflicting information if I do not believe coffee can be good and bad at the same time. Ambiguity can also occur when two or more states can hold true simultaneously, none of which conflict with one another. For example, the word "hot" in the sentence "The coffee is hot" could refer to all of the following meanings at the same time: high temperature, spiciness, and stolen drink.

In this dissertation, conflict is conceptualized as one type of ambiguity (Figure 2). Conflict uncertainty occurs when at least two states exist and the two states cannot hold true simultaneously.

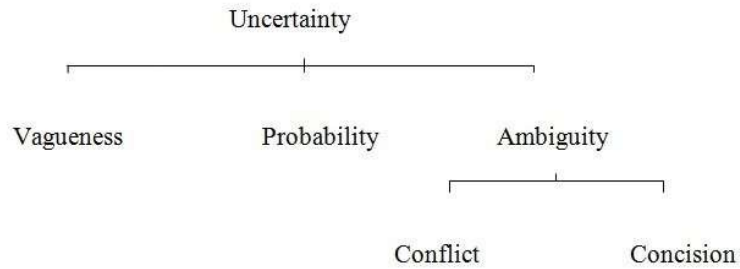


Figure 2. An Extended Typology of Uncertainty

2.2.2 An Example of Conflict

This section describes two studies (Brown, Beard, Kotz, Michie, & West, 2014; Grana, Popova, & Ling, 2014) published in medical journals in 2014. The two studies serve as the basis for stimulus materials for my dissertation.

Study 1 (Grana, Popova, & Ling, 2014) was an observational study using a national sample of current U.S. smokers. It found that electronic cigarette use at baseline was not associated with a change in cigarette consumption.

Study 2 (Brown, Beard, Kotz, Michie, & West, 2014), an observational study using a representative sample of the English population, found that electronic cigarettes dramatically boost smokers' chances of successfully quitting.

2.2.3 Prevalence of Scientific Conflict in Health-Related News

There is evidence that conflicting health-related messages exist in news media. For example, Friedman's (1999) content analysis found that news coverage of dioxin, a potential carcinogen found in many industrialized areas, was highly inconsistent in the 1990s.

Meissner, Rimer, Davis, Eisner, and Siegler (2003) documented three controversies in the news about mammography during the 1990s and early 2000s. The first two revolved around the

age at which women should begin having mammograms and the frequency with which they should have them. The third controversy was triggered by a **Lancet** article that concluded that there was insufficient evidence to make recommendations about mammography for women at any age. Squiers and colleagues documented the most recent controversy about mammography, which occurred in Fall 2009, when the U.S. Preventive Services released its breast cancer screening report (Squiers, et al., 2011). The report raised the same issue as the 1990s mammography controversies, i.e., the age at which women should begin routine screening.

A content analysis by Smith et al. (2010) also identified contradictory information about cancer screening practices. Specially, they found "an uneasy fusion of arguments about extending screening to new populations and new cancers, alongside stories that were structured to question the validity of several key screening protocols" (Smith et al., 2010, p.7).

There are concerns that contradictory information has also emerged in other domains such as prostate-specific antigen testing (Hobson, 2009; Dixon, Scully, Wakefield, & Murphy, 2008), prescription drugs, hormone replacement therapy, and genomics (McBride & Guttmacher, 2009). A content analysis of UK and Scottish newspapers by Rooke and Amos (2014) identified uncertainty, lack of knowledge, as a common theme in reporting electronic cigarettes.

2.2.4 Why We Get Conflicting Coverage

Conflicting coverage occurs for at least two reasons. First, the nature of news; second, the nature of science.

From the news reporting perspective, conflict is newsworthy (Lanson & Stephens, 1993; Masterton, 2005; Montgomery; 2007; PBS News Hour, 2013). One principle journalists use to decide whether a story is newsworthy is conflict or controversy. For example, Student Reporting

Labs at PBS's NEWSHOUR states "when violence strikes or when people argue about actions, events, ideas or policies, we care. Conflict and controversy attract our attention by highlighting problems or differences within the community." This point means that scientists disagreeing with each other is more newsworthy than scientists agreeing with each other.

From the science perspective, science is a process of self-correction (Jamieson, 2015). Conflicting findings may occur in health-related research for several reasons. Take preventative medicine as an example. First, it is difficult for researchers to accurately measure people's consumption. For example, one study finding that electronic cigarette may help smokers quit smoking is based on self-reported abstinence. An accurate measure of electronic cigarette consumption should be verified using biochemical method. However, using biochemical verification for abstinence on every subject in a large population study is difficult.

Second, a rigorous clinical trial suggesting stronger causal connections between a disease and a behavioral factor may contradict conclusions drawn from earlier observational research (Bazell, 2011). For example, an earlier study asked patients with pancreatic cancer about their dietary and other habits, then it asked healthy people the same question. Based on the differences in diet and other habits between the two groups, this study concluded that coffee consumption might account for a substantial proportion of the cases of pancreatic cancer in the United States. However, this case-control design is subject to recall bias (Hassan, 2006). People with a disease like pancreatic cancer often wonder why they got it (Bazell, 2011). If they learn that the scientists are investigating coffee as a possibility, they may be far more likely to remember every cup they ever drank than are the healthy participants. To avoid recall bias, researchers can use a prospective study, where they follow participants over a period of time. A prospective study might find that coffee consumption is inversely associated with risk of prostate cancer. There is

advantage for each type of study. Case-control studies require relatively few subjects and are particularly useful at the stage when the disease in question is rare, but they are subject to recall bias; prospective studies require relatively large samples that are followed over time, and they are not practical when the disease is rare, but they are able to ensure that the exposure precedes the outcome.

2.2.5 Why Conflicting Coverage of Health-Related Issues Matters

Non-experts may not possess the necessary scientific knowledge to make sense of conflicting account of a scientific topic. Studies sponsored by the National Science Foundation on the public's understanding of science have revealed that, in 2012, only one-third (34%) of Americans could answer a question about how to test a drug and then provide a correct response to an open-ended question that required them to explain the rationale for an experimental design (National Science Board, 2014). Further, in 2012 only 20% of Americans could explain what it means to study something scientifically.

Consequences of exposure to conflicting coverage include confusion about and lower intention to comply with health recommendations (Nagler, 2014) and distrust in scientists (Jensen & Hurley, 2012). Nagler found that people who reported greater exposure to contradictory health messages for topics such as red wine, fish, coffee, and vitamins/supplements experienced greater feelings of confusion and reported lower intention to comply with nutrition recommendations. These beliefs, in turn, were associated with doubt in public health recommendations in general. Jensen and Hurley found that mere news coverage of controversial health-related issues in general might provoke distrust in scientists.

2.2.6 News Consumers' Responses to Conflicting Health-Related Information

Given the nature of scientific discovery and prevalence of conflicting health-related information in news media, it is important to understand how news consumers respond to such information. In this section, I review two empirical studies that examined news consumers' responses to conflicting health-related information.

Jensen and Hurley (2012) examined readers' response to news stories about dioxin in sewage sludge, using a pretest- posttest experimental design. The news stories presented the topic as either conflicting or convergent. In the conflicting conditions, participants read two contradictory news articles about the topic. In the convergent conditions, participants also read two news articles about the same topic; however, the two articles provided agreeing messages. In the control condition², participants read a single, one-sided article about the same topic and a filler article. Key dependent variables were perceived coherence of news articles, perceived uncertainty about dioxin regulation, and scientists' credibility rating. Results showed that perceived coherence did not differ significantly across the three conditions. Perceived uncertainty about dioxin regulation differed significantly across the three conditions. Specifically, participants in the divergent condition expressed the highest uncertainty, and participants in the control condition expressed the lowest uncertainty. Scientists' credibility ratings did not differ significantly between the conflicting and convergent conditions. In fact, credibility ratings dropped significantly from pre-exposure to post-exposure across all

²This is not a control condition in the strictest sense. Readers in this condition were presented a one-sided article and a filler article. This condition serves as a control to the conflicting condition though. If this condition had not been present, it would have been unable to distinguish between effects caused by conflict and effects caused by one-sided articles.

conditions. This suggests that news coverage of controversial health-related issues in general might provoke distrust in scientists (Jensen & Hurley, 2012). The authors used Mazur's hypothesis (Mazur, 1981) to explain this finding. The hypothesis is about media coverage of controversial technological issues. It states that increased media coverage of scientific controversies can negatively influence public attitudes towards and perceptions of technology. Mazur (1981) suggested that "media attention tends to elicit a conservative public bias" (p.106).

Jensen and Hurley's study (2012) operationalized conflict as contradictory information from more than one article. My dissertation intends to extend their study by examining whether reading conflicting information from one article will differ from reading that same conflicting information from more than one article.

The other identified study that examined people's responses to conflicting health-related news coverage is by Nagler (2014). Nagler's survey-based study examined whether perceived exposure to conflicting nutrition information from news was associated with cognitive constructs such as nutrition confusion, and with behavioral intentions, such as intention to consume fruits and vegetables or to exercise (2014). The results show that exposure to conflicting information was positively associated with confusion about what foods are best to eat and the belief that nutrition scientists keep changing their minds. The result also suggested that these beliefs might result in people doubting nutrition and health recommendations in general (i.e., nutrition backlash), including nutrition recommendations that are not subject to contradiction (e.g., fruit/vegetable consumption, exercise).

To measure exposure to conflicting nutrition information, Nagler asked participants to think about "the past 12 months, how much conflicting or contradictory information have you heard from the media (including television, radio, newspapers, magazines and the Internet)"

about each of the following nutrition topics: red wine, fish, coffee, and vitamins/supplements (Nagler, 2014, p.127). The actual relationship between exposure and outcome variables might be confounded because of the limitations of a self-reported survey. First, Nagler mentioned that there is a concern of over-reporting of exposure to contradictory messages, as the survey explicitly asked respondents how much conflicting or contradictory information they had heard from the media. The mention of "conflicting information" in the question might suggest to respondents that such information does in fact exist. Nagler suggested that to reduce the likelihood of over-reporting, future exposure measures can include both "true" (e.g., red wine, fish, coffee, and vitamins/supplements) and "foil" (e.g. mushroom and poppy seeds) nutrition topics to ensure people are able to differentiate between topics about which contradictory information exists in the media and topics about which no such information exists. Another less obtrusive measure Nagler also suggested is to ask participants to recall separately both the positive and negative health consequences of consuming a specific food. Second, this dissertation argues that participants' recall might not be accurate, as the survey asked participants to think about their exposure in the past year. Third, Nagler's study did not examine the possible difference between influences of conflict presentation formats. Messages about contradiction can also appear in two presentation formats: one is from a single news article that reports conflicting scientific evidence, and the other is from two or more news articles.

My dissertation intends to extend Nagler's (2014) study by (a) using an experimental study to actually expose readers to conflicting information, (b) examining whether types of presentation format vary in their effects on source credibility, and (c) whether presentation format's influence on source credibility is mediated by perceived issue uncertainty.

2.3 Conceptualization of Presentation Format

In this section, I conceptualize presentation format, review different presentation formats of conflicting coverage in news media, and review prior studies on effects of presentation format.

2.3.1 Definition of Presentation Format

Two possible ways that an individual is exposed to conflicting information about a health-related topic are when conflicting information is presented in one document (C1D) and when conflicting information is presented in two documents (C2D).

An example of C1D is the reporting of contradictory scientific findings about a health issue within one single news article. A specific example is a news article reporting a study finding that electronic cigarettes may help tobacco smokers quit smoking and also reporting another study finding that use of electronic cigarettes may lower smokers' chances of abstaining from tobacco.

An example of C2D is the reporting of the contradictory information using more than one news articles. A specific example is one news article reporting a study finding that electronic cigarettes may help tobacco smokers quit smoking and another news article reporting about another study suggesting that use of electronic cigarettes may lower smokers' chances of abstaining from tobacco.

In a C1D situation, journalists often use integration devices to present the two opposing sides of an issue within the same news story. Integration devices are pieces of information used to organize a news story. Integration devices often appear in the title, the beginning (e.g., lede), and in transitional sentences or phrases of a news story. For example, a single news article reporting conflicting findings about whether e-cigarettes help smokers quit could be titled

"Studies Disagree on Whether E-Cigarettes Help Smokers Quit." The lede could also include information such as "two science journals are reporting conflicting results about whether e-cigarettes help smokers quit."

In a C2D situation, integration devices can be used in a subsequent article when a journalist knows the contradictory study.

2.3.2 Presentation Format in the News

There is evidence that both types of presentation format are used to present conflicting information in news media. In a content analysis of nutrition stories published in the top 49 U.S. newspapers between January 1, 2008, and January 1, 2010, Nagler examined the prevalence of nutrition-related C1D stories (Nagler, 2010). For common nutritional topics, she identified 190 C1D news articles across 49 newspapers for the 2-year period. In another study, Greiner, Smith, and Guallar (2010) identified C2D news articles about fish consumption. News articles were coded as either about health benefits of fish consumption or about mercury in fish. Their content analysis is based on five daily newspapers and five television networks across a 15-year period. Results showed that, over 15 years, 212 stories focused on the issue of mercury in fish (68 % of all stories), 62 stories focused on the health benefits of eating fish (20 %) and 36 stories described food safety concerns that were not mercury specific (12 %).

2.3.3 Effects of Presentation Format

Studies in cognitive and instructional psychology have studied effects of presentation format on issue understanding (Stadtler, Scharrer, Brummernhenrich, & Bromme, 2013; Wiley & Voss, 1996).

Wiley and Voss (1996) examined presentation format's effects on students' understanding of a historical topic. In their study, presentation format was operationalized as a combination of the number of documents and use of integration devices. In their study, one half of the students received information about Ireland from 1800 to 1850 in the form of eight separate documents such as a map, biographical accounts, legal act, census data, etc. The other half of the participants received the same factual information, but it was integrated into a textbook-like chapter. The textbook format also contained an introductory sentence and some transitional clauses at the beginning of paragraphs. Information in the textbook format was organized in a chronological order.

Wiley and Voss (1996) found that students reading multiple documents used more causal connections and evidence from various sources to construct arguments in their essays than did students reading a single document.

Stadtler and colleagues (2013) examined presentation format's effects on students' understanding of a controversial health topic. They operationalized presentation format as the number of documents used to communicate the same conflicting information. No integration devices were used. That is to say, no explicit statements were used to indicate that one document conflicted with the other documents. Half of the participants read separate documents, and the other half read a single document. For example, in the separate-document condition, participants read one document saying that the amount of cholesterol people ingest is an important determinant of their blood cholesterol level and that scientific studies show that foods such as eggs and meat contain high amounts of cholesterol. In another document, they read that the amount of cholesterol people ingest barely has an impact on the levels of cholesterol in their blood, and many studies have shown that humans have a regulatory mechanism to keep

cholesterol levels constant in healthy individuals. In the single-document condition, participants read all of the above information in one document.

Stadtler and colleagues (2013) found that participants reading separate documents had better memory of conflicting information about cholesterol than participants reading a single document. And participants who read multiple documents were also more likely to express conflict about cholesterol explicitly when they were asked to write a letter to a friend who was diagnosed with a high cholesterol level.

2.4 Conceptualization of Hedging

In this section, I conceptualize hedging, and review hedging in news coverage of health-related research and empirical studies on news consumers' responses to hedged news coverage.

2.4.1 Definition of Hedging

A reporting practice relevant to news coverage of health-related science is hedging. Hedging refers to any linguistic means used to indicate either "a) a lack of complete commitment to the truth value of an accompanying proposition, or b) a desire not to express that commitment categorically" (Hyland, 1998, p.1). As a result, a hedged proposition is more ambiguous compared with a non-hedged one.

There are two key ways that health-related science news stories can be hedged (Hyland, 1996). One is to express the tentative nature of science using sentences to describe caveats or limitations of a study. For example, a news article reporting "coffee is beneficial for men with prostate cancer" can include the primary scientist's disclosure of limitations of the study. The limitations could include information on how coffee consumption is measured or that survivor

bias, which means that participants who have died are less likely to be included in a study, cannot be ruled out as a potential confounder. The other occurs when news reports that scientists say X **may** cause Y or X is **likely to** cause Y, instead of saying X **causes** Y. The first hedging manifests itself in the form of discourse, and the second as lexical choices. Discourse hedging is helpful to illustrate why a scientific conclusion is limited or tentative. Lexical hedging is able to express an uncertainty in the relationship between two factors in a scientific conclusion. The two types of hedging can be used together when scientists report their research findings (Hyland, 1998).

Besides signaling tentativeness, discourse hedging, using sentences to describe limitations or caveats of a scientific study, also introduces new knowledge about a science topic. For example, limitations often include information about how scientists methodologically approach a research topic. With limitations included, news readers can learn more, for example, about why scientists choose one method over another and how this choice could influence their findings. Consequently, hedging is not just a device representing a powerless language style, but also provides new knowledge about an issue.

Scientists use hedging to cope with Smithson's (1989) three types of uncertainty relevant to their studies. Scientists use hedging when they cope with vague situations. For example, research findings suggest the anti-obesity effects of green tea cannot be generalized to other populations as the study is based on an Asian population (Huang et al., 2014). A similar finding that green tea consumption decreased body weight cannot be generalized to a larger population either as the subjects recruited in the study came solely from a university campus (Basu et al., 2010).

Scientists use hedging when they cope with probabilistic information. For example, scientists use a particular statistical model to predict a country's cancer incidence for the coming decades, and they acknowledge in their report that the projection of cancer incidence is “inherently subjective and unreliable” (Mistry, Parkin, Ahmad, & Sasieni, 2011).

Scientists also use hedging when they cope with ambiguity, where contextual information is lacking. For example, some scientists are cautious when it comes to the health impacts of electronic cigarettes. These scientists hedge their claims because, while electronic cigarettes may help traditional cigarette users stop smoking, electronic cigarettes may also encourage more people to take up nicotine, which is one of the most addictive substances, and electronic cigarettes emanate vapor that may also be harmful to users (Lyndon, 2014).

As a shared practice in the science community (Hyland, 1998) and cornerstone of scientific integrity (Puhan, et al., 2012), scientists use hedging to express how confident they are about their findings, to indicate what they do not yet know and future research directions, and/or to characterize information that, by nature, is never black or white. Moreover, "hedges are a crucial means of presenting new claims for ratification and are a primary factor in developing the research article as a vehicle for new knowledge" (Hyland, 1998, p. 6). Scientists frankly discuss limitations or caveats of their research not only in journal papers they publish, but they are also encouraged to acknowledge the uncertainty when they communicate their research to the press.

2.4.2 Examples of Hedging in Science

This section describes the limitations of the two studies (Brown, Beard, Kotz, Michie, & West, 2014; Grana, Popova, & Ling, 2014) that were used to create the present study's stimulus materials.

According to the published journal paper (Grana, Popova, & Ling, 2014), Grana and colleagues' study has the following limitations: 1) it lacked detailed data on electronic cigarette use characteristics, such as frequency, duration, use pattern, and motivation for use; 2) smoking cessation data were self-reported; and 3) the sample had a low number of electronic cigarette users, which might have limited the statistical power to detect a significant relationship between electronic cigarette use and quitting.

According to the published journal paper (Brown, et al., 2014), Brown and colleagues' study includes the following limitations: 1) smoking cessation data were self-reported and not verified biochemically; 2) participants' assessment of their most recent attempt to quit smoking required them to recall the previous 12 months. These introduce bias. Recall of failed quit attempts may have been underreported because successful attempts would be more salient than unsuccessful ones; and 3) both nicotine replacement therapy and e-cigarettes represent heterogeneous categories. The simple definition of using one or the other aid to support an attempt is likely to have masked variability in the usage of either nicotine replacement therapy or e-cigarettes.

2.4.3 Omission of Hedging in News Reporting

Studies show that newspapers routinely minimize or omit information that would limit the findings or conclusions of a study. A study on trends in coverage of science in three time periods (1966-1970, 1976-1980, 1986-1990) found that in all three time periods, less than 50% of the articles analyzed contained statements about limitations to the research being reported and the generalizability of the results to the public (Pellechia, 1997). As a result, news coverage of science presents research as more certain than it is (Stocking, 1999).

A more recent content analysis suggests that 43% of front-page stories reporting on medical research are based on preliminary findings presented at scientific or press meetings rather than in peer-reviewed journals (Lai & Lane, 2009). Given the amount of preliminary research being reported in the media, it seems reasonable and necessary to include hedging in news coverage of medical research.

Scientists, some journalists, and communication scholars have advocated for acknowledging limitations in news coverage of science (IFIC, 1998; IFIC & IFT, 2005; Stocking, 2010; Schwartz & Woloshin, 2004). For example, the Harvard School of Public Health (HSPH) and the International Food Information Council (IFIC) Foundation convened in 1998 and developed a set of guidelines for how food-related information could be communicated via media to promote public understanding (IFIC, 1998). In 2005, an advisory committee of journalists and nutrition professionals convened and developed a set of guidelines for communication issues specific to dietary components for health (IFIC & IFT, 2005). Both the 1998 guidelines for communicating food-related research and the 2005 guidelines for communicating dietary research include acknowledging limitations a study may have for all parties (scientists, journal editors, and journalists) in the communication process.

2.4.4 News Consumers' Responses to Hedged News Coverage

Two studies have examined whether hedged scientific discourse would have meaningful effects on news consumers. Jensen (2008) examined whether hedging affects readers' credibility perception of scientists and journalists. He found that both scientists and journalists were viewed as more trustworthy when news coverage of cancer research included limitations of the research and when the limitations were disclosed by the scientists responsible for the research.

In a replication of Jensen (2008), Jensen et al. (2011) conducted an experiment to examine the effects of hedged news coverage of cancer research on other cognitive constructs which include cancer fatalism, medical skepticism, patient trust in doctors, and nutrition backlash. Informed by Lang's Limited Capacity Model of Motivated Mediated Message Processing (2006), Jensen and colleagues postulated that news consumers use scientific uncertainty to organize information so that they can reduce information overload. People have more access to abundant information, cancer information in particular. Many people may feel overwhelmed, confused, and fatalistic (Niederdeppe & Levy, 2007). When experiencing information overload, people are likely to respond negatively to the information presented to them (Lang, 2006). In this case, they may categorize the information as representative of the content [i.e., "It seems like everything causes cancer." or "There are so many recommendations about preventing cancer, it's hard to know which ones to follow." (Niederdeppe & Levy, 2007, p.999).].

News consumers avoid information overload by using scientific uncertainty to categorize content. Based on the information hedged, cancer research, for example, can be categorized as conclusive, unusual, emerging, or preliminary. Caveats and limitations communicate the extent to which a topic is known and how a reader should categorize and react to the information. Jensen and colleagues' 2011 study found that readers of hedged news coverage of cancer research were significantly less cancer fatalistic, but hedging did not have effects on belief in medicine's influence on health outcomes and trust in medical professionals in general³.

Both the 2008 study (Jensen) and the 2011 study (Jensen, et al.) focused on hedging's effect in the context of one-sided news stories (Jensen, 2008; Jensen, et al., 2011). In other

³Jensen and colleagues' 2011 study examined trust in medical professionals (i.e., doctors) in general, not

research scientists.

words, the two studies did not examine hedging's effects on source credibility when it is used in a context where conflicting information exists.

My dissertation intends to extend this line of literature in the following aspects: (a) replicating whether hedging (including affiliated scientists' disclosure of research limitations) enhances scientists' and journalists' credibility; (b) examining the effects of hedging on source credibility in a conflict context; and (c) examining whether hedging's influence on source credibility is mediated by perceived issue uncertainty.

2.5 Credibility Research Review

This section reviews credibility literature. It consists of four parts: source credibility, message credibility, channel credibility, and source credibility of interest to this dissertation.

Research on credibility has been approached in at least three ways: source, message, and channel (Kiousis, 2001; Metzger et al., 2003). Credibility, in its simplest sense, is the believability of a source, a message, or a medium/channel (Tseng & Fogg, 1999). Source credibility focuses on how a communicator's characteristics influence perceptions of believability, and channel credibility focuses on how the channel's characteristics influence perceptions of believability. A communicator can be defined as an individual, group, or organization in interpersonal, organizational, and mass-mediated contexts. In addition, Metzger and colleagues (2003) noted that message credibility has also been studied. Message credibility focuses on how the message's characteristics influence perceptions of believability, either of the source or the source's message. In this way, source and message credibility are overlapping concepts (Slater & Rouner, 1997).

2.5.1 Source Credibility

Empirical studies on source credibility began with identifying important characteristics of persuasive speakers. These studies defined source credibility as "judgments made by a perceiver concerning the believability of a communicator" (O'Keefe, 1990, p. 130-131). Earlier studies on source credibility can be traced back to the communication and attitude change program launched by Hovland and his colleagues at Yale University in the 1940s (Self, 1996).

The Yale group and other scholars defined credibility as a communicator's expertise and trustworthiness (McCroskey & Teven, 1999; Hovland, Janis, & Kelley, 1953). Expertise refers to a communicator's qualifications, competence, or ability to know the truth about a topic.

Trustworthiness refers to a communicator's motivation to tell the truth about a topic. Hovland and colleagues suggested that source credibility is a subjective construct. This notion started the tradition of studying source credibility from the perspective of message recipients (Self, 1996).

Most researchers who conducted factor analytic studies found evidence for two primary dimensions of source credibility: trustworthiness and expertise; but they also identified several secondary dimensions of source credibility such as dynamism, composure, and sociability (Metzger et al, 2003). Metzger and colleagues suggested that credibility dimensions might differ depending upon the type of source being evaluated and the context in which the evaluation is made.

Besides an individual person as the source of a message, an organization's credibility has also been studied in marketing literature (Goldsmith, Lafferty, and Newell, 2000). Research has identified similar dimensions of organizational credibility with an individual person as the source. Organizational dimensions include expertise, trustworthiness, and likeability (Haley, 1996). Other dimensions such as prestige, competitiveness, and familiarity have also been

identified (Vanden Bergh, Soley, & Reid, 1981). Metzger and colleagues (2003) suggested that organizational credibility and source credibility might share primary dimensions (i.e., expertise, trustworthiness) and differ in secondary dimensions.

2.5.2 Message Credibility

Dimensions of message credibility have also been identified. These dimensions include: message organization (McCroskey & Mehrley, 1969), message quality (Slater & Rouner, 1997; Hamilton, 1998), language style (Hamilton, 1998), message discrepancy (Stamm & Dube, 1994), and message delivery (McCroskey & Mehrley, 1969; Burrell & Koper, 1998). McCroskey and Mehrley (1969) found that message organization affected perceptions of source expertise but not source trustworthiness. Slater and Rouner (1997) found that well-written and interesting messages were perceived as more credible. Hamilton (1998) found that the use of high-quality and relevant evidence increased perceptions of source credibility and the use of opinionated language decreased credibility. Hamilton also found that use of intensive language increased communicator's dynamism but might decrease expertise and trustworthiness perceptions. Stamm and Dube (1994) found that messages that support readers' views are seen as unbiased, and therefore trustworthy. McCroskey and Mehrley (1969) found that more delivery flaws (e.g., slips of the tongue) are associated with lower credibility. Powerless language style (e.g., use of hedges, qualifiers, tag questions) decreases perception of source credibility (Burrell & Koper, 1998). Burrell and Koper (1998), however, noted that context where hedging is used might be a potential moderating variable. The situations they reviewed were within one of two contexts: courtrooms or classrooms. Therefore, they suggested researchers explore powerless/powerful language in other contexts.

Message credibility is typically measured by message recipient's credibility perception of the source who delivered the message (Metzger et al., 2003). Rosenthal (1971), however, argued that credibility assessment is a function of characteristics of the source and of the message. When information about the source is absent, audience members determine the message credibility based on two factors: the specificity and verifiability of the message content. Thus, specific information and information that is able to be validated should be perceived as more credible. Metzger and colleagues (2003) recommended that communication researchers interested in measuring message credibility can turn to information quality literature to develop scales to assess a message's accuracy, comprehensiveness, currency, reliability, and validity.

My dissertation manipulates two message attributes (i.e., presentation format and hedging) to examine perceptions of source credibility.

2.5.3 Channel Credibility

Empirical studies on channel credibility began with interest in the relative credibility of various media channels through which a source sends a message (Metzger et al., 2003).

In the 1930s, the newspaper industry was concerned about the rise of radio as a news channel. In the 1950s, the research on channel credibility was driven by competition from television with the newspaper industry. Researchers were interested in which medium the public would believe if people got conflicting reports of the same news story from radio, television, magazines, and newspapers. In recent years, web credibility has gained attention. Empirical studies have approached web credibility in three ways: website credibility (Flanagin & Metzger, 2007), website message credibility (Gupta & Kumaraguru, 2012; Flanagin & Metzger, 2007), and web credibility (Schmierbach & Oeldorf-Hirsch, 2012).

Source attribution in the web environment is likely to be conflated. Source of an online message may be attributed to the author of the material on a particular website, the operator or sponsor of the site, or the medium itself (Eastin, 2001; Kioussis, 2001; Sundar & Nass, 2001). To sort out this issue, researchers have proposed typologies for source attributions. For example, Sundar and Nass (2001) argued that there are at least three distinct sources for online news: visible sources, technological sources, and receivers. Visible sources are those who present the information, technological sources are the channels through which the information is delivered, and receivers may be considered sources because receivers of online news may select the information they read or they may select information for others. Source attribution on the web may occur at multiple levels simultaneously.

2.5.4 Source Credibility of Interest

Schweiger (2000) proposes a hierarchy of source referents to distinguish the multiple potential sources of credibility attributions. The hierarchy consists of six levels of reference objects: presenters, actors, editorial units, media products, subsystems, and media types. Presenters are the authors of information (e.g., journalists who report science issues). Actors are those whose actions or statements are presented (e.g., scientists whose research is being reported). Editorial units consist of things such as an article (e.g., a news article about a science issue). Media products are the specific networks, newspapers, or web sites (e.g., **Public Library of Science, New York Times**). Subsystems refer to the genre of the media product (e.g., serious report vs. tabloid newspapers). Media types refer to the channel through which information is communicated (e.g., television, newspapers, and web).

Based on Schweiger's (2000) hierarchy of source referents, this dissertation studies message attributes' influence on credibility of source at two hierarchic levels: presenter and actor. In the context of health or science communication, presenters are journalists who report on health or science issues, and actors are scientists whose research is being reported.

Source credibility in health and science communication has also been studied at both individual level (Jensen, 2008) and group level (Jensen, et al., 2011). At the individual level, the source is directly responsible for the message being reported. For example, source credibility at the individual level can refer to the scientists who conducted the research being reported or the journalists who reported the scientific study. At the group level, the source is generalized as a group. For example, source credibility at the group level can refer to the scientists who are in a specialized field, or the journalists who primarily report news about one field.

Source credibility at both individual level and group level deserves examination. This is because it is not clear yet whether news consumers generalize group-level source credibility from individual level. Jensen (2008) found that features of news coverage of cancer research influenced journalists' credibility and scientists' credibility at the individual level. However, Jensen and colleagues (2011) found that the same features of news coverage of cancer research might not influence credibility of medical professions. There are two explanations. First, news readers do not generalize source credibility from the individual level to the group level. Second, news readers do not generalize source credibility of one group (i.e., scientists who actually conduct cancer research) to a similar but different group (i.e., medical professions who treat cancer patients).

This dissertation examines credibility of journalists and credibility of scientists at both individual level and group level.

2.6 Theoretical Frameworks

This section presents an uncertainty communication model (Figure 3). This model proposes that message attributes of conflicting information have direct impacts on source credibility (c_1), and message attributes have indirect impacts on source credibility via perceived issue uncertainty (a_1b_1).

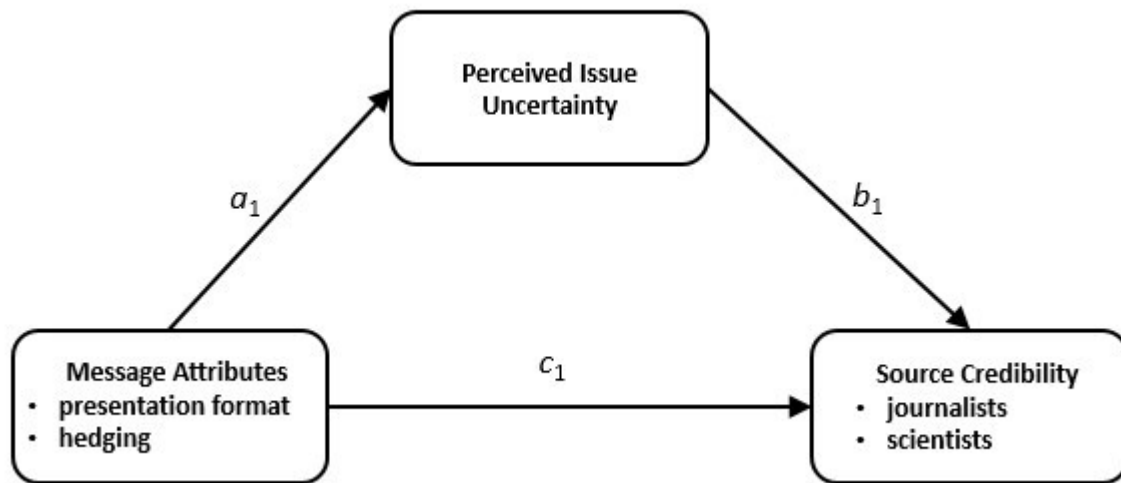


Figure 3. Uncertainty Communication Model

2.6.1 Message Attributes' Direct Effects on Source Credibility

Message attribute refers to how conflicting information is communicated. Message attributes can influence source credibility. As shown in Figure 3, message attributes may have direct effects on source credibility (c_1).

Presentation Format's Effects on Source Credibility

Journalists' credibility. Allen's discounting hypothesis (Allen, 1991) argues that a source who fails to meet an expectation or exceeds an expectation generates a reevaluation by an audience. For example, suppose an audience knows an issue is controversial and a source is thought to be fair-minded, open, and honest. The source fails to meet audience's expectation by

not acknowledging the existence of an opposing side. The audience might react negatively to the source and discount the evidence. A two-sided message acknowledges the controversy and increases the evaluation of the source. For a non-controversial topic, a source that acknowledges the existence of a possible opposing side increases the evaluation of honesty, fair-mindedness, and expertise by the audience.

Therefore, I hypothesized that two-article format would lead to lower journalists' credibility than one-article format.

Scientists' credibility. When two scientific studies are reported in one news story, readers might perceive that the conflict between the two studies is more explicit than when the studies are reported in two separated stories. Festinger's (1957; 1964) theory of cognitive dissonance postulates that people desire consistency among their attitudes, inconsistencies cause cognitive dissonance, therefore, people tend to respond to avoid or reduce cognitive dissonance. Cognitive dissonance refers to a feeling of mental discomfort that occurs when people experience inconsistencies between multiple attitudes they hold. The two scientific studies, one stating e-cigarettes helped smokers quit smoking, whereas the other stating e-cigarettes did not, have the potential to induce inconsistency between readers' attitudes about e-cigarettes. The present study assumes that more explicit conflict causes more cognitive dissonance. One possible way news readers use to reduce cognitive dissonance is to discredit one group or both groups of the scientists who are behind the studies (Stadtler, Scharrer, & Bromme, 2013), either of which could lead to lower overall scientists' credibility.

Therefore, I hypothesized that scientists' credibility would be lower than that in the two-article format because of the more cognitive dissonance induced by the explicit conflict.

Hedging's Effects on Source Credibility

As shown in Figure 3, hedging may affect source credibility (Crismore & Vande Kopple, 1997; Jensen, 2008). Jensen studied effects of discourse-based hedging in news coverage of cancer research on people's credibility perceptions of scientists and journalists. Jensen found that both the scientists and the journalists were viewed as more trustworthy when news stories included scientific limitations and when the limitations were disclosed by the scientists who conducted the reported research. Hedging increased scientists' and journalists' credibility because it might have helped people navigate through overload of cancer-related information existing in news environment (Jensen, 2008).

Study by Crismore and Vande Kopple (1997) had consistent findings. They found that readers rated the author of a scientific text as more believable when the text was hedged.

Therefore, I hypothesized that in a context of where conflicting scientific evidence occurred, hedged news coverage would also improve both scientists' and journalists' credibility.

2.6.2 Message Attributes' Indirect Effects on Source Credibility via Perceived Issue Uncertainty

As shown in Figure 3, message attributes have indirect effects on source credibility via perceived issue uncertainty (a_1b_1).

Message Attributes Influence Perceived Issue uncertainty

Perceived issue uncertainty refers to an individual's perceptions of how incomplete knowledge about a particular issue, object, or question is (Smithson, 1989). A person's perceptions of incompleteness of knowledge include at least perceptions of his/her own

knowledge of the issue, perception of the public's knowledge of the issue, and perception of the scientists' knowledge of the issue.

When perceived uncertainty is high, an individual perceives the knowledge about a situation is incomplete; and when perceived uncertainty is low, an individual perceives the knowledge is complete.

Presentation format and perceived issue uncertainty. When conflicting information is presented in two documents (C2D), readers will report higher perceived issue uncertainty than when it is presented in one document (C1D). This prediction is based on prior educational psychology studies that compare cognitive performance between reading a single document vs. reading multiple documents (Britt & Aglinskias, 2002; Britt & Rouet, 2012; Stadtler, Scharrer, Brummernhenrich, & Bromme, 2013; Wiley et al., 2009; Wiley & Voss, 1996; Wiley & Voss, 1999). These studies found that multiple documents instead of a single document motivated readers to integrate information. For example, Stadtler and colleagues (2013) examined whether reading information from multiple documents instead a single document might enhance readers' chance of detecting conflicting information. They found that readers of multiple documents had a more accurate memory for conflicts than those reading a single document. An accurate memory of a conflict implies that readers remember each of the two claims of a conflict and have established a conflicting relationship between the two claims during their integration process. They also found that participants were more likely to explicitly state the conflicts mentioned in the multiple-document conditions than those mentioned in the single-document conditions.

Therefore, conflicting information presented in the two-article format would lead to higher perceived issue uncertainty than the one-article format. One explanation is that in the single document, conflict is presented explicitly by the writers, whereas in the multiple

documents, readers have to integrate information across documents before they will see the conflict. When conflict is explicitly presented, the cognitive efforts readers make in processing information are less than when the conflict is not explicitly presented. More cognitive efforts might lead to better memory of the conflicting claims, thus a higher level of perceived issue uncertainty.

Hedging and perceived issue uncertainty. Studies on language and social psychology have shown that powerless language that included hedging undermined persuasion (Gibbons, Busch, & Bradac, 1991; Hosman, Huebner, & Siltanen, 2002). Moreover, researchers have isolated the effects of hedging from other powerless linguistic cues (e.g., hesitation, tag questions) and found that hedged messages dampened the strength of the argument and led to less persuasion (Blankenship & Holtgraves, 2005). Researchers have also examined effects of hedge placement (e.g., where hedging is placed in a message) and hedge type (e.g., used for interpretation, used for data) on argument strength and found that hedging diminished the argument strength (Durik, Britt, Reynolds, & Storey, 2008).

When journalists communicate health-related research, hedging, including limitations of a study, will generate lower perceived issue uncertainty than non-hedging. This prediction is based on the two characteristics of discourse hedging.

First, hedging reduces strength of arguments from the two opposing sides in a conflicting situation. Bradac and colleagues studied effects of powerless (e.g., hedging) and powerful (e.g., without hedging) language on strength of claims in a conflicting situation (Bradac, Hemphill & Tardy, 1981). In the study, powerless and powerful styles were used by a defendant and a plaintiff in a hypothetical courtroom context. Participants read testimony, in high versus low power. The finding suggested that the use of powerful language in a conflicted situation

increased strength of claims made by both sides of a conflict. Specially, they found that a person using high-power speech while discussing his participation in a violent interpersonal encounter produced in his audience a judgment that both parties were quite blameworthy. However, the strength of claims decreased when the audience was serially presented with both powerful and powerless styles.

Second, discourse hedging, the type of hedging used by the present study, can introduce new information about a particular issue, object, or question. In addition to reducing the strength of claims, hedging can draw attention to the limitations of results or the research conditions where they were obtained. This can be achieved by commenting on difficulties encountered (Hyland, 1998). Jensen et al. (2011) found that nutrition backlash, negative feelings about dietary recommendations, was lower in readers of hedged nutrition news articles than in readers of non-hedged articles. Nagler (2014) found that nutrition backlash was positively associated with nutrition confusion. These findings suggest that hedged articles might be able to reduce people's confusion or uncertainty by introducing new information.

Therefore, hedged coverage would lead to lower perceived issue uncertainty than non-hedged coverage.

Perceived Issue Uncertainty Predicts Source Credibility

Studies on relationship between issue uncertainty and source credibility found an association between the two variables. Specifically, perceived uncertainty is negatively associated with source credibility (Hmielowski, Feldman, Myers, & Maibach, 2013; Jensen & Hurley, 2012). Jensen and Hurley (2012) found that the more uncertain people felt about whether reintroducing the gray wolf into the northwestern United States was beneficial or harmful, the lower they rated scientists' credibility. Hmielowski and colleagues (2013) found that the more

uncertain people felt about whether global warming is happening, the lower was their trust in scientists as a source of information about global warming.

Conflict aversion hypothesis (Smithson, 1999) suggests a direction of causal order from perceived issue uncertainty to source credibility. The hypothesis posits that people rate ambiguous-but-agreeing scientists higher in trustworthiness than disagreeing-but-precise scientists. Smithson (1999) manipulated the two types of scientists in his experiment. One explanation to the hypothesis is that disagreement makes people feel more uncertain about an issue than ambiguity does. This dissertation, therefore, hypothesizes that higher perceived issue uncertainty was associated with lower source credibility (b_1).

In summary (a_1b_1), therefore, I hypothesized that the two-article format would lead to lower journalists' credibility and lower scientists' credibility because of integration-induced higher perceived issue uncertainty. Hedged coverage would lead to higher scientists' and journalists' credibility because it reduced uncertainty.

2.7 Hypotheses

2.7.1 Message Attributes' Direct Effects on Source Credibility

Presentation Format's Direct Effects on Source Credibility

Allen's discounting hypothesis suggests that people rate a source higher in credibility when the source uses two-sided message than when the source uses one-sided message.

Therefore, I hypothesized that two-article format would lead to lower journalists' credibility than one-article format. Studies on source credibility, for example, by Schweiger, found that credibility could transfer between two sources. For example, readers valuing a particular newspaper also tend to consider its website credible, even if they have never seen it. Similarly, a

credibility transfer would occur between journalists and scientists, when conflicting scientific evidence was reported. I hypothesized that in the one-article format, credibility would transfer from scientists to journalists, scientists' credibility, therefore, would be lower in the one-article format than that in the two-article format.

- **Hypothesis 1-a:** Presentation format can have direct effect on individual journalists' competence. Specifically, two-article format would lead to lower individual journalists' competence than one-article format.
- **Hypothesis 1-b:** Presentation format can have direct effect on individual journalists' trustworthiness. Specifically, two-article format would lead to lower individual journalists' trustworthiness than one-article format.
- **Hypothesis 1-c:** Presentation format can have direct effect on individual scientists' competence. Specifically, one-article format would lead to lower individual scientists' competence than two-article format.
- **Hypothesis 1-d:** Presentation format can have direct effect on individual scientists' trustworthiness. Specifically, one-article format would lead to lower individual scientists' trustworthiness than two-article format.
- **Hypothesis 1-e:** Presentation format can have direct effect on group journalists' competence. Specifically, two-article format would lead to lower group journalists' competence than one-article format.
- **Hypothesis 1-f:** Presentation format can have direct effect on group journalists' trustworthiness. Specifically, two-article format would lead to lower group journalists' trustworthiness than one-article format.
- **Hypothesis 1-g:** Presentation format can have direct effect on group scientists' competence. Specifically, one-article format would lead to lower group scientists' competence than two-article format.
- **Hypothesis 1-h:** Presentation format can have direct effect on group scientists' trustworthiness. Specifically, one-article format would lead to lower group scientists' trustworthiness than two-article format.

Hedging's Direct Effects on Source Credibility

Jensen's 2008 study found that hedging increased scientists' and journalists' credibility because it helped people navigate through overload of health information existing in news environment. Therefore, I hypothesized that in a context of where conflicting scientific evidence occurred, hedged news coverage would also improve both scientists' and journalists' credibility.

- **Hypothesis 2-a:** Hedging can have direct effect on individual journalists' competence. Specifically, hedged news coverage would improve individual journalists' competence.
- **Hypothesis 2-b:** Hedging can have direct effect on individual journalists' trustworthiness. Specifically, hedged news coverage would improve individual journalists' trustworthiness.
- **Hypothesis 2-c:** Hedging can have direct effect on individual scientists' competence. Specifically, hedged news coverage would improve individual scientists' competence.
- **Hypothesis 2-d:** Hedging can have direct effect on individual scientists' trustworthiness. Specifically, hedged news coverage would improve individual scientists' trustworthiness.
- **Hypothesis 2-e:** Hedging can have direct effect on group journalists' competence. Specifically, hedged news coverage would improve group journalists' competence.
- **Hypothesis 2-f:** Hedging can have direct effect on group journalists' trustworthiness. Specifically, hedged news coverage would improve group journalists' trustworthiness.
- **Hypothesis 2-g:** Hedging can have direct effect on group scientists' competence. Specifically, hedged news coverage would improve group scientists' competence.
- **Hypothesis 2-h:** Hedging can have direct effect on group scientists' trustworthiness. Specifically, hedged news coverage would improve group scientists' trustworthiness.

2.7.2 Message Attributes' Indirect Effects on Source Credibility via Perceived Issue Uncertainty

Presentation Format's Indirect Effects on Source Credibility via Perceived Issue Uncertainty

Prior educational psychology studies, for example, by Wiley and Voss (1996), found that multiple-document presentation format motivated information integration as compared with single document-format. Therefore, conflicting information presented in two-article format would lead to higher perceived issue uncertainty than one-article format. Studies on relationship between issue uncertainty and source credibility, for example, by Jensen and Hurley (2012), found that higher perceived issue uncertainty was associated with lower source credibility.

Therefore, I hypothesized that the two-article format would lead to lower journalists' credibility and lower scientists' credibility because of integration-induced higher perceived issue uncertainty.

- **Hypothesis 3-a:** Perceived issue uncertainty will mediate the relationship between presentation format and individual journalists' competence. Specifically, two-article format would lead to higher perceived issue uncertainty than one-article format, and higher perceived issue uncertainty, in turn, would lead to lower individual journalists' competence.
- **Hypothesis 3-b:** Perceived issue uncertainty will mediate the relationship between presentation format and individual journalists' trustworthiness. Specifically, two-article format would lead to higher perceived issue uncertainty than one-article format, and higher perceived issue uncertainty, in turn, would lead to lower individual journalists' trustworthiness.
- **Hypothesis 3-c:** Perceived issue uncertainty will mediate the relationship between presentation format and individual scientists' competence. Specifically, two-article format would lead to higher perceived issue uncertainty than one-article format, and higher perceived issue uncertainty, in turn, would lead to lower individual scientists' competence.
- **Hypothesis 3-d:** Perceived issue uncertainty will mediate the relationship between presentation format and individual scientists' trustworthiness. Specifically, two-article format would lead to higher perceived issue uncertainty than one-article format, and higher perceived issue uncertainty, in turn, would lead to lower individual scientists' trustworthiness.
- **Hypothesis 3-e:** Perceived issue uncertainty will mediate the relationship between presentation format and group journalists' competence. Specifically, two-article format would lead to higher perceived issue uncertainty than one-article format, and higher perceived issue uncertainty, in turn, would lead to lower group journalists' competence.
- **Hypothesis 3-f:** Perceived issue uncertainty will mediate the relationship between presentation format and group journalists' trustworthiness. Specifically, two-article format would lead to higher perceived issue uncertainty than one-article format, and higher perceived issue uncertainty, in turn, would lead to lower group journalists' trustworthiness.
- **Hypothesis 3-g:** Perceived issue uncertainty will mediate the relationship between presentation format and group scientists' competence. Specifically, two-article format would lead to higher perceived issue uncertainty than one-article format, and higher perceived issue uncertainty, in turn, would lead to lower group scientists' competence.
- **Hypothesis 3-h:** Perceived issue uncertainty will mediate the relationship between presentation format and group scientists' trustworthiness. Specifically, two-article format

would lead to higher perceived issue uncertainty than one-article format, and higher perceived issue uncertainty, in turn, would lead to lower group scientists' trustworthiness.

Hedging's Indirect Effects on Source Credibility via Perceived Issue

Uncertainty

Studies on language and social psychology, for example, by Bradac and colleagues (1981), found that hedging, as a powerless speech, reduced strength of an argument. Therefore, hedged coverage would lead to lower perceived issue uncertainty than non-hedged coverage.

Studies on relationship between issue uncertainty and source credibility, for example, by Jensen and Hurley (2012), found that higher perceived issue uncertainty was associated with lower source credibility.

Therefore, I hypothesized that hedged coverage would lead to higher scientists' and journalists' credibility because it reduced uncertainty.

- **Hypothesis 4-a:** Perceived issue uncertainty will mediate the relationship between hedging and individual journalists' competence. Specifically, hedged news coverage would lead to lower perceived issue uncertainty, and lower perceived issue uncertainty, in turn, would lead to higher individual journalists' competence.
- **Hypothesis 4-b:** Perceived issue uncertainty will mediate the relationship between hedging and individual journalists' trustworthiness. Specifically, hedged news coverage would lead to lower perceived issue uncertainty, and lower perceived issue uncertainty, in turn, would lead to higher individual journalists' trustworthiness.
- **Hypothesis 4-c:** Perceived issue uncertainty will mediate the relationship between hedging and individual scientists' competence. Specifically, hedged news coverage would lead to lower perceived issue uncertainty, and lower perceived issue uncertainty, in turn, would lead to higher individual scientists' competence.
- **Hypothesis 4-d:** Perceived issue uncertainty will mediate the relationship between hedging and individual scientists' trustworthiness. Specifically, hedged news coverage would lead to lower perceived issue uncertainty, and lower perceived issue uncertainty, in turn, would lead to higher individual scientists' trustworthiness.
- **Hypothesis 4-e:** Perceived issue uncertainty will mediate the relationship between hedging and group journalists' competence. Specifically, hedged news coverage would lead to lower perceived issue uncertainty, and lower perceived issue uncertainty, in turn, would lead to higher group journalists' competence.

- **Hypothesis 4-f:** Perceived issue uncertainty will mediate the relationship between hedging and group journalists' trustworthiness. Specifically, hedged news coverage would lead to lower perceived issue uncertainty, and lower perceived issue uncertainty, in turn, would lead to higher group journalists' trustworthiness.
- **Hypothesis 4-g:** Perceived issue uncertainty will mediate the relationship between hedging and group scientists' competence. Specifically, hedged news coverage would lead to lower perceived issue uncertainty, and lower perceived issue uncertainty, in turn, would lead to higher group scientists' competence.
- **Hypothesis 4-h:** Perceived issue uncertainty will mediate the relationship between hedging and group scientists' trustworthiness. Specifically, hedged news coverage would lead to lower perceived issue uncertainty, and lower perceived issue uncertainty, in turn, would lead to higher group scientists' trustworthiness.

2.8 Potential Covariates

2.8.1 Predisposition Variables as Potential Covariates

Prior Issue knowledge

Prior issue knowledge in this dissertation is conceptualized as a person's perception or self-assessment of his/her actual knowledge of a specific issue (Brucks, 1985; Raju, Lonial, & Mangold, 1995). Perception of actual knowledge is distinctive from actual knowledge.

The two do not necessarily match. Actual knowledge and self-assessment of that knowledge match at two stages of an individual's knowledge development for a given issue. One stage is when the individual has no knowledge, such as at the very beginning of knowledge acquisition. At this initial stage, the person's total absence of actual knowledge is expected to be self-evident. The other stage when actual knowledge and self-assessment of that knowledge match occurs after the person has acquired and integrated much knowledge, such as at an expert level. At this expert stage, the person is aware of the extensive learning process he or she has gone through to acquire that high level of expertise. Mismatch between the two types of knowledge occur at the in-between stage. When some initial knowledge is acquired but evidence

for knowledge adequacy is neither easily available nor convincing, the mismatch between actual knowledge and perceived knowledge occurs.

Empirical findings from consumer psychology suggest that perceived prior knowledge can influence how an individual processes messages (Park, Gardner, & Thukral, 1988; Rao & Monroe, 1988).

Park and colleagues (1988) presented consumers with a message about a videocassette recorder. The message presented usage benefits of three new features of a videocassette recorder. Two of the three features actually offered very similar performance benefits. This similarity was not explicitly stated in the message. Before the message exposure, consumers were asked how familiar they were with videocassette recorders. That is, did they know which videocassette recorder features are important if they were to buy one? After the message exposure, think-aloud protocol was used to record consumers' thoughts about the product. Park and colleagues found that consumers with low perceived knowledge inferred and expressed the similarity significantly more than those with high perceived knowledge. They suggest that lower perceived knowledge might motivate consumers' information processing. That is, perceived knowledge might negatively influence processing.

In contrast to Park and colleagues' finding, a study by Rao and Monroe (1988) suggests that perceived knowledge positively influences processing. They presented consumers with messages that compared features of two women's blazers. The features included intrinsic ones, such as physical and performance attributes, and an extrinsic feature (i.e., price). Before the message exposure, consumers were asked 13 questions that assessed their factual knowledge and one question that measured their perceived knowledge of blazers. After answering the knowledge questions and reading the message, consumers assessed the quality of the blazers.

The researchers found that, for a product (e.g., Harris Tweed blazers) known not to have significant quality variations due to industry standards, the use of extrinsic cue (i.e., price) in product quality assessment tends to decrease as prior knowledge increases. This result might suggest that consumers with high prior knowledge can process and use the intrinsic cues to assess product quality. That is, prior knowledge might positively influence information processing.

One explanation to the inconsistent findings is that whether actual objective knowledge and perceived knowledge match. In Park and colleagues' study (1988), there is a mismatch between the two types of knowledge; however, in Rao and Monroe's study (1988), the two types of knowledge match. Assuming that objective and subjective knowledge are empirically highly correlated, Rao and Monroe operationalized prior knowledge as a composite assessment of both objective and subjective knowledge. As discussed earlier, a match between the two types of knowledge occurs at two stages of an individual's knowledge development for a given topic: initial stage and expert stage. At the in-between stage, a mismatch might develop. Rao and Monroe's finding suggests that high perceived prior knowledge enables information processing when objective and subjective knowledge match, and Park and colleagues' finding suggests that low perceived prior knowledge motivates information processing when objective and subjective knowledge mismatch. This dissertation argues that perceived prior knowledge influences information processing depending on an individual's stage of knowledge development.

Based on the extent of processing, prior issue knowledge might influence presentation format' s effect on perceived issue uncertainty.

When actual knowledge and perceived prior knowledge mismatch, lower perceived prior knowledge increases information processing. When actual knowledge and perceived prior

knowledge match, higher perceived prior knowledge might also increase one's ability and motivation to process information. When processing is increased, it is likely that integration between two documents is also enhanced. Enhanced integration between two documents might elicit higher perceived issue uncertainty because claims on each of the conflicting sides were processed more and remembered well. Decreased integration between two documents might result in lower perceived issue uncertainty because claims on each of the conflicting sides were processed less and were less likely to be remembered. In short, effects of presentation format on perceived uncertainty might be determined by an individual's perceived prior knowledge.

Based on the extent of processing, prior issue knowledge also might influence the relationship between hedging and perceived issue uncertainty.

When actual knowledge and perceived prior knowledge mismatch, lower perceived prior knowledge increases information processing. When actual knowledge and perceived prior knowledge match, higher perceived prior knowledge also increases information processing. When processing is increased, hedged information is more likely to be processed and remembered. When this occurs, the influence of hedging on perceived uncertainty will be enhanced. When processing is decreased, hedged information is less likely to be processed and remembered. When this occurs, the influence of hedging on perceived uncertainty will be decreased. In short, effects of hedging on perceived uncertainty might be determined by an individual's perceived prior knowledge.

Understanding of Science

Understanding of science involves ability in various aspects (National Science Board, 2014). Aspects relevant to the present study might include one's understanding of scientific study, understanding of experiment, and understanding of probability. Understanding of

scientific study refers to one's ability to understand what it means to study something scientifically. Understanding of experiment refers to one's ability to understand why to use an experiment and how to conduct an experiment. Understanding of probability is one's ability to understand the likeliness that an event will occur.

People with higher understanding of these aspects of science might differ from those with lower understanding in how they process science messages (Petty & Cacioppo, 1986). As a result, message attributes' effects on perceived issue uncertainty and source credibility might be dependent on one's understanding of science.

Prior Issue Involvement

Prior issue involvement is a motivational variable that affects the likelihood of message elaboration (Petty & Cacioppo, 1986). People with high issue involvement may be more likely to engage in issue-relevant activities, such as actively seeking the most recent information, thinking a lot about the issue, and being interested in the issue. As a result, prior issue involvement might influence message attributes' effects on perceived issue uncertainty and source credibility.

Tolerance for Ambiguity

Tolerance for ambiguity is a personal characteristic. It refers to how an individual perceives and processes ambiguous information which can involve an array of unfamiliar, complex, or incongruent cues (Furnham, 1994; Furnham & Ribchester, 1995).

Individuals with low tolerance for ambiguity perceive an ambiguous situation rigidly in black or white, express dislike in response to an ambiguous situation, and express responses indicating rejection or avoidance of an ambiguous situation (Grenier, Barrette, & Ladouceur, 2005). Consequently, individuals with low and individuals with high tolerance for ambiguity are expected to differentially evaluate source credibility and perceived issue uncertainty when they

feel uncertain about a health-related issue. It is likely that there is a negative association between perceived issue uncertainty and source credibility for people with low tolerance for ambiguity.

Epistemic Belief

Epistemic belief concerns whether a person believes absolute knowledge exists or whether knowledge changes over time (Welch & Roy, 2012). Epistemic beliefs refer to beliefs about knowledge and knowing (DeBacker, Crowson, Beesley, Thoma, & Hestevold, 2008).

Epistemic beliefs are related to learners' achievement motivation, cognitive engagement and strategy use, text comprehension, and achievement (DeBacker, Crowson, Beesley, Thoma, & Hestevold, 2008). People with more sophisticated epistemic beliefs who believe that knowledge changes over time might differ from those with less sophisticated beliefs who believe that absolute knowledge exists in their ability or willingness to process information about conflicting scientific findings. As a result, epistemic belief can influence message attributes' effects on perceived issue uncertainty and source credibility.

2.8.2 Behavior Variables as Potential Covariates

Use of E-Cigarettes

Use of e-cigarettes is an objective indicator of personal issue involvement. Issue involvement can affect the likelihood of message elaboration (Petty & Cacioppo, 1986). People use e-cigarettes may be more likely than non-users to engage in issue-relevant activities, such as actively seeking the most recent information, thinking a lot about the issue, and being interested in the issue. As a result, use of e-cigarettes might influence message attributes' effects on perceived issue uncertainty and source credibility.

Use of Regular Cigarettes

Use of regular cigarettes might also be an objective indicator of personal issue involvement with e-cigarette-related issues. As mentioned, issue involvement can affect the likelihood of message elaboration (Petty & Cacioppo, 1986). Cigarette users may be more likely than non-users to engage in issue-relevant activities. As a result, use of cigarettes might influence message attributes' effects on perceived issue uncertainty and source credibility.

News Reading Frequency

News reading frequency refers to how often an individual reads news stories. It is an indicator of one's use of media for news. Use of media for news is associated with perception of scientists' credibility (Anderson et al., 2012; Hmielowski et al., 2013). For example, Anderson and colleagues (2012) found that people who paid more attention to science news in media and people who paid more attention to public affairs news in media were more likely to trust scientists. Therefore, news reading frequency might explain variance in the dependent variables.

2.8.3 Demographic Variables as Potential Covariates

Majors

Students' major might be an indicator of their interest, actual knowledge in a topic, and epistemic beliefs. For example, students with a science major have higher interests in science than non-science majors (Larson, Pesch, Bonitz, Wu, & Werbel, 2013). Biology major is associated with increased knowledge used in reasoning about common health beliefs (Keselman, Hundal, Chentsova-Dutton, Bibi, & Edelman, 2015). Students who major in "soft" fields (i.e., social science and arts/humanities) have a stronger tendency to believe that knowledge is often uncertain, rely more on their independent reasoning, and have a stronger belief that learning is

not an orderly process than students major in “hard” fields (i.e., engineering) (Jehng, Johnson, & Anderson, 1993). Therefore, students’ major might influence message attributes’ effects on dependent variables.

Student Status

Student status might be an indicator of students’ thinking disposition and epistemic beliefs. For example, upper division students score higher on average than lower division students on critical thinking disposition (Giancarlo & Facione, 2001). Graduate students have a higher tendency than undergraduate students to believe that knowledge is often uncertain, rely more on their independent reasoning, and have a stronger belief that learning is not an orderly process (Jehng, Johnson, & Anderson, 1993). Therefore, student status might influence message attributes’ effects on dependent variables.

2.8.4 Perceived Message Features as Potential Covariates

Perceived Message Believability

Perceived message believability is the degree to which an individual perceives message portrayals reflect reality (Austin & Dong, 1996). Austin and Dong’s study found that people’s assessment of news reality is associated with their perceptions of source credibility. The higher the news believability the higher the source credibility. Therefore, perceived message believability was included as a potential covariate.

Perceived Ease of Understanding the Message

Perceived ease of understanding the message is the degree to which an individual perceives message as easy to read and understand. A prior study found that evaluations of messages’ readability can influence perception of source credibility. Specifically, health message

of moderate difficulty was found to be more trustworthy than health message of the easiest or message of the most difficulty (Bates, Romina, & Ahmed, 2007). Therefore, perceived ease of understanding the message was included as a potential covariate.

Perceived Message Interestingness

Perceived message interestingness is the degree to which an individual perceives message as interesting. More interesting message can be associated with greater source liking, closer information processing, and reduced counterargument (Nabi, Moyer-Gusé, & Byrne, 2007). As a result, perceived interestingness might influence source credibility. Therefore, it was included as a potential covariate.

CHAPTER 3. METHODS

3.1 Design

To examine the effects of presentation format and hedging on perceived issue uncertainty and source credibility, a 2 (two presentation formats: C1D vs. C2D) x 2 (hedged vs. not hedged) x 2 (presentation order: pro-first vs. con-first) between-subjects design plus a control group (i.e., non-exposure) was used. The eight manipulation groups and one control group constitute nine conditions in total. Participants were randomly assigned to one of the nine conditions.

It should be noted that no hypotheses about presentation order were made in the present study. Presentation order was manipulated only to assess whether it might be an alternative explanation for the variances in the dependent variables.

In the Results chapter, effects of presentation order on all dependent variables are presented before the results of hypotheses testing are presented.

The study was approved by IRB at Colorado State University.

3.2 Power Analysis

G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) was used to identify the ideal sample size for this study. A priori power analysis (numerator = 1, number of groups = 9) determined that a sample size of 210 was needed to achieve power = 0.95 for detecting medium effects as $f = 0.25$ (a medium effect was classified by G*Power).

3.3 Participants

Participants were recruited through a communication course at a mid-sized, western U.S. university. The communication course was a large undergraduate lecture course that had multiple sections. Students earned extra credit in the course for participating in the study. Students who chose not to participate were given an alternative way to earn the same amount of extra credit. A total of 491 students completed the study.

Description of participants is presented in Section 3.7.7.

3.4 Procedure

To recruit participants, I went to the sections of the class to introduce the study, and students were asked to let their course instructors know if they did not want to participate. Then I sent inviting emails to students who wanted to participate. In the emails participants were directed to a web-based experiment. The experiment was hosted by Qualtrics. After logging in, participants completed a background questionnaire that measured their predispositions, which included understanding of the scientific process, prior issue involvement, prior issue knowledge, tolerance for ambiguity, and epistemic belief. For prior issue involvement and prior issue knowledge, two other health-related issues, vaccination and genetically modified organisms (GMO), were also included to mask the specific topic of the study.

Participants were randomly assigned to one of the nine conditions. Participants who were assigned to one of the eight manipulation groups then read the stimulus materials. After reading the stimulus, participants completed a series of questions that measured perceived issue uncertainty, individual scientists' credibility, individual journalists' credibility, group scientists' credibility, and group journalists' credibility. After these dependent variable measures,

participants answered questions that measured features of the message and the manipulation check.

Participants who were assigned to the control group did not read a message. Instead they completed a series of questions that measured perceived issue uncertainty, group scientists' credibility, and group journalists' credibility.

All participants answered questions that measured news reading frequency, cigarette and e-cigarette use, demographic information, student status, student major, and the type of electronic device they used to complete the study. All participants then saw a debriefing statement about the purpose of the study (Appendix 16).

3.5 Pilot Tests

Before the study was conducted, three pilot tests were conducted using students from the same communication course. Findings of each pilot test are discussed in the relevant sections in the rest of the chapter.

The first pilot test was a full experiment. Participants ($N = 68$) were randomly assigned to the nine conditions. Using the pilot test data, measurement reliability was assessed.

The second pilot test was a face-to-face interview. Participants ($N = 12$) were randomly assigned to read one of the eight treatment stimulus messages. After reading, they were asked whether the news story they just read included any limitations. If they said the message contained limitations, they were asked to describe the limitations they found in the message. Through this test, stimulus materials were improved.

The third pilot test was a full experiment. Participants ($N = 44$) were randomly assigned to the nine conditions. Through this test, measurement reliability was assessed again and whether

people in hedged conditions were more likely than people in non-hedged conditions to report that the stimulus messages included limitations was also tested.

3.6 Stimulus Materials

The stimulus materials used in this study were newspaper articles (Appendix 17) written by a journalist who has worked for 20 years and has written for **The New Yorker**, **Forbes.com**, **National Catholic Reporter**, and **The Kansas City Star**. The journalist created the articles by following Stocking's (2010) readers' checklist for science stories. The checklist is made based on what information should be reported and what should result in higher understanding among the general news readers. It outlines the information to include in science stories and the order in which to present the information. According to the checklist, what scientists claim to have found and the apparent significance of these findings to science and/or society should appear high in the story because such information entails the most essential facts about a scientific study. After that, information should be presented about where and when the findings were announced, the affiliations of the researchers, the context of the discovery, the research methods, any important caveats or qualifiers, independent comments, ethical issues, and if any, future directions the research might go in.

The journalist used two scientific studies published in medical journals in 2014 to create the stimulus messages (Brown, Beard, Kotz, Michie, & West, 2014; Grana, Popova, & Ling, 2014). One study reported that e-cigarettes helped people quit smoking, and the other study reported that e-cigarettes did not help people quit smoking.

It should be noted that the news articles used in the final experiment did not contain numerals in the paragraphs where methods and results were reported. This decision was made

based on the interviews in the second pilot test. In that pilot test, participants considered the numbers reported in the news articles to be limitations. For example, one participant said that the fact that one study used 5,863 smokers while the other study only used 949 smokers was a limitation. Another student said that the fact that 20% of participants who used e-cigarettes quit smoking was a limitation because 20% was far away from 100%.

Before removing the numbers, the paragraph in the news article that described one of two studies was this:

The study surveyed 5,863 smokers between 2009 and 2014 who attempted to quit smoking without the aid of prescription medication or professional support. Twenty percent of people trying to quit with the aid of e-cigarettes reported having stopped smoking conventional cigarettes at the time of the survey.

After removing the numbers, the corresponding paragraph read as follows:

The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

Before removing the numbers, the paragraph in the news article that described the other study was the following:

The study surveyed 949 smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users (69% vs. 57.9%).

After removing the numbers, the corresponding paragraph read as follows:

The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

Manipulation of presentation format was achieved by varying the number of articles and use of integration devices. The one-article condition covered both studies in one article, while the two-article condition covered one study in each article. However, the two conditions were equivalent in the information provided about the two studies.

The one-article condition also differed from the two-article condition in the use of integration devices. Integration devices are pieces of information used to organize the structure of a news story, such as titles and transitions. In the present study, a single news article reporting conflicting findings about whether e-cigarettes help smokers quit was titled "Studies Disagree on Whether E-Cigarettes Help Smokers Quit," while in the two-article condition one article was titled "Study Reports E-Cigarettes Help Smokers Quit" and the other was titled "Study Reports E-Cigarettes Do Not Help Smokers Quit." Other integration devices used in the one-article condition included the transition from one study to the other study.

Integration devices were used to make the article in the one-article condition more realistic. When findings from scientific studies conflict, journalists explicitly report the conflict because conflict is one of the principles that journalists use to judge the newsworthiness of a story. For example, they would use a title such as "Studies Disagree on Whether E-Cigarettes Help Smokers Quit" to highlight the conflict. When findings are consistent, journalists also tend to explicitly report the consistency. For example, a sentence can go like "the finding of the new study is consistent with earlier studies."

The manipulation of hedging was achieved by whether or not the methodological limitations of the two studies were included in the article. In the hedged condition, study limitations were disclosed by the scientist(s) responsible for the studies. Limitations were taken from the original medical journal articles where the studies were published. In the non-hedged condition, filler information, such as the price and history of e-cigarettes, was used to make sure that the hedged and non-hedged articles were of approximately equal length.

Presentation order was also varied in both the one-article and the two-article conditions to assess whether it is an alternative explanation to the variances in dependent variables. Half of the stimulus articles had the study reporting that e-cigarettes helped people quit smoking first, while the other half had the study reporting that e-cigarettes did not help people quit smoking first.

All stimulus news articles were attributed to the Associated Press so the journalists who wrote the stories were not identified.

The exact number of words and readability of article(s) in each condition were also checked (see Table 1). This was done to rule out the possibility that variance in dependent variables was not due to variance in number of words and readability. To check readability, two indexes were used: SMOG Index (McLaughlin, 1969), which is based on the total number of words in the text that have three or more syllables, and Coleman-Liau Index (Coleman, M., & Liau, 1975), which is based on the average number of letters and the average number of sentences per 100 words.

Table 1. Readability Score and Total Words of Article(s)

Stimulus	SMOG Index	Coleman-Liau Index	Total Words
1. 1-article hedged pro-first	11.3	13.7	557
2. 1-article hedged con-first	11.3	13.8	560
3. 2-article hedged pro-first	10.6	12.7	559
4. 2-article hedged con-first	10.6	12.7	559
5. 1-article non-hedged pro-first	11.1	14.1	564
6. 1-article non-hedged con-first	11.0	14.1	567
7. 2-article non-hedged pro-first	10.5	13.1	567
8. 2-article non-hedged con-first	10.5	13.1	566

As can be seen in Table 1, both index scores suggested that stimulus articles used in the study were essentially the same.

3.7 Measures

This section presents the conceptualizations and operationalizations of dependent variables, predisposition variables, behavior variables, demographic variables, perceived message features, and the manipulation check. Descriptive statistics and reliability measures for these variables are presented in Section 3.7.8.

3.7.1 Dependent Variables

Dependent variables in the present study include source credibility and perceived issue uncertainty. Source credibility includes journalists' credibility and scientists' credibility.

Journalists' Credibility

Journalists' credibility is the competence and trustworthiness of journalists as a source of information (McCroskey & Teven, 1999). This dissertation is interested in the credibility of journalists at both the individual level and group level.

Jensen (2008) used McCroskey and Teven's (1999) source credibility scale to measure journalists' competence ($\alpha = 0.81$, 6 items) and trustworthiness ($\alpha = 0.78$, 6 items). McCroskey and Teven (1999) reported that the alpha reliabilities of their measures usually range between 0.80 and 0.94. Meyer's media channel credibility (1988) includes five items: fairness, biasness, accuracy, trustworthiness, and comprehensiveness of media as channels. It has a Cronbach's alpha of 0.83. Meyer's measure was relevant to the present study because its validity in measuring newspapers' credibility in reporting health-related controversies has been tested. McComas and Trumbo (2001) used it to measure newspapers' credibility in environmental health-risk controversies. In McComas and Trumbo's study, the Cronbach's alpha in five cases ranged between 0.76 and 0.90. However, there is theoretical and empirical distinction among credibility of journalists and credibility of media channels.

McCroskey and Teven's (1999) source credibility scale, therefore, was chosen to measure journalists' credibility. This scale was chosen for two reasons. First, it measures source credibility rather than channel credibility; second, the measure recognizes that competence and trustworthiness should be two separate dimensions. Message attributes such as hedging can influence journalists' competence and trustworthiness differently (Jensen, 2008). Because competence and trustworthiness were measured as separate dimensions, relevant hypotheses for each dimension were tested separately.

Individual journalists' competence. In the final study, participants were asked to indicate their feelings about the competence of journalists who wrote the news coverage. They rated individual journalists on six items (**unintelligent /intelligent, untrained/trained, inexpert/expert, uninformed/informed, incompetent/competent, and stupid/bright**) using seven-point scales. The six items were averaged into a single individual journalists' competence scale.

Individual journalists' trustworthiness. In the final study, participants were asked to indicate their feelings about trustworthiness of journalists who wrote the news coverage. They rated individual journalists on six items (**dishonest /honest, untrustworthy/trustworthy, dishonorable/honorable, immoral/moral, unethical/ethical, and phony/genuine**) using seven-point scales. The six items were averaged into a single individual journalists' trustworthiness scale.

Group journalists' competence. In the final study, participants were asked to indicate their feelings about competence of journalists who report research on health topics (e.g., e-cigarettes). They rated group journalists on six items (**unintelligent/intelligent, untrained/trained, inexpert/expert, uninformed/informed, incompetent/competent, and stupid/bright**) using seven-point scales. The six items were averaged into a single group journalists' competence scale.

Group journalists' trustworthiness. In the final study, participants were asked to indicate their feelings about trustworthiness of journalists who report research on health topics (e.g., e-cigarettes). They rated group journalists on six items (**dishonest /honest, untrustworthy/trustworthy, dishonorable/honorable, immoral/moral, unethical/ethical, and phony/genuine**) using seven-point scales. The six items were averaged into a single group journalists' competence scale.

Reliability of journalists' credibility in pilot tests. McCroskey and Teven's (1999) source credibility scale was tested for internal reliability in the first and third pilot tests. Cronbach's alpha for individual journalists' competence, individual journalists' trustworthiness, group journalists' competence, and group journalists' trustworthiness was 0.81, 0.92, 0.80, and 0.90 respectively in the first pilot test; Cronbach's alpha for individual journalists' competence,

individual journalists' trustworthiness, group journalists' competence, and group journalists' trustworthiness was 0.82, 0.90, 0.83, and 0.91 respectively in the third pilot test.

Therefore, journalists' credibility (Appendix 4 for individual journalists' credibility and Appendix 5 for group journalists' credibility) in the final study was measured using McCroskey and Teven's (1999) source credibility scale.

Scientists' Credibility

Scientists' credibility is the competence and trustworthiness of scientists as a source of information (McCroskey & Teven, 1999). This dissertation is interested in the credibility of scientists at both the individual level and group level.

Researchers have conceptualized scientists' credibility into two dimensions: competence and trustworthiness. For example, Jensen (2008) used McCroskey and Teven's (1999) source credibility scale to measure scientists' expertise ($\alpha = 0.89$, 6 items) and trustworthiness ($\alpha = 0.84$, 6 items) separately. Nadelson et al. (2014) developed and validated an instrument to measure trust in science and scientists. Their Trust in Science and Scientist Inventory is a 21-item instrument that has Cronbach's alpha of 0.86. Because message attributes such as hedging can influence scientists' competence and trustworthiness differently (Jensen, 2008), the present study measured scientists' competence and trustworthiness separately.

Individual scientists' competence. In the final study, participants were asked to indicate their feelings about the competence of scientists who conducted the studies that were mentioned in the news coverage. They rated individual scientists on six items (**unintelligent /intelligent, untrained/trained, inexpert/expert, uninformed/informed, incompetent/competent, and stupid/bright**) using seven-point scales. The six items were averaged into a single individual scientists' competence scale.

Individual scientists' trustworthiness. In the final study, participants were asked to indicate their feelings about the trustworthiness of scientists who conducted the studies that were mentioned in the news coverage. They rated individual scientists on six items (**dishonest /honest, untrustworthy/trustworthy, dishonorable/honorable, immoral/moral, unethical/ethical, and phony/genuine**) using seven-point scales. The six items were averaged into a single individual scientists' competence scale.

Group scientists' competence. In the final study, participants were asked to indicate their feelings about the competence scientists who conduct research on health topics (e.g., e-cigarettes). They rated group scientists on six items (**unintelligent /intelligent, untrained/trained, inexpert/expert, uninformed/informed, incompetent/competent, and stupid/bright**) using seven-point scales. The six items were averaged into a single group scientists' competence scale.

Group scientists' trustworthiness. In the final study, participants were asked to indicate their feelings about the trustworthiness of scientists who conduct research on health topics (e.g., e-cigarettes). They rated group scientists' trustworthiness on six items (**dishonest /honest, untrustworthy/trustworthy, dishonorable/honorable, immoral/moral, unethical/ethical, and phony/genuine**) using seven-point scales. The six items were averaged into a single group scientists' competence scale.

Reliability of scientists' credibility in pilot tests. McCroskey and Teven's (1999) source credibility scale was tested for internal reliability in the first and third pilot tests. Cronbach's alphas for individual scientists' competence, individual scientists' trustworthiness, group scientists' competence, and group scientists' trustworthiness were 0.88, 0.92, 0.90, and 0.93, respectively, in the first pilot test; Cronbach's alphas for individual scientists' competence,

individual scientists' trustworthiness, group scientists' competence, and group scientists' trustworthiness were 0.89, 0.90, 0.91, and 0.92, respectively, in the third pilot test.

Therefore, scientists' credibility (Appendix 2 for individual scientists' credibility and Appendix 3 for group scientists' credibility) in the final study was measured using McCroskey and Teven's (1999) source credibility scale.

Perceived Issue Uncertainty

Perceived issue uncertainty refers to an individual's perceptions of how incomplete knowledge about a particular issue is (Smithson, 1989). Researchers have conceptualized it as how uncertain a person feels about an issue. For example, Jensen and Hurley (2012) asked participants to rate how certain/uncertain they felt about dioxin regulation; Hmielowski and colleagues (2013) asked participants how sure they were about whether global warming was happening. Other researchers have conceptualized it as a person's perception of how uncertain scientists are and/or scientific evidence is about an issue. For example, Corbett and Durfee (2004) asked participants to rate to what extent they agree that global warming is a scientific uncertainty and to what extent they agree that scientists are unsure whether global climate change is occurring ($\alpha = 0.71$, number of items = 2); Dixon and Clarke (2013) asked participants to rate how certain they are that vaccines do not cause autism (with 1 item) and how certain they believe scientists are that vaccines do not cause autism (with 1 item). Dixon and Clarke conceptualized what one knows or does not know as internal uncertainty, and one's belief about what others know as external uncertainty.

The perceived issue uncertainty measure (Appendix 1) used in the final study was modeled from uncertainty measured by Corbett and Durfee (2004) and Dixon and Clarke (2013). Perceived issue uncertainty in the present study included perception of a person's own

knowledge of the issue, perception of the scientists' knowledge of the issue, perception of scientific evidence, as well as perception of the public's knowledge of the issue.

Using four items, participants rated how they, scientists, and the public feel about the certainty of the scientific evidence about e-cigarettes' association with smoking cessation. Response options (**uncertain/certain**) were assessed using seven-point scales. The four items were averaged into a single perceived issue uncertainty scale.

Reliability of perceived issue uncertainty in pilot tests. The measure was tested for internal reliability in the first and third pilot tests. The Cronbach's alpha was 0.77 in the first pilot test and 0.80 in the third pilot test.

3.7.2 Predisposition Variables

Predisposition variables included prior issue knowledge, understanding of science, prior issue involvement, tolerance for ambiguity, and epistemic belief.

They were measured for two purposes. First, to determine whether the participants in the nine conditions differed substantially. Doing this enables me to know whether the variance in the dependent variables across conditions is the result of treatment, or predisposition differences, or both. Second, to examine whether these variables moderated effects of the manipulations. Doing this has both theoretical and practical implications.

Prior Issue Knowledge

Prior issue knowledge refers to a person's perception or self-assessment of his/her actual knowledge of a specific issue (Brucks, 1985; Raju, Lonial & Mangold, 1995). Prior knowledge has been measured by asking to what extent people had heard about a particular issue with a one-item scale (Jensen & Hurley, 2012). A multiple-item scale was developed to measure people's

subjective knowledge of a product (Raju, Lonial, & Mangold, 1995). Raju and colleagues' measure asked people their ability to use the product, judge the quality of the product, understand various attributes of the product, and offer advice to others about the product. The measure had a Cronbach alpha of 0.83. Another multiple-item scale (Brucks, 1985) for products asked people how familiar they were with various characteristics of a product. The scale had an alpha of 0.91.

E-cigarette is a health-related issue or product; knowledge about it encompasses various aspects. For the present study, knowledge of e-cigarettes was informed by a systematic review of e-cigarettes' safety and risk assessment (Farsalinos & Polosa, 2014). Knowledge included e-cigarettes' clinical safety, addictiveness, chemical composition, and association between use of e-cigarettes and use of traditional cigarettes.

The measure achieved good internal reliability in the first and third pilot tests. The Cronbach's alpha in the first pilot test was 0.89; the alpha in the third pilot test was 0.81.

Therefore, prior issue knowledge (Appendix 9) in the final study was measured by compiling items from the two product measures (Brucks, 1985; Raju, Lonial & Mangold, 1995) and knowledge content of e-cigarettes (Farsalinos & Polosa, 2014). Participants were asked how familiar they were with aspects of e-cigarettes (i.e., addictiveness as compared with traditional cigarettes, clinical safety, chemical composition, association between use of e-cigarettes and use of traditional cigarettes), how familiar they were with e-cigarettes' health effects, how capable they feel if they were asked to give advice to a friend/family member who wants to use e-cigarettes to quit smoking, and how confident of the vote they would cast if they were asked to vote on whether to regulate e-cigarettes as a way to help people quit smoking. A seven-point response set was used. All the items were averaged into a single scale.

Understanding of Science

Public understanding of science concerns knowledge of science and attitudes toward science (Bauer, 2009). According to Bauer (2009), the concept of science knowledge or literacy includes four elements: (a) knowledge of basic textbook facts of science, (b) an understanding of scientific inquiry, (c) an appreciation of the positive outcomes of science and technology, and (d) the rejection of superstitious beliefs such as astrology or numerology. This four-element approach is the basis of the best-known surveys (e.g., the U.S. National Science Foundation's **Science and Engineering Indicators** report and Eurobarometer study) of public understanding of science among adult populations.

Conceptualization of understanding of science in the present study did not include knowledge of basic textbook facts of science. This is for two reasons. First, critics have argued that the essence of science is method and not facts (Bauer, 2009). Second, facts are topic specific and methods can be applicable to various topics. For example, knowledge of physical and biological sciences in the National Science Foundation (NSF) study was measured separately using items from the Eurobarometer study.

Appreciation of the positive outcomes of science and technology, and rejection of superstitious beliefs were not relevant to the present study which is about e-cigarettes' efficiency in helping quit smoking.

Understanding of science in the present study was conceptualized as understanding of scientific inquiry. To measure the understanding of scientific inquiry, the NSF study used 5 items from the Eurobarometer study. These items were meant to measure understanding of science in three ways: by measuring understanding of experimental method, by measuring understanding of probability, and by measuring understanding of scientific study.

All three of these ways to operationalize understanding of science were used in the present study. Understanding of experimental method was relevant because one manipulation was about whether to include method limitations in news stories. Understanding of probability was also relevant because it is a basic concept in understanding the nature and results of scientific research. And with increasing frequency, the results of medical research and medical diagnoses are presented in probability terms (Miller, 2004). Understanding of scientific study was relevant as well because the news in the present study was based on two scientific studies.

Regarding the measurement of understanding of experimental method, there are different ways to do it. For example, the measure in the NSF study used a multiple-choice question to ask people how to test the effectiveness of a certain drug and a follow-up, open-ended question about why the chosen method is better to test the drug. Other methods can also be used to measure understanding of experimental method. For example, in class settings where students are expected to understand scientific research methods teachers used quiz questions to test students understanding of the difference between correlational studies and experimental studies ("Correlational versus Experimental Studies," n.d.). As difference between the two types of studies is relevant to the understanding of experimental method, these quiz questions were used in the first pilot test. Quiz questions (4 items) included items such as "is the finding that heavy drinkers get lower college grades based on a correlational study or an experimental study? "Of the 68 participants, no one got 4 items correctly, 5 got 3 items correctly, 12 got 2 items correctly, 25 got 1 item correctly, and 26 got 4 items incorrectly. This finding suggests that the questions used in this measure were difficult for the majority of the students. Also the Cronbach's alpha was 0.53. Therefore, it was not a sensitive or valid measure and was dropped.

The measures from the NSF study were tested in the third pilot. The NSF study adopted categorical measures. Understanding of experimental method was measured with a multiple-choice question asking people how to test the effectiveness of a certain drug and a follow-up, open-ended question about why the chosen method is better to test the drug. Participants were categorized into those who answered both correctly, those who answered one correctly, and those who answered none correctly. In the third pilot test, only the multiple-choice question was used and the follow-up, open-ended question was not. In the NSF study, understanding of probability was measured using two multiple-choice questions asking what a one-in-four chance of getting a genetic illness meant, and understanding of scientific study was measured by asking participants whether they had a clear understanding, a general sense, or little understanding of what it meant by study something scientifically. For understanding of probability, participants were categorized into those who answered both correctly, those who answered one correctly, and those who answered none correctly. In the third pilot test, the items for understanding of probability and scientific study were the same as those from the NSF study.

Understanding of experimental method. Of the 44 participants in the third pilot test, 38 participants (86.4%) correctly chose the way with a control group should be used for comparison to test the effectiveness of a drug, 4 participants (9.1%) incorrectly chose the way without a control group, and 2 (4.5%) did not provide answers to the question. This categorical scale captured the variation among the participants so it was kept in the final study.

Understanding of probability. Of the 44 participants, 32 participants (72.7%) answered both questions correctly, 6 participants (13.6%) answered one correctly, 4 participants (9.1%) answered none correctly, and 2 (4.5%) did not provide answers to the question. This categorical scale captured the variation among the participants so it was kept in the final study.

Understanding of scientific study. Of the 44 participants, 2 (4.5%) reported that they had little understanding, 24 participants (54.5%) had a general understanding, and 18 participants (40.9%) said they had a clear understanding. This categorical scale also captured the variation among the participants so it was kept in the final study.

Scale of understanding of science. In the final study, points for understanding of experimental method, probability, and scientific study were summed to create a single scale of understanding of science.

Prior Issue Involvement

Prior issue involvement is the degree to which a person perceives an issue to be personally relevant (Petty & Cacioppo, 1981). Researchers have measured issue involvement as a post-exposure variable. For example, people were asked to rate how involved they were when they were exposed to experiment stimulus materials about an issue, and how important to them was the issue (Cacioppo, Petty, Kao, & Rodriguez, 1986). However, Cacioppo and colleagues did not report a reliability for their measure.

A widely used personal involvement inventory was developed by Zaichkowsky (1985) to capture the concept of consumers' product involvement. The five-item inventory includes interest in reading information about how a product is made, interest in reading articles from a specific magazine about this product category, comparison among product attributes, perception of similarity among different brands, and preference for a particular brand. The first two items are about active information seeking. Zaichkowsky (1985) tested the measure's reliability for various products. The Cronbach alpha for the measure ranged between 0.95 and 0.99, depending on the topic. However, among the five items, only the items about active information seeking can be applied to the topic and participants of the present study.

Nowak and Salmon (1987) developed an involvement measure for social issues. Their measure had high reliability with an alpha between 0.89 and 0.93, depending on the issue. This measure has 10 items on which each issue is rated, such as the extent to which an issue is important, relevant, significant, vital, or matters to them. Nowak and Salmon mentioned that this measure is unidimensional.

There might be other dimensions for the concept of issue involvement, such as need of information. For example, the Yale Project on Climate Change Communication (Leiserowitz, Maibach, Roser-Renouf, & Smith, 2013) asked people how much more information they needed before making up their mind about climate change (one item) and how easily people change their mind about global warming (one item). The Yale Project also asked how much people thought about global warming (one item) and how interested people were in the issue of global warming (one item). A study using three of the four items reported an alpha of 0.56 (Myers, Anderson, Roser-Renouf, & Maibach, 2013).

The present study used the measure by the Yale Project. But because of the low reliability, the present study used all four items and tested its internal reliability in the first and third pilot tests.

In the first pilot test, the Cronbach's alpha was 0.43 with the four items. Among the four items, two items (i.e., need for more information and easiness to change mind) had low correlation with the other two items. If the two items were removed, the alpha would be 0.61, which is still not acceptable.

To improve reliability, two items from a measure of issue involvement in a health issue (Flora & Maibach, 1990) were added to replace the two items with low correlations. The two added items asked to what extent people actively seek the most recent information about the

issue and the extent to which they consider that the issue poses a risk to their health. The revised measure was tested for internal reliability in the third pilot test. The measure achieved an alpha of 0.78.

Therefore, prior issue involvement with e-cigarette health issues (Appendix 8) in the final study was measured by combining the Yale Project's involvement measure and Flora and Maibach's health issue involvement measure (1990). Participants were asked to rate the following: 1) how much they had thought about e-cigarettes-related health issues, 2) how interested they are in e-cigarettes-related health issues, 3) to what extent they actively sought the most recent information about e-cigarettes-related health issues, and 4) to what extent they consider themselves at risk of e-cigarettes-related health issues. The four items were measured using four-point scales. All four items were averaged into a single prior issue involvement scale

Tolerance for Ambiguity

Tolerance for ambiguity refers to an individual's tendency to interpret an ambiguous situation as a threat or a source of discomfort (Budner, 1962; Kirton, 1981). Three types of situations are conceptualized as ambiguous. They are: novel (e.g., I would like to live in a foreign country for a while), complex (e.g., A good job is one where what is to be done and how it is to be done are not always clear), and insoluble (e.g., There is really no such thing as a problem that cannot be solved).

One of the most used early measures is Budner's (1962) 16-item scale (Grenier, Barrette, & Ladouceur, 2005). Budner reported an alpha of 0.59. To develop a more reliable scale, the scale became even more extended over time (Grenier, Barrette, & Ladouceur, 2005). Bhushan and Amal (1986) developed a 40-item scale to measure situational intolerance of ambiguity without reporting its reliability (Leyro, Zvolensky, & Bernstein, 2010). McLain (1993) reported

a good reliability of 0.86, but the scale had 22 items. Buhr and Gugas (2002) reported an excellent reliability of 0.94, but the scale had 27 items.

Kirton (1981) shortened Budner's scale into a 7-item scale and reported a reliability of 0.65. To find a reliable scale with number of items reasonable to the present study, Kirton's scale was tested for internal reliability in the first pilot test. The Cronbach's alpha was 0.62. This is below 0.70, but similar to Kirton's reported alpha level. Kirton's scale was tested again in the third pilot test. The same alpha, 0.62, was found. In the final study, Kirton's original scale was still used because of its advantage in smaller number of items.

Tolerance for ambiguity (Appendix 10) in the final study, was measured using Kirton's (1981) seven items and a seven-point response set. The seven items were averaged into a single scale.

Epistemic Beliefs

Epistemic beliefs are beliefs about the nature of knowledge (Schommer, 1990). According to Schommer, the nature of knowledge has four dimensions: certainty of knowledge, structure of knowledge, speed of knowledge, and learnability of knowledge. Certainty of knowledge refers to the extent to which people believe that knowledge is certain rather than tentative. Structure of knowledge refers to the extent to which people believe that knowledge is interrelated concepts. Speed of knowledge refers to people's belief in how fast knowledge can be learned. Learnability of knowledge refers to the extent to which people believe that the ability to learn is innate.

Other measures offer alternative conceptualizations of beliefs about knowledge (Rouet, 2008). In their review, Hofer and Pintrich (1997) identified concerns about the definition of epistemic beliefs as a construct and the lack of conceptual clarity regarding various belief

dimensions. They pointed out that speed of knowledge and learnability of knowledge pertained more to the beliefs about the nature of learning rather than the beliefs about knowledge. They posited that epistemic beliefs have four belief dimensions: certainty of knowledge, simplicity of knowledge, source of knowledge, and justification of knowledge.

The present study chose one knowledge dimension, certainty of knowledge. This is because it is a common dimension of belief in knowledge as demonstrated by the Schommer (1990) and Hofer and Pintrich (1997). It is also because belief in certainty of knowledge is relevant to the topic of the present study.

Studies involving certainty of knowledge have shown inconsistency in its internal reliability. Ravindran et al. (2005) reported a Cronbach's alpha of 0.66, Nussbaum and Bendixen (2003) reported a Cronbach's alpha of 0.69, and Schraw et al. (2002) reported a Cronbach's alpha of 0.68. However, Welch and Ray's (2012) belief in certainty of knowledge had an alpha of 0.75. A shorter version by Bendixen, Schraw, and Dunkle (1998) reported an alpha of 0.76 using college students as participants.

Bendixen et al.' s scale was tested for internal reliability in the first and third pilot tests. The alpha was 0.53 in the first pilot test, and the alpha was 0.69 in the third pilot test. In the final study, Bendixen et al.' s scale was still used because their original study reported an alpha of 0.76, and the third pilot test had an alpha that was very close to 0.69. Their scale was chosen also because of its advantage in smaller number of items.

Epistemic belief (Appendix 11) in the final study was measured using Bendixen et al.' s four-item belief in certainty of knowledge (1998). Participants were asked to indicate the extent to which they agreed or disagreed with statements about certainty of knowledge (e.g., Science is

easy to understand because it contains so many facts). Participants used a five-point response set. The four items were averaged into a single epistemic belief scale.

3.7.3 Behavior Variables

Behavior variables included news reading frequency, use of regular cigarette, and use of e-cigarette.

News reading frequency was measured for two reasons. First, media use has been associated with perceptions of science and scientific authorities (Anderson, Scheufele, Brossard, & Corley, 2012; Nisbet et al., 2002; Shanahan, Morgan, & Stenbjørre, 1997). For example, science media use is a predictor of trust in scientists (Anderson et al., 2012). The present study tested its association with the dependent variables. Second, it was measured to determine whether the participants in the nine conditions differed substantially in this variable so as to increase internal validity of the present study.

Use of regular cigarettes and use of e-cigarettes were measured for two reasons. First, to test their association with dependent variables. Second, they were measured to determine whether the participants in the nine conditions differed substantially in the two variables so as to increase internal validity of the present study.

News Reading Frequency

The present study conceptualized news reading frequency as an individual's use of media for news.

Use of media for news has been operationalized differently by past studies. It has been measured as the time spent using various media for news (Althaus & Tewksbury, 2000). Althaus and Tewksbury (2000) operationalized time as the product of frequency of weekly use and time

spent each day consuming news. They asked participants two open-ended questions: how many days, during an average week, did participants use a particular medium (e.g., newspapers, TV) for news, and on days when participants used that particular medium (e.g., newspapers, TV), about how many hours did they spend using it. This operationalization assumes that the days people spend on a particular media each week are the same and the hours spent on each day are the same.

Use of media for news has also been measured as frequency of using various media types for various types of news (McLeod & Perse, 1994). McLeod and Perse (1994) asked participants how often (1 = never, 5 = all the time) they use various media types (e.g., TV, newspapers) for various types of news (e.g., international affairs, national government politics, and local government and politics).

Following the idea of distinguishing types of media and types of news, Anderson and colleagues (2012) measured science media use. They used a 9-item measure, which included attention to specific aspects of science issues (e.g., scientific development, social or ethical implications of science) in three types of media (i.e., the Internet, newspapers, and television).

A different approach to operationalize media use is based on perception modes. News can be read, listened to, or watched. The three activities are different in at least the amount of cognitive resources needed to process news. The present study operationalized media use for news as how often people read news. Also this approach did not distinguish types of media, types of news, or aspects of science issues. What types of news participants often read, what types of media participants often get their news from, and what is news and non-news were left for the participants to decide.

News reading frequency was measured by asking participants how often (1 = never, 7 = every time) they read news stories. This is a categorical scale. The measure's ability to capture variation among students was tested in the first and third pilot tests.

In the first pilot test, among the 68 participants, 4 participants (5.9%) reported that they never read news stories, 11 participants (16.2%) rarely read news stories, 21 participants (30.9%) occasionally read news stories, 14 participants (20.6%) read news stories sometimes, 11 participants (16.2%) frequently read news stories, 5 participants (7.4%) usually read news stories, 1 participant (1.5%) read news every time, and 1 (1.5%) missing.

In the third pilot test, among the 44 participants, 1 participant (2.3%) reported that they never read news stories, 4 participants (9.1%) rarely read news stories, 19 participants (43.2%) occasionally read news stories, 8 participants (18.2%) read news stories sometimes, 6 participants (13.6%) frequently read news stories, 4 participants (9.1%) usually read news stories, and 2 participants (4.5%) read news every time.

The first and third pilot test results suggested that this general-measure approach was able to capture the variation among students. Therefore, in the final study, news reading frequency (Appendix 12) was measured by asking participants how often (1 = never, 7 = every time) they read news stories.

Use of Regular Cigarettes

The present study conceptualized use of regular cigarettes as current use of traditional cigarettes.

Prior studies operationalized a current user differently but all provided a standard for their participants. For example, in the surveys of young people, a current user is someone who used tobacco at least once during the past 30 days (Warren et al., 2006; Hibell et al., 2004;

WHO, 2007). In surveys of school-aged children, a current user is someone who uses tobacco either daily or weekly (Godeau et al., 2004; Hublet et al., 2006). In surveys of adults (e.g., Global Adult Tobacco Survey, STEPwise Approach to Chronic Disease Factor Surveillance), a current smoker is someone who currently smokes daily or less than daily. In the International Tobacco Control Policy Evaluation Survey, a current smoker has to meet two criteria. First, persons who have ever smoked at least 100 cigarettes in their lifetime. Second, persons who have smoked daily, weekly, or monthly. Measures by these studies may be able to accurately include daily, weekly, or monthly smokers, but may exclude social smokers because they don't smoke daily, weekly, or monthly.

The present study operationalized a current user by allowing the participants to decide whether they are users. Participants were asked whether they use regular cigarettes.

In the first pilot test, of the 68 participants, 4 (5.9%) reported that they smoke regular cigarettes. In the third pilot test, of the 44 participants, 2 (4.5%) reported that they smoke regular cigarettes.

These figures are substantially lower than what researchers from the Harvard School of Public Health reported about college students nationwide (Wechsler, Lee, & Rigotti, 2001). The Harvard scholars surveyed a nationally representative sample of college students at 128 U.S. 4-year colleges and found that the prevalence of current cigarette users was above 21%. One explanation to the substantial difference could be that the general measure is less reliable than a more specific one. It also could be that when people get to decide some smokers (e.g., weekly, monthly, or even daily smokers but who are defensive or in denial) did not identify themselves as smokers and/or other less frequent smokers (e.g., social smokers) tended to identify themselves as smokers.

In the final study, use of regular cigarettes (Appendix 13) was measured by asking participants whether they smoke regular cigarettes, which allowed them to decide.

Use of E-Cigarettes

The present study conceptualized use of e-cigarettes as current use of e-cigarettes. Similar to the operationalization of use of regular cigarettes, prior studies provided a time period to define an e-cigarette user. For example, a current e-cigarette user is someone who uses an e-cigarette in the past 30 days on at least 1 day (Sutfin et al., 2013; Dutra & Glantz, 2014).

For the same reason why use of regular cigarettes was operationalized the way it was, the present study operationalized use of e-cigarettes also by allowing participants to decide whether they are an e-cigarette user.

Participants were asked in the first and third pilot test whether they use e-cigarettes. In the first pilot test, of the 68 participants, 6 (8.8%) reported that they use e-cigarettes. In the third pilot test, of the 44 participants, 5 (11.4%) reported that they use e-cigarettes.

These figures are substantially higher than what researchers found out about college e-cigarette users. A study (Sutfin et al., 2013) using a stratified random sample of undergraduate students who attend eight universities in North Carolina found that 1.5% reported using e-cigarettes in the past month, 2.0% reported use in the past year but not the past month, and 1.4% reported use more than a year ago but not in the past year. The rates of ever e-cigarette use across the eight universities ranged from 3.9% to 5.8%, while the rates of current e-cigarette use across the eight universities ranged from 0.9% to 2.0%.

One explanation to the difference is that the two samples are different. Another explanation is that when people get to decide whether they are e-cigarette users, they tend to identify themselves as users.

In the final study, use of e-cigarettes (Appendix 13) was measured by asking participants whether they use e-cigarettes.

3.7.4 Demographic Variables

Demographic variables included age, gender, and ethnicity. Student status and student major were also included as demographic variables. Demographic variables (Appendix 14) included age, gender, race/ethnicity, student status, and student major. Age, gender, and race/ethnicity were included as sample descriptors; student status and student major were included as both sample descriptors and potential covariates.

3.7.5 Perceived Message Features

Perceived Message Believability

Perceived message believability was measured using a one-item question like Opgenhaffen and d' Haenens (2011) did in their study. Participants were asked to rate the believability of the news coverage they just read. They used a five-point response set to answer the question (strongly disagree/disagree/neither agree or disagree/agree/strongly agree).

Perceived Ease of Understanding the Message

A two-item scale of perceived ease of understanding the message was adapted from Opgenhaffen and d' Haenens's study (2011), and it was tested in the first and third pilot tests. The two-item (i.e., how easy to understand, how easy to read) scale used a five-point response set (strongly disagree/disagree/neither agree or disagree/agree/strongly agree). The two items were averaged into a single index. In the first pilot, the Cronbach's alpha was 0.78. In the third pilot

test, the alpha was 0.77. In the final study, perceived ease of understanding the message was measured using these two items and averaged into a single index.

Perceived Message Interestingness

It was measured using a one-item question like Opgenhaffen and d' Haenens (2011) in their study. It was measured by asking participants to rate interestingness of the news coverage they just read. They used a five-point response set to answer the question (strongly disagree/disagree/neither agree or disagree/agree/strongly agree).

3.7.6 Manipulation Check

Manipulation Check Questions

The present study has two manipulations. One manipulation was hedging (i.e., reporting scientific limitations in news stories), and the other manipulation was presentation format.

A check on the first manipulation is necessary to make sure that participants who were assigned to hedged conditions noticed the limitation(s) included in the stories. However, a check on the second manipulation, presentation format (as one or two stories), is not necessary because of the way that the study was designed. The experiment was designed so that participants who were assigned to the two-article conditions had to be exposed to two articles before they completed the study. Participants assigned to the one-article conditions had to be exposed to one article before they completed the study.

To determine whether the manipulation on hedging (Appendix 15) was successful, participants were asked, "In the news coverage you just read, was there an outright mention of a specific limitation of either scientific study? A limitation of a scientific study is defined as a potential flaw in the way scientists carried out their study and it could influence the results of a

study." If participants chose "Yes," a follow-up question asked them to describe what the outright mentioned, specific limitation(s) was/were; if they chose "No" or "I don't know," a follow-up question asked them to describe why they chose "No" or "I don't know."

A definition of limitation was included in the check question to reduce the chance of people reporting other information in the news as limitations.

Three Manipulation Check Approaches: Low-Awareness Approach, Medium-Awareness Approach, and High-Awareness Approach

With the multiple-choice question and the follow-up, open-ended question, the present study proposes three approaches to use the manipulation check.

The first approach uses only the multiple-choice question and statistical analyses to determine whether responses to the question differ significantly among conditions as researchers intended them to be. For example, Steele and Aronson (1998) wanted to know whether descriptions of purposes of a difficult test could influence African-American students' performance. They manipulated three conditions: a diagnostic condition, a non-diagnostic condition, and a challenge condition. In the diagnostic condition, the test was described as a diagnostic of intellectual ability, as the researchers thought that describing a test as diagnostic would prime African-American students to feel the threat of racial stereotype. In the non-diagnostic condition, the same test was described simply as a laboratory problem to better understand the "psychological factors involved in solving verbal problems." In the challenge condition, participants were encouraged to view the test as a challenge. To check their manipulations on purposes of the test, Steele and Aronson used Chi-square analyses to check whether participants were more likely to believe that the experiment was an evaluation of ability in the diagnostic condition than in the non-diagnostic or the challenge conditions. Other

researchers also used statistical analyses to check their manipulations (Garcia, Schmitt, Branscombe, & Ellemers, 2010; Jensen, 2008). If statistical analyses suggest that the responses to the multiple-choice question differ significantly as the researchers intended them to be, researchers keep all cases in the sample for their subsequent hypotheses testing.

The second approach also uses only the multiple-choice question. If participants answer the question incorrectly, they are removed from subsequent analyses. This approach is widely used. For example, Boiarsky, Rouner, and Long (2013) wanted to know the effects of responsibility attribution and message source on people's health-related attitudes and behaviors. Responsibility to take care of one's health was attributed to either the individual or the society in the stimulus messages used in the study; message source was manipulated as a web log or as an online magazine in the stimulus messages. To check the manipulation of attribution of responsibility, participants were asked how much they agreed that the message they read emphasized the responsibility of the social organizations; to check the manipulation of message source, participants were asked the "message you just read was from which of the following sources? a) web log b) magazine c) I don't remember. In their study participants who answered one or both of the questions incorrectly were removed from subsequent analyses.

The third approach uses both the multiple-choice question and the open-ended question. Only the participants who answer the multiple-choice question correctly and can accurately describe the manipulation are included for subsequent analyses.

To use the first approach, a Chi-square test was conducted. The test found that whether participants answered "Yes" or "No" to the question of whether there was an outright mention of a specific limitation of either scientific study did differ by whether the stories were hedged or not, $\chi^2(1, N = 427) = 83.58, \phi = 0.44, p < 0.01$. The effect size is close to large when $\phi = 0.50$.

People in hedged conditions were more likely to think the stories they read had mentioned specific limitation(s), people in non-hedged conditions were less likely to do so, and the two conditions did not differ in whether participants answered "I don't know" to the question.

To use the second approach, I removed the cases that answered the multiple-choice question incorrectly. Answering the question incorrectly means choosing "Yes" when the case was in a non-hedged condition or choosing "No" when the case was in a hedged condition. Of the 491 participants, 73 participants answered the multiple-choice question incorrectly, 233 answered the question correctly, and 121 chose "I don't know."

Chi-square tests were conducted to check the distribution of incorrect cases, correct cases, and "I don't know" cases across two levels of hedging, presentation format, and presentation order. The distribution of the three types of cases did not differ across the two conditions of hedging, $\chi^2(2, N = 427) = 5.08$, $\phi = 0.11$, $p = 0.08$. The distribution of the three types of cases did not differ across the two conditions of presentation format, $\chi^2(2, N = 427) = 1.85$, $\phi = 0.07$, $p = 0.40$. The distribution of the three types of cases did not differ across the two conditions of presentation order, $\chi^2(2, N = 427) = 1.59$, $\phi = 0.06$, $p = 0.45$. In summary, the removed cases distributed evenly between the two conditions of presentation format, between the two conditions of hedging, and between the two conditions of presentation order. Knowing the removed cases distributed evenly across conditions is important because it rules out uneven distribution as an alternative explanation to the findings.

To use the third approach, a coding scheme for checking manipulation of hedging (Appendix 18) was developed. The coding scheme was used for the open-ended question asking participants to describe what the limitation(s) was/were if they thought there was/were limitation(s).

Two coders were involved in the coding. Both coders read the stimulus articles and one was aware of the purpose of the study. Before intercoder reliability was tested, a draft codebook was first written and two training sessions were conducted.

The draft codebook included information about what the two limitations are and instruction on coding. The instructions told coders "if an answer identified what one of the two limitations is or the two limitations are, code it as 1; otherwise, code it as 0." Examples of what should be counted as "1" were included.

In the first training session, the two coders coded 33 example answers together and discussed their disagreement and questions. These examples of answers were constructed based on the answers being used for the actual study. One disagreement emerged was whether to count answers only mentioning "sample size" or similar variants such as "number of participants." One coder thought it should be counted because that is what appeared in the hedged condition. The other coder thought the otherwise because the answer might be referring to the size of all participants in general when "e-cigarette users" is not included. Coders agreed that any mentioning of sample size or similar variants should be counted as "1". One question both coders raised was whether to count answers only mentioning where the limitation(s) is/are but without mentioning what they are/it is. A similar question was whether to count answers only emphasizing there is/are limitation(s) without mentioning what they are/it is. Coders agreed that only mentioning where or only emphasizing should not be counted.

In the second training session, 33 example answers were constructed again based on the answers being used for the actual study. The two coders coded them independently and discussed disagreement afterwards. One disagreement emerged about whether to count answers only generally said the method is flawed. Coders agreed that general references to method flaws

without identifying sample size or lapse data should not be counted. The intercoder reliability was 0.82.

Final intercoder reliability was then tested using 10% subsample that was randomly selected from the answers being used for the actual study. The two coders coded them independently. Inter-coder reliability was 0.87 in Cohen's kappa. One of the coders, who developed the code scheme and was aware of the purpose of the study, coded the rest of the sample.

Of the 491 participants in the study, 222 were assigned to the hedged conditions; of the 222 assigned to hedged conditions, 101 answered the multiple-choice question correctly and were able to recall or describe at least one limitation.

The High-Awareness Approach Was Used

The three approaches used in the present study represent three levels of participants' awareness of the limitation(s). The third approach represents a high level, the second approach represents a medium level, and the first approach represents a low level. Among the participants who were assigned to the hedged condition, only participants who recognized and described the limitation(s) were included when the third approach was used. When the second approach was used, among the participants who were assigned to the hedged condition, only participants who recognized the limitation(s) were included. When the first approach was used, no participants were removed, regardless whether they recognized or described the limitation(s) or not, because participants in the hedged condition were significantly more likely than participants in the non-hedged condition to recognize the limitation(s).

For this reason, the present study refers to the first, the second, and the third approach as low-awareness approach, medium-awareness approach, and high-awareness approach respectively.

In the Results chapter, only results for the high-awareness approach are presented because this approach used the strongest manipulation check. Using the strongest manipulation check possible is a general principle in experimental studies (Cozby & Bates, 2011). According to Cozby and Bates (2011), following the principle is particularly important in the early stages of research, when a researcher is most interested in demonstrating that an effect does, in fact, exist. If the early experiments reveal an effect of hedging on source credibility, later research can systematically vary the levels of hedging to provide a more detailed understanding of the effect.

3.7.7 Description of Participants

This section presents demographic descriptions of participants using the high-awareness approach. Those using the other two approaches are included in Appendix 19.

The sample ($N = 260$) was 38.1% male and 61.9% female. The sample was largely Caucasian (see Table 2). Participants ranged from 19 to 51 years of age, with a mean of 22.43 years ($SD = 4.28$). The majority of the participants were 25 years or younger (90.3%).

Table 2. Ethnicity Composition of Participants Using the High-Awareness Approach (N = 260)

Ethnicity	Number	Percent
Caucasian	231	88.8%
Hispanic, Latino, or Spanish Origin	23	8.8%
Asian or Pacific Islander	20	7.7%
African American	8	3.1%
Arabic, Egyptian or Maghreb	1	0.4%
American Indian or Native American	6	2.3%
Other	2	0.8%
	Total 291 ^a	

^a There are more than 260 because participants of multiple ethnicities consisted of 11.9 % of the sample.

Also of interest in this study are science major and student status. Science major in the present study was defined using the National Survey of Student Engagement's (NSSE, 2012) major field categories. There are three science categories in the NSSE. They are biological sciences (e.g., biology, biochemistry, zoology, environmental science), physical sciences (e.g., chemistry, statistics, geology, astronomy), and social sciences (e.g., psychology, economics, anthropology, social work).

One coder coded all the participants' answers to this open-ended question. Consequently, the measure was not tested for reliability.

Twenty-nine percent of the sample were science majors, and 0.4% were first-year, 21.1% were second-year, 50.8% were third-year, and 27.7% were fourth-year students.

3.7.8 Descriptive Statistics and Reliability Measures for Variables

This section presents descriptive statistics and reliability measures for variables using the high-awareness approach. Those using the other two approaches are included in Appendix 20.

Based on a commonly accepted rule for describing internal reliability (see Table 3) using Cronbach's alpha (DeVellis, 2012), all dependent variables and one predisposition variable (i.e. prior issue knowledge) achieved good reliability with alpha level above 0.80. Reliability of prior issue involvement and ease of reading were acceptable, which was above 0.70. Reliability of epistemic belief was questionable with an alpha of 0.66. Reliability of tolerance for ambiguity was poor, at 0.57. Reliability of understanding of science was unacceptable at an alpha of 0.43.

Table 3. Descriptive Statistics and Reliability for Variables Using the High-Awareness Approach

Variables	Cronbach's alpha	M	SD
Perceived Issue Uncertainty	0.83	4.74	1.33
Individual Scientists' Competence	0.88	5.15	0.95
Individual Scientists' Trustworthiness	0.90	4.94	1.00
Group Scientists' Competence	0.92	5.57	0.98
Group Scientists' Trustworthiness	0.94	5.19	1.02
Individual Journalists' Competence	0.91	4.64	1.16
Individual Journalists' Trustworthiness	0.94	4.56	1.16
Group Journalists' Competence	0.89	4.65	1.11
Group Journalists' Trustworthiness	0.94	4.54	1.11
Prior Issue Involvement	0.70	2.08	0.70
Understanding of Science	0.43	4.26	0.82
Prior Issue Knowledge	0.90	2.86	1.28
Tolerance for Ambiguity	0.57	3.87	0.89
Epistemic Beliefs	0.66	3.86	0.72
Perceived Message Easiness	0.79	3.78	0.75
Perceived Message Believability*		3.27	0.95
Perceived Message Interestingness*		3.32	0.93

* Variables with * in this table were one-item scale measures. Only their *M* and *SD* were reported in this table.

The present study has four one-item categorical variables. They are news reading frequency, use of regular cigarettes, use of e-cigarettes, and device used to complete the study. The following is the distribution of these variables.

News reading frequency. In the final study, 4 participants (1.5%) reported that they never read news stories, 34 participants (13.1%) rarely read news stories, 67 participants (25.8%) occasionally read news stories, 56 participants (21.5%) read news stories sometimes, 68 participants (26.2%) frequently read news stories, 23 participants (8.8%) usually read news stories, and 8 participants (3.1%) read news every time.

Use of regular cigarettes. In the final study, 9 participants (3.5%) reported that they smoke cigarettes, and 250 participants (96.5%) reported that they do not smoke cigarettes.

Use of e-cigarettes. In the final study, 11 participants (4.2%) reported that they use e-cigarettes, and 249 participants (95.8%) reported that they do not use e-cigarettes.

Three participants (0.8%) reported that they use both regular cigarettes and e-cigarettes.

CHAPTER 4. RESULTS

This chapter consists of five sections. First, effects of presentation order are presented. Second, effectiveness of random assignment to conditions is assessed. Third, variances in dependent variables explained by potential covariates are presented. Fourth, results of hypothesis are presented. Fifth, results of exploratory follow-up analysis are presented.

4.1 Effects of Presentation Order

Effects of presentation order are about variances in the dependent variables caused by difference in presentation order: the positive story first or the negative story first. Presentation order was tested to rule out the possibility that the presentation order could be a potential explanation for the variances in the dependent variables. Presentation order could affect the dependent variables because people might either recall information presented at the end best (i.e., the recency effect) or information presented at the beginning best (i.e., the primacy effect) (Hogarth & Einhorn, 1992).

To assess the effects of presentation order on the dependent variables, one-way ANOVA was conducted for each dependent variable. The ANOVA was conducted when each of the manipulation check approaches was used. This section presents results using the high-awareness approach. Results using the other two approaches are included in Appendix 21.

Table 4 presents one-way ANOVA results for effects of presentation order on all dependent variables when the high-awareness approach was used.

Table 4. One-Way ANOVA Results for Effects of Presentation Order on Dependent Variables Using the High-Awareness Approach (N = 260)

DVs	Presentation Order						F	p
	Positive-first			Negative-first				
	M	SD	n	M	SD	n		
Perceived Issue Uncertainty	4.65	1.35	99	4.59	1.20	103	0.09	0.76
Individual Journalists' Competence	4.72	1.20	99	4.56	1.11	103	0.92	0.34
Individual Journalists' Trustworthiness	4.58	1.17	99	4.55	1.16	103	0.04	0.85
Individual Scientists' Competence	5.18	0.98	99	5.11	0.92	103	0.32	0.58
Individual Scientists' Trustworthiness	4.95	1.09	99	4.93	0.93	102	0.01	0.94
Group Journalists' Competence	4.69	1.14	98	4.61	1.09	104	0.24	0.63
Group Journalists' Trustworthiness	4.57	1.08	97	4.50	1.14	103	0.19	0.66
Group Scientists' Competence	5.58	1.00	98	5.56	0.97	103	0.03	0.86
Group Scientists' Trustworthiness	5.20	1.04	98	5.17	1.00	103	0.05	0.83

As the table shows, presentation order did not significantly affect any of the dependent variables when the high-awareness approach was used. This finding rules out the possibility of presentation order as an alternative explanation for the variances in the dependent variables.

4.2 Effectiveness of Random Assignment to Experimental Condition

This section presents results about the effectiveness of randomization using the high-awareness approach. If randomization of participants to experimental conditions was successful, then predisposition variables, relevant demographic variables (i.e., majors, student status), and behavioral variables should not differ significantly across conditions. The results for the low- and medium-awareness approaches were included in Appendix 22.

Predisposition variables were measured with scale variables. Relevant demographic variables (i.e., majors, student status) and behavioral variables were measured with nominal scales. For nominal measures, chi-square tests were performed, and for scale measures, one-way ANOVAs were performed to assess the effectiveness of randomization. Table 5 presents one-

way ANOVA results for predisposition variables measured by scale measures, and Table 6 presents chi-square results for predisposition variables, demographic variables and behavioral variables measured by nominal measures.

Table 5. Effectiveness of Randomization for Predisposition Variables with Scale Measures Using the High-Awareness Approach (N = 260)

Scale DVs	Hedging						Presentation Format									
	Hedged			Non-hedged			One-Article				Two-Article					
	M	SD	n	M	SD	n	F	p	M	SD	n	M	SD	n	F	p
Prior Issue Involvement	2.19	0.57	101	2.29	0.58	101	1.65	0.20	2.31	0.54	109	2.16	0.61	93	3.48	0.06
Understanding of Science	4.45	0.60	93	4.15	0.85	92	7.67	0.01*	4.38	0.63	98	4.22	0.85	87	2.10	0.15
Prior Issue Knowledge	2.70	1.24	101	3.03	1.26	101	3.63	0.06	2.85	1.20	109	2.88	1.33	93	0.02	0.89
Tolerance for Ambiguity	3.91	0.83	100	3.81	0.96	101	0.58	0.45	3.92	0.88	108	3.80	0.92	93	0.93	0.34
Epistemic Belief	3.92	0.66	101	3.72	0.76	102	3.84	0.06	3.80	0.67	109	3.85	0.76	94	0.33	0.57

* $p < 0.05$

Table 6. Effectiveness of Randomization for Predisposition Variables, Demographic Variables, and Behavioral Variables with Nominal Measures Using the High-Awareness Approach (N = 260)

	Hedging		Presentation Format	
	χ^2	p	χ^2	p
Major	1.06	0.72	0.81	0.57
Student Status	5.87	0.12	6.75	0.08
Use of Cigarettes*		0.31		0.05
Use of E-Cigarettes*		0.49		0.59
News Reading Frequency	7.43	0.28	8.90	0.17

* Because two cells have expected count less than 5, a Fisher's exact test was used. Therefore, only p value was reported.

As the tables show, understanding of science differed significantly between the hedged condition and non-hedged condition. Therefore, in Section 4.4 where results are presented, understanding of science is controlled in the relevant analyses.

4.3 Variance in Dependent Variables Explained by Potential Covariates

This section presents results about the amount of variance (r^2) in dependent variables that are attributed to each potential covariate when the high-awareness approach was used. Linear regression was conducted with each source credibility variable as the dependent variable and each potential covariate as the independent variable. When r^2 was less than 0.1, the potential

covariate was not included in the following hypothesis testing. The results when the other two approaches were used are included in Appendix 23.

As Table 7 shows, variance in dependent variables explained only by perceived message believability is over 0.1. Therefore, in the following relevant hypothesis testing, perceived message believability was included as a covariate.

Table 7. Variance in Dependent Variables Explained by Potential Covariates Using High-Awareness Approach (N = 260)

	Individual Journalists' Competence	Individual Journalists' Trustworthiness	Individual Scientists' Competence	Individual Scientists' Trustworthiness	Group Journalists' Competence	Group Journalists' Trustworthiness	Group Scientists' Competence	Group Scientists' Trustworthiness
Prior Issue Knowledge	0.000	0.001	0.002	0.005	0.000	0.001	0.001	0.001
Understanding of Science	0.000	0.003	0.015	0.023	0.000	0.000	0.022	0.013
Prior Issue Involvement	0.004	0.007	0.002	0.003	0.002	0.000	0.001	0.002
Tolerance for Ambiguity	0.002	0.005	0.007	0.007	0.000	0.005	0.008	0.030
Epistemic Belief	0.010	0.007	0.005	0.002	0.008	0.005	0.011	0.011
News Reading Frequency	0.066	0.074	0.058	0.025	0.067	0.052	0.022	0.007
Use of Cigarettes	0.004	0.003	0.009	0.006	0.004	0.002	0.003	0.005
Use of E-Cigarettes	0.005	0.002	0.001	0.005	0.002	0.005	0.002	0.000
Student Status	0.051	0.039	0.000	0.002	0.059	0.032	0.000	0.003
Student Major	0.004	0.007	0.008	0.011	0.006	0.008	0.003	0.012
Perceived Message Believability	0.13*	0.17*	0.18*	0.18*	0.12*	0.14*	0.11*	0.17*
Perceived Message Interestingness	0.013	0.042	0.067	0.097	0.011	0.031	0.044	0.073
Perceived Message Easiness	0.051	0.046	0.079	0.050	0.037	0.036	0.049	0.065

*Variance in dependent variables explained by potential covariates is over 0.10.

4.4 Results

4.4.1 Analysis Method

The present study hypothesized that message attributes had direct effects on source credibility (Section 2.6.1) and message attributes had indirect effects via perceived issue uncertainty (Section 2.6.2). To test these hypotheses, a simple mediation analysis (i.e., model 4) using Hayes' PROCESS macro for SPSS (2013) was conducted with each message attribute as

the independent variable, each source credibility variable as the outcome variable, and perceived issue uncertainty as the mediator. Relevant covariates mentioned in Section 4.2.4 and Section 4.3.4 were also included in each mediation analysis.

The mediation analysis was used because it is able to demonstrate how an independent variable's total effect on a dependent variable can be partitioned into direct effects (see Appendix 24) and indirect effects (see Appendix 25). The mediation analysis was used also because it is able to demonstrate whether a mediator serves as an enhancer or suppressor to an independent variable's direct effect on a dependent variable. If direction of an indirect effect is consistent with that of a direct effect, the mediator acts as an enhancer; if direction of an indirect is opposite to that of a direct effect, the mediator acts as a suppressor.

For each of the following mediation analysis, a message attribute's direct and indirect effects on a source credibility variable were reported.

4.4.2 Results for Hypotheses

This section presents results in details for hypotheses using the high-awareness approach. Results for hypotheses using the low-awareness approach and the medium-awareness approach are also included, but in Appendix 24 and Appendix 25, together with results of the high-awareness approach. Appendix 24 is about message attributes' direct effects on source credibility and Appendix 25 is message attributes' indirect effects on source credibility via perceived issue uncertainty.

Presentation format as the independent variable and individual journalists' competence as the dependent variable. Hypothesis 1-a hypothesized that presentation format directly predicted individual journalists' competence. Hypothesis 3-a hypothesized that perceived issue

uncertainty mediated the relationship between presentation format and individual journalists' competence.

Mediation analysis found that presentation format directly predicted individual journalists' competence, $b = -0.324$, $SE = 0.155$, $t = -2.094$, $p = 0.038$. More specifically, two-article format led to lower individual journalists' competence than one-article format. Hypothesis 1-a was supported.

Perceived issue uncertainty did not mediate the relationship between presentation format and individual journalists' competence, $b = -0.014$, $SE = 0.021$, $Z = -0.661$, $p = 0.509$. Hypothesis 3-a was not supported.

Presentation format as the independent variable and individual journalists' trustworthiness as the dependent variable. Hypothesis 1-b hypothesized that presentation format directly predicted individual journalists' trustworthiness. Hypothesis 3-b hypothesized that perceived issue uncertainty mediated the relationship between presentation format and individual journalists' trustworthiness.

Mediation analysis found that presentation format did not directly predict individual journalists' trustworthiness, $b = -0.169$, $SE = 0.153$, $t = -1.107$, $p = 0.270$. Hypothesis 1-b was not supported.

Perceived issue uncertainty did not mediate the relationship between presentation format and individual journalists' trustworthiness, $b = -0.011$, $SE = 0.019$, $Z = -0.595$, $p = 0.552$. Hypothesis 3-b was not supported.

Presentation format as the independent variable and individual scientists' competence as the dependent variable. Hypothesis 1-c hypothesized that presentation format directly predicted

individual scientists' competence. Hypothesis 3-c hypothesized that perceived issue uncertainty mediated the relationship between presentation format and individual scientists' competence.

Mediation analysis found that presentation format directly predicted individual scientists' competence, $b = 0.414$, $SE = 0.122$, $t = 3.406$, $p = 0.001$. More specifically, two-article format led to higher individual scientists' competence than one-article format. Hypothesis 1-c was supported.

Perceived issue uncertainty did not mediate the relationship between presentation format and individual scientists' competence, $b = -0.003$, $SE = 0.014$, $Z = -0.223$, $p = 0.823$. Hypothesis 3-c was not supported.

Presentation format as the independent variable and individual scientists' trustworthiness as the dependent variable. Hypothesis 1-d hypothesized that presentation format directly predicted individual scientists' trustworthiness. Hypothesis 3-d hypothesized that perceived issue uncertainty mediated the relationship between presentation format and individual scientists' trustworthiness.

Mediation analysis found that presentation format did not directly predict individual scientists' trustworthiness, $b = 0.253$, $SE = 0.131$, $t = 1.926$, $p = 0.056$. Hypothesis 1-d was not supported.

Perceived issue uncertainty did not mediate the relationship between presentation format and individual scientists' trustworthiness, $b = -0.001$, $SE = 0.012$, $Z = -0.010$, $p = 0.992$.

Hypothesis 3-d was not supported.

Presentation format as the independent variable and group journalists' competence as the dependent variable. Hypothesis 1-e hypothesized that presentation format directly predicted

group journalists' competence. Hypothesis 3-e hypothesized that perceived issue uncertainty mediated the relationship between presentation format and group journalists' competence.

Mediation analysis found that presentation format did not directly predict group journalists' competence, $b = -0.160$, $SE = 0.150$, $t = -1.066$, $p = 0.288$. Hypothesis 1-e was not supported.

Perceived issue uncertainty did not mediate the relationship between presentation format and group journalists' competence, $b = -0.010$, $SE = 0.018$, $Z = -0.570$, $p = 0.569$. Hypothesis 3-e was not supported.

Presentation format as the independent variable and group journalists' trustworthiness as the dependent variable. Hypothesis 1-f hypothesized that presentation format directly predicted group journalists' trustworthiness. Hypothesis 3-f hypothesized that perceived issue uncertainty mediated the relationship between presentation format and group journalists' trustworthiness.

Mediation analysis found that presentation format did not directly predict group journalists' trustworthiness, $b = -0.067$, $SE = 0.150$, $t = -0.446$, $p = 0.656$. Hypothesis 1-f was not supported.

Perceived issue uncertainty did not mediate the relationship between presentation format and group journalists' trustworthiness, $b = 0.002$, $SE = 0.014$, $Z = -0.129$, $p = 0.898$. Hypothesis 3-f was not supported.

Presentation format as the independent variable and group scientists' competence as the dependent variable. Hypothesis 1-g hypothesized that presentation format directly predicted group scientists' competence. Hypothesis 3-g hypothesized that perceived issue uncertainty mediated the relationship between presentation format and group scientists' competence.

Mediation analysis found that presentation format did not directly predict group scientists' competence, $b = 0.144$, $SE = 0.135$, $t = 1.069$, $p = 0.286$. Hypothesis 1-g was not supported.

Perceived issue uncertainty did not mediate the relationship between presentation format and group scientists' competence, $b = -0.008$, $SE = 0.015$, $Z = -0.492$, $p = 0.623$. Hypothesis 3-g was not supported.

Presentation format as the independent variable and group scientists' trustworthiness as the dependent variable. Hypothesis 1-h hypothesized that presentation format directly predicted group scientists' trustworthiness. Hypothesis 3-h hypothesized that perceived issue uncertainty mediated the relationship between presentation format and group scientists' trustworthiness.

Mediation analysis found that presentation format did not directly predict group scientists' trustworthiness, $b = 0.167$, $SE = 0.134$, $t = 1.242$, $p = 0.216$. Hypothesis 1-h was not supported.

Perceived issue uncertainty did not mediate the relationship between presentation format and group scientists' trustworthiness, $b = 0.004$, $SE = 0.014$, $Z = 0.319$, $p = 0.750$. Hypothesis 3-h was not supported.

Hedging as the independent variable and individual journalists' competence as the dependent variable. Hypothesis 2-a hypothesized that hedging directly predicted individual journalists' competence. Hypothesis 4-a hypothesized that perceived issue uncertainty mediated the relationship between hedging and individual journalists' competence.

Mediation analysis found that hedging did not directly predict individual journalists' competence, $b = -0.045$, $SE = 0.170$, $t = 0.267$, $p = 0.790$. Hypothesis 2-a was not supported.

Perceived issue uncertainty did not mediate the relationship between hedging and individual journalists' competence, $b = 0.043$, $SE = 0.040$, $Z = 1.089$, $p = 0.276$. Hypothesis 4-a was not supported.

Hedging as the independent variable and individual journalists' trustworthiness as the dependent variable. Hypothesis 2-b hypothesized that hedging directly predicted individual journalists' trustworthiness. Hypothesis 4-b hypothesized that perceived issue uncertainty mediated the relationship between hedging and individual journalists' trustworthiness.

Mediation analysis found that hedging did not directly predict individual journalists' trustworthiness, $b = -0.115$, $SE = 0.163$, $t = -0.705$, $p = 0.482$. Hypothesis 2-b was not supported.

Perceived issue uncertainty did not mediate the relationship between hedging and individual journalists' trustworthiness, $b = 0.038$, $SE = 0.038$, $Z = 1.020$, $p = 0.308$. Hypothesis 4-b was not supported.

Hedging as the independent variable and individual scientists' competence as the dependent variable. Hypothesis 2-c hypothesized that hedging directly predicted individual scientists' competence. Hypothesis 4-c hypothesized that perceived issue uncertainty mediated the relationship between hedging and individual scientists' competence.

Mediation analysis found that hedging did not directly predict individual scientists' competence, $b = -0.074$, $SE = 0.136$, $t = -0.546$, $p = 0.586$. Hypothesis 2-c was not supported.

Perceived issue uncertainty did not mediate the relationship between hedging and individual scientists' competence, $b = 0.001$, $SE = 0.028$, $Z = 0.041$, $p = 0.968$. Hypothesis 4-c was not supported.

Hedging as the independent variable and individual scientists' trustworthiness as the dependent variable. Hypothesis 2-d hypothesized that hedging directly predicted individual

scientists' trustworthiness. Hypothesis 4-d hypothesized that perceived issue uncertainty mediated the relationship between hedging and individual scientists' trustworthiness.

Mediation analysis found that hedging did not directly predict individual scientists' trustworthiness, $b = 0.111$, $SE = 0.142$, $t = 0.786$, $p = 0.433$. Hypothesis 2-d was not supported.

Perceived issue uncertainty did not mediate the relationship between hedging and individual scientists' trustworthiness, $b = -0.007$, $SE = 0.029$, $Z = -0.243$, $p = 0.808$. Hypothesis 4-d was not supported.

Hedging as the independent variable and group journalists' competence as the dependent variable. Hypothesis 2-e hypothesized that hedging directly predicted group journalists' competence. Hypothesis 4-e hypothesized that perceived issue uncertainty mediated the relationship between hedging and group journalists' competence.

Mediation analysis found that hedging did not directly predict group journalists' competence, $b = -0.063$, $SE = 0.164$, $t = -0.386$, $p = 0.700$. Hypothesis 2-e was not supported.

Perceived issue uncertainty did not mediate the relationship between hedging and group journalists' competence, $b = 0.033$, $SE = 0.037$, $Z = 0.904$, $p = 0.366$. Hypothesis 4-e was not supported.

Hedging as the independent variable and group journalists' trustworthiness as the dependent variable. Hypothesis 2-f hypothesized that hedging directly predicted group journalists' trustworthiness. Hypothesis 4-f hypothesized that perceived issue uncertainty mediated the relationship between hedging and group journalists' trustworthiness.

Mediation analysis found that hedging did not directly predict group journalists' trustworthiness, $b = -0.072$, $SE = 0.163$, $t = -0.444$, $p = 0.658$. Hypothesis 2-f was not supported.

Perceived issue uncertainty did not mediate the relationship between hedging and group journalists' trustworthiness, $b = 0.003$, $SE = 0.035$, $Z = 0.090$, $p = 0.929$. Hypothesis 4-f was not supported.

Hedging as the independent variable and group scientists' competence as the dependent variable. Hypothesis 2-g hypothesized that hedging directly predicted group scientists' competence. Hypothesis 4-g hypothesized that perceived issue uncertainty mediated the relationship between hedging and group scientists' competence.

Mediation analysis found that hedging did not directly predict group scientists' competence, $b = -0.116$, $SE = 0.147$, $t = -0.788$, $p = 0.432$. Hypothesis 2-g was not supported.

Perceived issue uncertainty did not mediate the relationship between hedging and group scientists' competence, $b = 0.026$, $SE = 0.035$, $Z = 0.758$, $p = 0.449$. Hypothesis 4-g was not supported.

Hedging as the independent variable and group scientists' trustworthiness as the dependent variable. Hypothesis 2-h hypothesized that hedging directly predicted group scientists' trustworthiness. Hypothesis 4-h hypothesized that perceived issue uncertainty mediated the relationship between hedging and group scientists' trustworthiness.

Mediation analysis found that hedging did not directly predict group scientists' trustworthiness, $b = -0.152$, $SE = 0.145$, $t = -1.043$, $p = 0.298$. Hypothesis 2-h was not supported.

Perceived issue uncertainty did not mediate the relationship between hedging and group scientists' trustworthiness, $b = -0.012$, $SE = 0.035$, $Z = -0.344$, $p = 0.731$. Hypothesis 4-h was not supported.

Summary. Two-article format led to lower individual journalists' competence, but higher individual scientists' competence than one-article format. Source credibility did not differ

between the hedged condition and non-hedged condition. Perceived issue uncertainty did not mediate presentation format's effects on source credibility, and it did not mediate hedging's effects on source credibility either.

4.4.3 Exploratory Follow-Up Analysis Including Perceived Message Believability as a Mediator

This section presents results based on an exploratory follow-up analysis including perceived message believability as a mediator between presentation format and source credibility. First, rationale of including perceived message believability as a mediator was presented. Second, results from the follow-up analysis using the high-awareness approach were presented. Results for all the low- and the medium-awareness approaches, together with the high-awareness approach, were included in Appendix 26.

Rationale

Perceived message believability is the degree to which people perceive news coverage as real (Austin & Dong, 1996). It was included in the follow-up exploratory analysis as a mediator for two reasons.

First, the analysis is an effort to distinguish effect of number of articles from that of integration device. As mentioned earlier (see Section 2.3), the manipulation of presentation format involved both number of articles and use of integration devices. Follow-up literature review suggests that use of integration devices, such as a conflict frame in news coverage, might have increased perceived message believability (Bell, 1991; Caple & Bednarek; 2013; Masterton, 2005; Shapiro & Chock, 2004), and perceived message believability, in turn, might have increased source credibility (Austin & Dong, 1996).

Second, regression analysis suggests that perceived message believability explained more than 10% variance in source credibility variables (see Section 4.3). Including it as a mediator in a mediation analysis enabled me to understand how it might have affected presentation format's effects on source credibility. If perceived message believability acted as a mediator, by comparing direction of its mediating effect with direction of presentation format's direct effects, I can assess whether it enhanced or suppressed presentation format's effects on source credibility.

Before perceived message believability was included as a mediator, correlation between perceived message believability and perceived issue uncertainty was calculated. The calculation was conducted to assess whether the two are distinct concepts. To assess whether they are distinct, Pearson's correlation was first conducted. With Pearson's coefficient, proportion of variance shared by the two mediators was calculated. Proportion of variance shared by two concepts indicates to what extent the two concepts are distinct from each other.

The Pearson coefficient between perceived issue uncertainty and perceived message believability was -0.153 (r). The proportion of variance shared by the two mediators was 0.023 (r^2). According to Cohen's rules of thumb (1988), when the proportion of variance shared by two concepts is less than 0.1 , the correlation is considered as small. Therefore, in the following mediation analysis, perceived issue uncertainty and perceived message believability were treated as two distinct concepts.

Results for the Exploratory Follow-Up Analysis

The same simple mediation model (i.e., model 4) from Hayes' PROCESS macro for SPSS (2013) was conducted with each message attribute as the independent variable, each source credibility variable as the outcome variable, and both perceived issue uncertainty and perceived

message believability as the mediators. Relevant covariate mentioned in Section 4.2 was also included in each mediation analysis.

Presentation format as the independent variable and individual journalists' competence as the dependent variable. The follow-up mediation analysis found that perceived message believability mediated the relationship between presentation format and individual journalists' competence, $b = -0.149$, $SE = 0.064$, $Z = -2.337$, $p = 0.019$. Specifically, two-article format led to lower perceived message believability than one-article format, and lower perceived message believability, in turn, led to lower individual journalists' competence.

Presentation format as the independent variable and individual journalists' trustworthiness as the dependent variable. The follow-up mediation analysis found that perceived message believability mediated the relationship between presentation format and individual journalists' trustworthiness, $b = -0.178$, $SE = 0.073$, $Z = -2.430$, $p = 0.015$. Specifically, two-article format led to lower perceived message believability than one-article format, and lower perceived message believability, in turn, led to lower individual journalists' trustworthiness.

Presentation format as the independent variable and individual scientists' competence as the dependent variable. The follow-up mediation analysis found that perceived message believability mediated the relationship between presentation format and individual scientists' competence, $b = -0.171$, $SE = 0.067$, $Z = -2.573$, $p = 0.010$. Specifically, two-article format led to lower perceived message believability than one-article format, and lower perceived message believability, in turn, led to lower individual scientists' competence.

Presentation format as the independent variable and individual scientists' trustworthiness as the dependent variable. The follow-up mediation analysis found that

perceived message believability mediated the relationship between presentation format and individual scientists' trustworthiness, $b = -0.157$, $SE = 0.067$, $Z = -2.348$, $p = 0.019$. Specifically, two-article format led to lower perceived message believability than one-article format, and lower perceived message believability, in turn, led to lower individual scientists' trustworthiness.

Presentation format as the independent variable and group journalists' competence as the dependent variable. The follow-up mediation analysis found that perceived message believability mediated the relationship between presentation format and group journalists' competence, $b = -0.140$, $SE = 0.063$, $Z = -2.242$, $p = 0.021$. Specifically, two-article format led to lower perceived message believability than one-article format, and lower perceived message believability, in turn, led to lower group journalists' competence.

Presentation format as the independent variable and group journalists' trustworthiness as the dependent variable. The follow-up mediation analysis found that perceived message believability mediated the relationship between presentation format and group journalists' trustworthiness, $b = -0.148$, $SE = 0.064$, $Z = -2.315$, $p = 0.024$. Specifically, two-article format led to lower perceived message believability than one-article format, and lower perceived message believability, in turn, led to lower group journalists' trustworthiness.

Presentation format as the independent variable and group scientists' competence as the dependent variable. The follow-up mediation analysis found that perceived message believability mediated the relationship between presentation format and group scientists' competence, $b = -0.118$, $SE = 0.054$, $Z = -2.181$, $p = 0.029$. Specifically, two-article format led to lower perceived message believability than one-article format, and lower perceived message believability, in turn, led to lower group scientists' competence.

Presentation format as the independent variable and group scientists' trustworthiness as the dependent variable. The follow-up mediation analysis found that perceived message believability mediated the relationship between presentation format and group scientists' trustworthiness, $b = -0.149$, $SE = 0.065$, $Z = -2.281$, $p = 0.023$. Specifically, two-article format led to lower perceived message believability than one-article format, and lower perceived message believability, in turn, led to lower group scientists' trustworthiness.

Summary. Perceived message believability negatively mediated presentation format's effects on all source credibility variables. The two-article format led to lower perceived message believability than the one-article format, and lower perceived message believability, in turn, led to lower source credibility.

4.4.4 Summary

Message Attributes' Direct Effects on Source Credibility

As Section 4.4.2 presents, presentation format had significant direct effects on individual journalists' competence and individual scientists' competence. Specifically, the two-article format led to lower individual journalists' competence, but higher individual scientists' competence, than the one-article format. With hedging's direct effects on source credibility, the hedged condition and the non-hedged condition did not differ.

Message Attributes' Indirect Effects on Source Credibility via Perceived Issue Uncertainty

As Section 4.4.2 presents, perceived issue uncertainty did not mediate presentation format's effects on source credibility, and it did not mediate hedging's effects on source credibility either.

Message Attributes' Indirect Effects on Source Credibility via Perceived Message Believability

As Section 4.4.3 presents, perceived message believability negatively mediated presentation format' s effects on source credibility. Specifically, the two-article format led to lower perceived message believability than the one-article format, and lower perceived message believability, in turn, led to lower source credibility.

Because perceived message believability negatively mediated presentation format' s effects on source credibility, and presentation format had negative direct effect on individual journalist' s competence but positive direct effect on individual scientists' competence, perceived message believability enhanced presentation format' s effects on individual journalist' s competence but suppressed its effects on individual scientists' competence.

5.1 Overview of the Study

When covering emerging scientific issues, journalists are expected to highlight diverse viewpoints (Dunwoody, 2005). When conflicting scientific evidence about an issue or when a controversial science issue has to be communicated, however, negative outcomes might emerge (Chang, 2015; Jensen & Hurley, 2012; Nagler, 2014). For example, Nagler (2014) found that people who reported greater media exposure to contradictory health messages experienced greater feelings of confusion and reported lower intention to comply with nutrition recommendations. Chang (2015) found that people expressed higher uncertainty and more negative attitudes toward health research after exposure to news covering contradictory (as opposed to one-sided) research findings. Jensen and Hurley's study (2012) found that mere exposure to news coverage of controversial health-related issues in general, regardless of the presentation format (i.e., divergent or convergent format), provoked distrust in scientists.

As an attempt to minimize these negative outcomes on perceived issue uncertainty and source credibility, the present study empirically examined effectiveness of two journalistic practices, presentation format and hedging, in communicating conflicting health-related scientific evidence. Specifically, the present study examined two overarching questions: 1) whether message attributes had direct effects on source credibility (Section 2.7.1), and 2) whether message attributes had indirect effects on source credibility via perceived issue uncertainty (Section 2.7.2).

The two journalistic practices manipulated represent two message attributes journalists can use. Presentation format was manipulated as one-article format with integration devices

versus two-article format without integration devices (Section 2.3). Hedging was manipulated as reporting methodological limitations versus not reporting the limitations in news stories covering scientific studies (Section 2.4).

To check effectiveness of the manipulation on hedging, three approaches were used. The three approaches represent three levels of participants' awareness of the limitations reported. Therefore, they are referred to as the low-awareness approach, the medium-awareness approach, and the high-awareness approach.

To improve internal validity, effects of presentation order (Section 4.1), effectiveness of random assignment (Section 4.2), and variance in dependent variables explained by potential covariates (Section 4.3) were assessed. Presentation order did not affect source credibility. A potential covariate (i.e., understanding of science) was not evenly distributed between experimental conditions was controlled in subsequent relevant analysis. Among potential covariates, perceived message believability explained more than 10% of variance in source credibility; therefore, it was controlled in subsequent analysis.

To answer the two questions, a mediation analysis was conducted (Section 4.4.1). As the research on using discourse hedging in science communication is still at its early stage, the present study followed the principle of using the strongest manipulation check possible (Cozby & Bates, 2011). Therefore, only results of the high-awareness approach were reported and discussed in detail.

Results for hypotheses about the two overarching questions are presented in Section 4.4.2. An exploratory follow-up analysis including perceived message believability as a mediator was conducted to assess how it might have affected presentation format' s effects on source

credibility (Section 4.4.3). Perceived message believability is the degree to which people perceive news coverage as real (Austin & Dong, 1996).

The follow-up analysis was conducted for two reasons. First, it is an effort to distinguish the effect of number of articles from that of integration devices. As mentioned earlier, the manipulation of presentation format involved both number of articles and use of integration devices. Some research suggests that use of integration devices, such as a conflict frame in news coverage, might have increased perceived message believability (Bell, 1991; Caple & Bednarek, 2013; Masterton, 2005; Shapiro & Chock, 2004); an increase in perceived message believability, in turn, might have increased source credibility (Austin & Dong, 1996). Second, perceived message believability explained more than 10% of variance in source credibility.

As Section 4.4.2 presents, presentation format directly affected individual journalists' competence and individual scientists' competence. Specifically, the two-article format led to lower individual journalists' competence, but higher individual scientists' competence than the one-article format. Hedging did not have direct effects on source credibility. Perceived issue uncertainty did not mediate presentation format's effects on source credibility, and it did not mediate hedging's effects on source credibility either.

As presented in Section 4.4.3, perceived message believability mediated presentation format's effects on source credibility. Specifically, perceived message believability was lower in the two-article format than in the one-article format, and lower perceived message believability, in turn, led to lower source credibility. Because perceived message believability negatively mediated presentation format's effects on source credibility, and presentation format had a negative direct effect on individual journalists' competence but a positive direct effect on individual scientists' competence, perceived message believability enhanced presentation

format' s effects on individual journalists' competence but suppressed its effects on individual scientists' competence.

The present study involves multiple statistic testing, which increases the potential of Type I error. Forty tests were conducted with each using 0.05 as the alpha. This means that two of the results are significant by chance ($40 \times 0.05 = 2$).

Ten significant results emerged and they are all about presentation format. Of the ten significant results, two patterns emerged. First, presentation format had direct effects on competence (i.e., individual journalists' competence and individual scientists' competence) (see results for the high-awareness manipulation check in Appendix 24). Second, presentation format had indirect effects on source credibility (i.e., all the eight source credibility variables) via perceived message believability (see results for the high-awareness manipulation check in Appendix 26).

There are three possibilities regarding what the two by-chance significant findings are. First, they are about presentation format' s direct effects. Second, they are about presentation format' s indirect effects via perceived message believability. Third, one is about presentation format' s direct effects and the other is about presentation format' s indirect effects via perceived message believability.

Regardless of the three possibilities, the two patterns provide confidence that the ten results are not by chance.

5.2 Theoretical Implications

5.2.1 Perceived Message Believability as a Mechanism to Evaluate Source Credibility

Perceived message believability explained more than 10% of the variance in source credibility. This suggests that when people are exposed to conflicting scientific evidence in news, perceived message believability is one mechanism people use to evaluate scientists' and journalists' credibility. This finding is consistent with Stadtler and colleagues' study (2013). Their study found that readers used a source's lack of understanding of the subject matter to account for the conflicts they encountered. The present study added to the literature by showing that message believability can be used to evaluate a source's credibility when readers are exposed to conflicting scientific information. However, perceived message believability in the present study was measured using a one-item measurement. Future studies should use a more valid measure to test whether people use perceived message believability as a mechanism to evaluate source credibility.

5.2.2 Presentation Format's Direct Effects on Source Credibility

In testing hypotheses about presentation format's direct effects on source credibility, perceived message believability was controlled. One reason to control it is to distinguish the effects from the number of articles from those of integration devices, because manipulation of presentation format involved both number of articles and integration devices. Analyses found that presentation format had direct effects on journalists' and scientists' credibility. If perceived message believability was affected only by integration devices, this finding suggests that it is the

number of articles, instead of integration devices or combination of the two, that affected journalists' and scientists' credibility.

Presentation format had direct effects on journalists' credibility. Specifically, journalists' competence was lower in the two-article format than that in the one-article format. This finding is consistent with Allen's discounting hypothesis (1991). The hypothesis posits that a source who fails to meet an expectation or exceeds an expectation generates a reevaluation by an audience. The finding suggests that news readers expect journalists to use one two-sided story rather than two one-sided stories.

This preference has two theoretical implications. First, news readers expect journalists to be balanced when reporting an emerging topic or issue. The present study used scientific evidence about e-cigarette, assuming it is an emerging topic. Participants' prior knowledge measured in the present study supported the assumption. On a seven-point scale, participants' self-reported average prior knowledge was below 3 points (see Section 3.7.8).

Second, news readers' perception of journalists' credibility is sensitive to the number of articles the news readers are exposed to when it comes to controversial topics or issues. Prior studies have found that increased media coverage of scientific controversies could negatively impact public attitudes towards and perceptions of technology, and perhaps science in general (Mazur, 1981), and could provoke distrust in scientists (Jensen & Hurley, 2012). The present study adds to the literature by suggesting that increased exposure could also damage the credibility of journalists, who are the messengers of scientific controversies.

Presentation format had direct effects on scientists' credibility. Specifically, scientists' competence was lower in the one-article format than in the two-article format. This is consistent with the present study's hypothesis. The hypothesis is based on the argument that the one-article

format's explicit conflict induced more cognitive dissonance than the two-article format and readers discredited scientists to reduce the dissonance. Cognitive dissonance was not measured in the present study, because there are no existing measures of cognitive dissonance stemming from exposure to attitude-challenging news sources (Metzger, Hartsell, & Flanagin, 2015). Therefore, whether cognitive dissonance explains number of articles' effect on scientists' credibility is not known. Metzger and colleagues (2015) recently developed a scale to assess news readers' dissonance. Future research can use the scale to examine whether cognitive dissonance can explain number of articles' effect on scientists' credibility.

In addition, it is not known whether news readers were more likely to discredit both groups of scientists or one group of scientists. The finding about participants' prior issue knowledge and prior issue involvement suggests that it is likely that readers discredited both groups of scientists. The subject matter used in the present study, whether e-cigarettes help smokers quit smoking, is an emerging topic as participants' prior issue knowledge ($M = 2.86$ on a 7-point scale) and issue involvement ($M = 2.08$ on a 4-point scale) are relatively low. Brashers (2001) argued that for emerging health-related issues, the public tends to remain uncertain. One way to remain uncertain is to discredit both sides of the conflict. For issues toward which people have higher prior issue knowledge and/or issue involvement, it is likely that people tend to discredit one side of the conflict, the side that presents attitude-challenging information (Metzger, Hartsell, & Flanagin, 2015).

It is also not known whether the two presentation formats differed in how readers discredited scientists, in other words, whether the one-article format or the two-article format is more likely to induce readers to discredit both groups of scientists. The finding that scientists' credibility in the one-article format was lower than that in the two-article format might suggest

that the one-article format is more likely than the two-article format to induce readers to discredit both groups of scientists.

Presentation format had direct effects on journalists' credibility and scientists' credibility. Specifically, journalists' credibility increased in the format where scientists' credibility decreased, and journalists' credibility decreased in the format where scientists' credibility increased. This finding suggests that a credibility transfer might have occurred between journalists and scientists. Prior studies on source credibility found that credibility could transfer between two sources on a horizontal level. Horizontal transfer occurs when, for example, readers valuing a particular newspaper also tend to consider its website credible, even if they have never seen it (Schweiger, 2000). In the present study scientists' competence decreased in the one-article format whereas journalists' competence increased as compared with that in the two-article format. This finding, therefore, suggests that credibility transfer could occur on a vertical level between reporters and scientists. Vertical transfer occurs, based on Schweiger's hierarchy of source referents (2000), between presenters and actors. Presenters are the authors of information (e.g., journalists who report science issues); actors are those whose actions or statements are presented (e.g., scientists whose research is being reported).

5.2.3 Hedging's Direct Effects on Source Credibility

The present study found that hedging did not have direct effects on journalists' or scientists' credibility. This is contradictory to prior studies examining hedging's effects in science communication. Jensen's studies found that hedging increased scientists' and journalists' trustworthiness (Jensen, 2008; Jensen et al, 2011).

There are three explanations. First, the situations in which hedging was used differ between the present study and prior studies. In the present study, hedging was used in a situation where conflicting evidence occurs. Jensen's studies, on the other hand, involve a situation where health-related scientific information overload exists. Specifically, in Jensen's studies, multiple news stories (about 2,500 words in total), each representing a breakthrough in cancer research, were presented to participants. There was no conflict in the cancer research that was presented. Participants in Jensen's studies might have used scientific uncertainty, as conveyed by hedging, to avoid information overload. In the present study, however, news coverage about conflicting information was presented in about 500 words.

Second, the topics used in the stimuli differ. The present study used e-cigarettes; Jensen's studies used cancer research.

Third, the amount of hedging differs. In the present study, hedged content consisted of 17% of the stimulus, while hedged content consisted of 32% of the stimulus in Jensen's studies.

The present study used a high-awareness manipulation check approach where only participants who recognized and described the scientific limitations accurately were included in the analysis. Therefore, the first two explanations are more possible than the third explanation. Future studies should examine whether hedging's effects on source credibility in science communication depend on contexts, such as situations and topics.

5.2.4 Perceived Issue Uncertainty Did Not Mediate Message Attributes' Effects on Source Credibility

Perceived issue uncertainty did not mediate message attributes' effects on source credibility. For perceived issue uncertainty to mediate the effects, two conditions must be met

(see Figure 3). First, message attributes predict perceived issue uncertainty (a_1 path). Second, perceived issue uncertainty predicts source credibility (a_2 path). Mediation analysis found that presentation format and hedging did not predict perceived issue uncertainty, and perceived issue uncertainty did not predict source credibility.

Presentation Format and Perceived Issue Uncertainty

Perceived issue uncertainty did not differ between the one-article format and the two-article format. This finding suggests that integration between the two articles did not occur as hypothesized. The hypothesis was based on prior educational psychology studies (Britt & Aglinskas, 2002; Britt & Rouet, 2012; Stadtler, Scharrer, Brummernhenrich, & Bromme, 2013; Wiley et al., 2009; Wiley & Voss, 1996; Wiley & Voss, 1999). These studies found that readers' integration of information from multiple documents is better than that from a single document.

The finding of the present study has two theoretical implications. First, integration may be more likely to occur when information is implicitly conflicting rather than when it is explicitly conflicting. In the study by Stadtler and colleagues (2013), participants read one document claiming food, such as eggs and meat, contains high amounts of cholesterol and the amount of cholesterol we ingest is an important determinant of our blood cholesterol level, and another document claiming that humans have a regulatory mechanism to keep cholesterol levels constant in healthy individuals. The conflict is implicit in their study. However, in the present study, the two stories used in the stimulus are explicitly conflicting, as one story reports e-cigarettes helped people quit smoking and the other reports that e-cigarettes did not help people quit smoking.

Second, integration is less likely to occur when information is conflicting than when it is not. Prior educational psychology studies did not involve conflicting information. For example,

one study (Wiley & Voss, 1996) found that people reading historical information presented in multiple documents (e.g., maps, biographical accounts) performed better in integration than people reading the same information presented in a single document format (e.g., a textbook chapter). The information presented is about relationships among historical events. The present study, however, involves two scientific studies that contradict to each other.

In other words, the two implications suggest that presentation format's effect on motivating information integration depends on the type of information presented.

Hedging and Perceived Issue Uncertainty

Perceived issue uncertainty did not differ between the hedged condition and the non-hedged condition. This is inconsistent with the present study's hypothesis that hedging should reduce uncertainty caused by a conflict.

One explanation is that hedges' effects on strength of an argument depend on the context where the hedges are used (Meyer, 1997). According to Meyer (1997), in oral face-to-face communication, hedging is considered as a signal of powerless speech style, while in written academic discourse, hedging may serve to strengthen an argument. In the present study, in the hedged coverage the journalists are warding off potential criticism in advance by having the scientists disclosing their study's methodological limitations. So by weakening the study that is meant to strengthen the study's finding, the finding is ultimately weakened. The weakening, however, has a paradoxical strengthening effect because it makes the finding more impregnable.

Another explanation is that use of hedges is associated with power or control rather than the lack of it. This explanation is consistent with the finding of a study on expertise and leadership conducted in massively multiplayer online role-play games (Newon, 2010). Newon

found that hedges were used frequently by leaders to achieve group cohesion and downgrade their assertion of expert knowledge.

One more explanation is that hedging in the present study was used on both sides of a conflict. As a result, hedging's effect on the strength of arguments of one side cancelled that on the other side.

Future studies should investigate how hedging is cognitively processed in various contexts.

Perceived Issue Uncertainty and Source Credibility

Perceived issue uncertainty did not predict source credibility. This is not consistent with the present study's hypothesis that higher perceived uncertainty about e-cigarettes would predict lower journalists' and scientists' credibility. The hypothesis is based on prior studies that found higher perceived uncertainty about wolf reintroduction (Jensen & Hurley, 2012) and global warming (Hmielowski, Feldman, Myers, & Maibach, 2013) were associated with lower perceptions of source credibility.

One possible explanation for the inconsistency is that political ideology underlying each issue varies. Both issues cited from prior studies (i.e., wolf reintroduction and global warming) might have been more likely to be associated with political ideology than the issue used in present study (i.e., e-cigarettes). Future studies should investigate this explanation.

Another explanation for the inconsistency is that perceived prior knowledge of each issue varies. As mentioned earlier, participants' self-reported knowledge about e-cigarettes in the present study was below 3 points, on a seven-point scale. People might be less familiar with e-cigarettes than they are with wolf reintroduction and global warming. However, lower prior issue knowledge should be associated with higher source credibility. This is because people actively

manage uncertainty in ways that best serve their interests, as the basic tenet of uncertainty management theory posits (Brashers, 2001). For emerging issues, it serves people's interest to remain uncertain; therefore, uncertain feelings should positively impact their perceptions of source credibility.

Perceived issue uncertainty in the present study included perception of one's own knowledge, others' knowledge, and scientists' knowledge about an issue. It would be interesting to conduct a follow-up analysis to examine whether perceptions of one's own knowledge, other's knowledge, and scientists' knowledge would differ in predicting source credibility.

5.2.5 Perceived Message Believability Mediated the Relationship Between Presentation Format and Source Credibility

In the exploratory follow-up mediation analysis, the present study found that perceived message believability mediated presentation format's effects on journalists' and scientists' competence. Theoretically this means that, in addition to its direct effects (as discussed in Section 5.2.2), presentation format also had indirect effects on source credibility via perceived message believability.

The mediation analysis also found that the one-article format predicted higher perceived issue uncertainty than the two-article format, and higher perceived issue uncertainty, in turn, predicted higher journalists' and scientists' competence. This finding is consistent with prior studies which suggest that the use of integration devices, such as a conflict frame in news coverage, makes news more real (Bell, 1991; Caple & Bednarek; 2013; Masterton, 2005; Shapiro & Chock, 2004). In the present study, integration devices were used in the one-article format, but not in the two-article format. The finding is also consistent with a prior study that suggests the

more real news readers perceive a news story to be, the higher credibility they attribute to the source (Austin & Dong, 1996).

As mentioned earlier in the discussion, perceived message believability in the present study was measured using a one-item measurement. Future studies should investigate whether it mediates presentation format's effects on source credibility when a more valid measure is used.

5.3 Practical Implications

5.3.1 One-Article Format vs. Two-Article Format in Reporting

Conflicting Evidence

The present study found that when conflicting evidence has to be reported, the one-article format is beneficial to journalists' credibility; however, it hurts scientists' credibility. Thus, when the one-article format is used, journalists should use strategies to counteract its negative effect on scientists' credibility; when the two-article format is used, journalists should use strategies to counteract its negative effect on their own credibility.

One effective strategy, for example, that is able to counteract presentation format's negative effects is evidentiary balance (Clarke, Dixon, Holton, & McKeever, 2015). Evidentiary balance is a strategy journalists can use to balance attention to competing scientific evidence while also communicating the appropriate level of certainty surrounding the competing evidence. For example, Clarke and colleagues' study (2015) found that evidentiary balance led people to perceive vaccines are safe even though people were exposed to competing evidence about the safety of vaccination.

Therefore, the implication is that for the one-article format, evidentiary balance should be included to allow journalists to be balanced in their reporting while also communicating the

current level of scientific certainty; for the two-article format, evidentiary evidence should be included in every single article to communicate the current level of certainty.

5.3.2 Reporting Scientific Limitations

The way that the manipulation check was designed in the present study enables the researcher to assess whether and to what extent news readers could recognize and describe scientific limitations. Of the 491 total participants, 222 were assigned to the hedged condition. Of the 222 participants, 131 recognized the limitations and 101 recognized and were able to describe the limitation(s).

Participants in the present study are college students whose understanding of methodological limitations in scientific studies should be higher than the general public. If only 101 out of 222 college students were able to recognize and describe the limitations, it is reasonable to believe that the general public's understanding would be even lower.

Such a belief is shared by journalists. To accommodate different audience's health literacy levels, journalists often oversimplify scientific findings while struggling to maintain their scientific credibility (Hinnant & Len-Ríos, 2009). However, according to Hinnant and Len-Ríos (2009), scientists, driven by a different occupational identity subculture, tend to overemphasize technical information and the scientific process.

Therefore, the implication is that journalists should present limitations of scientific studies in a way that facilitates readers' understanding of the limitations.

5.4 Methodological Implications

The present study has methodological implications for how researchers conduct manipulation checks in experiments. Two questions were used to check the manipulation of hedging. The first question assessed participants' recognition of the manipulation with "Yes" / "No" / "I don't know" response choices to the question of whether there was hedging in the news article(s) they read. The second question was a follow-up to participants who were able to recognize the manipulation; this question asked these participants to describe the hedging in the article(s). With the two-question design, the present study was able to assess the effectiveness of the manipulation using three approaches.

The three approaches are all valid methods to check the effectiveness of the manipulation. The first approach is valid because statistical analysis suggests that participants in the hedged condition were significantly more likely to report "Yes" to the first question than were participants in the non-hedged condition. The second approach is valid because only participants who answered the first question correctly were included. The third approach is valid because only participants who answered both questions correctly were included.

The three approaches differ in participants' awareness of the manipulation. The first, second, and third approaches represent low awareness, medium awareness, and high awareness, respectively, of the manipulation.

5.5 Limitations

First, the manipulation of presentation format included the number of news articles and use of integration devices. Specifically, integration devices were used in the one-article format but not in the two-article format. Integration devices were used in the one-article format because

such linguistic devices make the news more realistic. As a consequence, variances in source credibility between the two formats are difficult to interpret. Variance may be the result of the number of news articles, use of integration devices, or both. To distinguish the effects of integration devices from those of number of articles, an exploratory follow-up mediation analysis using perceived message believability was conducted. The follow-up analysis might be effective in distinguishing the effects because prior studies suggest that use of integration devices (i.e., making the conflict explicit) might predict source credibility via perceived message believability. However, it should be noted that a more valid approach to distinguish the effects of the two is to manipulate the two independently in an experiment.

Second, perceived message believability was a one-item measure. Perceived message believability was used as a mediator in an exploratory follow-up analysis in an effort to distinguish the effects of the number of articles from the use of integration devices. Participants were asked to rate how believable the news coverage was. Believability of news coverage should include at least perceptions of believability of the news itself and believability of the scientific studies being reported. Therefore, the findings in the present study about perceived message believability's mediational impact on the relationship between presentation format and source credibility are exploratory.

Third, the way source credibility was measured might be limited. Source credibility the present study is interested in is the overall credibility of each source. To measure the overall credibility, participants were asked to rate their feelings about each source in an overall manner. Specifically, with journalists' credibility, participants were asked to indicate their feelings of journalists who wrote the news coverage after they were exposed to the coverage about the two studies; with scientists' credibility, participants were asked to indicate their feelings of scientists

who conducted the studies that were mentioned in the news coverage after they were exposed to the coverage about the two studies. An alternative way to measure the overall credibility of each source would be to ask participants to rate their feelings of journalists who reported one study and feelings of journalists who reported the other study and then to average the two; and to do the same for scientists' credibility. The present study did not use the alternative way because the alternative way assumes that participants have weighed the source of each study equally.

Participants might have weighted the source of one study more than that of the other. But it is important to acknowledge that it is possible that the source of each study was weighed equally by some participants.

Fourth, the present study used a convenience sample of college students. As a result, the results might not be generalizable to the general public. College student participants' having more science education may lead to greater understanding of scientific uncertainty and trust in science (Sturgis & Allum, 2004).

CHAPTER 6. CONCLUSIONS

6.1 Conclusions

When conflicting scientific evidence is reported, negative outcomes, such as feelings of confusion and lower perceptions of source credibility, can occur. The present study has implications for journalists on how to reduce the negative outcomes when conflicting scientific evidence has to be reported. Specifically, one-article format is beneficial to journalists' credibility, but detrimental to scientists' credibility, as compared with two-article format. Encouraging journalists to understand that presentation format's effect on journalists' credibility differs from that on scientists' credibility and to use appropriate strategies to protect the source that is negatively affected appears to be a worthwhile endeavor, one that has significant implications for the communication of science, emerging and controversial issues in particular.

6.2 Future Research

First, future research should compare results across the three manipulation-check approaches.

Second, future research should distinguish the effects of integration devices on source credibility from those effects that are from the number of articles. One way to do so is to use a 2 (use of integration devices: yes vs. no) x 2 (number of articles: 1 vs. 2), between-subjects factorial design experiment.

Third, future research should further examine how people evaluate source credibility when they encounter conflicting scientific evidence in news stories. Exploratory follow-up analysis in the present study suggests that news readers used message believability, a one-item

measurement, to evaluate journalists' and scientists' credibility. For example, a starting point would be to develop a more valid measure of perceived message believability.

Fourth, future research should examine why hedging did not have the expected effects on source credibility. A starting point would be to test whether hedging's effects depend on nature of topics (e.g., politicized vs. non-politicized topics, topics with low prior issue knowledge vs. topics with high prior issue knowledge) and other contextual factors (e.g., a conflicting situation vs. a non-conflicting situation).

Fifth, future research should examine why integration of information from the two-article format did not occur. A starting point would be to use less explicitly conflicting health-related scientific information to test presentation format's effects on perceived issue uncertainty and source credibility. The rationale to conduct such research is that the present study, using explicitly conflicting information, found that the hypothesized integration did not occur, but a prior study (Stadtler, Scharrer, Brummernhenrich, & Bromme, 2013), using implicitly conflicting information, found that information was better integrated in the multiple-document condition. One example of implicitly conflicting information is like this: in one study, scientists found that food, such as eggs and meat, contains high amounts of cholesterol and the amount of cholesterol we ingest is an important determinant of our blood cholesterol level, but in another study, scientists found that humans have a regulatory mechanism to keep cholesterol levels constant in healthy individuals (Stadtler, Scharrer, Brummernhenrich, & Bromme, 2013).

Sixth, future research can also examine effects of the two journalistic practices in other contexts for science journalism, such as when a science area is highly politicized. One starting point would be to examine whether news stories using the two practices to report a politicized

science topic (e.g., genetically modified organism, climate change) could allow people to expose themselves to information or sources that they perceive as attitude-challenging.

With presentation format, one future study can examine whether the one-article format would be more likely than the two-article format to allow people to expose themselves to a source that they perceive as attitude-challenging. The present study found that journalists' credibility is higher in the one-article format than that in the two-article format. Higher news source credibility leads to lower likelihood of selective exposure (Metzger, Hartsell, & Flanagin, 2015), which means higher likelihood to use an attitude-challenging news source. For example, in a one-article format, would CNN's website and Fox's website make conservative (for CNN's website) and liberal (for Fox's website) readers more likely to expose themselves to these news outlets than when a two-article format is used?

With hedging, attitude-challenging information can be presented in a less threatening way, which could provide room for people to accept sources that offer such information. This room is a latitude of acceptance around one's attitudes (Sherif & Hovland, 1961). Exposure to attitude-challenging information causes cognitive dissonance (Festinger, 1957). Message attributes providing a latitude of acceptance can reduce cognitive dissonance (Knowles & Linn, 2004). Cognitive dissonance encourages selective exposure to sources providing attitude-consistent information (Johnson, Bichard, & Zhang, 2009; Knobloch-Westerwick, 2014). Reduced cognitive dissonance is likely to reduce the likelihood of selective exposure. For example, a future study can examine whether when CNN's website and Fox's website use hedged coverage, conservative readers (for CNN) and liberal readers (for Fox) are more likely to expose themselves to the news outlet than when hedges are not used.

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APPENDICES

APPENDIX 1: PERCEIVED ISSUE UNCERTAINTY

Instruction for experimental conditions: Based on what you just read, answer the following questions regarding how you feel about electronic cigarettes.

Instruction for control group: Answer the following questions regarding how you feel about electronic cigarettes.

1. How do you feel about scientific evidence about electronic cigarettes' association with smoking cessation?

Uncertain 1 2 3 4 5 6 7 Certain

2. How do scientists feel about electronic cigarettes' association with smoking cessation?

Uncertain 1 2 3 4 5 6 7 Certain

3. How does the public feel about electronic cigarettes' association with smoking cessation?

Uncertain 1 2 3 4 5 6 7 Certain

4. How do you feel about electronic cigarettes' association with smoking cessation?

Uncertain 1 2 3 4 5 6 7 Certain

APPENDIX 2: INDIVIDUAL SCIENTISTS' CREDIBILITY

Instruction: Based on what you just read, on the scales below, indicate your feelings about the scientists who conducted the studies that were mentioned in the news coverage.

1. Intelligent 1 2 3 4 5 6 7 Unintelligent
2. Untrained 1 2 3 4 5 6 7 Trained
3. Honest 1 2 3 4 5 6 7 Dishonest
4. Untrustworthy 1 2 3 4 5 6 7 Trustworthy
5. Inexpert 1 2 3 4 5 6 7 Expert
6. Honorable 1 2 3 4 5 6 7 Dishonorable
7. Informed 1 2 3 4 5 6 7 Uninformed
8. Moral 1 2 3 4 5 6 7 Immoral
9. Incompetent 1 2 3 4 5 6 7 Competent
10. Unethical 1 2 3 4 5 6 7 Ethical
11. Bright 1 2 3 4 5 6 7 Stupid
12. Phony 1 2 3 4 5 6 7 Genuine

APPENDIX 3: GROUP SCIENTISTS' CREDIBILITY

Instruction for experimental conditions: Based on what you just read, on the scales below, indicate your feelings about **scientists who conduct research on health topics** (e.g., electronic cigarettes).

Instruction for control group: On the scales below, please indicate your feelings about **scientists who conduct research on health topics** (e.g., electronic cigarettes).

1. Intelligent 1 2 3 4 5 6 7 Unintelligent
2. Untrained 1 2 3 4 5 6 7 Trained
3. Honest 1 2 3 4 5 6 7 Dishonest
4. Untrustworthy 1 2 3 4 5 6 7 Trustworthy
5. Inexpert 1 2 3 4 5 6 7 Expert
6. Honorable 1 2 3 4 5 6 7 Dishonorable
7. Informed 1 2 3 4 5 6 7 Uninformed
8. Moral 1 2 3 4 5 6 7 Immoral
9. Incompetent 1 2 3 4 5 6 7 Competent
10. Unethical 1 2 3 4 5 6 7 Ethical
11. Bright 1 2 3 4 5 6 7 Stupid
12. Phony 1 2 3 4 5 6 7 Genuine

APPENDIX 4: INDIVIDUAL JOURNALISTS' CREDIBILITY

Instruction: Based on what you just read, on the scales below, indicate your feelings about the journalists who wrote the news coverage.

1. Intelligent 1 2 3 4 5 6 7 Unintelligent
2. Untrained 1 2 3 4 5 6 7 Trained
3. Honest 1 2 3 4 5 6 7 Dishonest
4. Untrustworthy 1 2 3 4 5 6 7 Trustworthy
5. Inexpert 1 2 3 4 5 6 7 Expert
6. Honorable 1 2 3 4 5 6 7 Dishonorable
7. Informed 1 2 3 4 5 6 7 Uninformed
8. Moral 1 2 3 4 5 6 7 Immoral
9. Incompetent 1 2 3 4 5 6 7 Competent
10. Unethical 1 2 3 4 5 6 7 Ethical
11. Bright 1 2 3 4 5 6 7 Stupid
12. Phony 1 2 3 4 5 6 7 Genuine

APPENDIX 5: GROUP JOURNALISTS' CREDIBILITY

Instruction for experimental conditions: Based on what you just read, on the scales below, indicate your feelings about **journalists who report research on health topics** (e.g., electronic cigarettes).

Instruction for control group: On the scales below, please indicate your feelings about **journalists who conduct research on health topics** (e.g., electronic cigarettes).

1. Intelligent 1 2 3 4 5 6 7 Unintelligent
2. Untrained 1 2 3 4 5 6 7 Trained
3. Honest 1 2 3 4 5 6 7 Dishonest
4. Untrustworthy 1 2 3 4 5 6 7 Trustworthy
5. Inexpert 1 2 3 4 5 6 7 Expert
6. Honorable 1 2 3 4 5 6 7 Dishonorable
7. Informed 1 2 3 4 5 6 7 Uninformed
8. Moral 1 2 3 4 5 6 7 Immoral
9. Incompetent 1 2 3 4 5 6 7 Competent
10. Unethical 1 2 3 4 5 6 7 Ethical
11. Bright 1 2 3 4 5 6 7 Stupid
12. Phony 1 2 3 4 5 6 7 Genuine

APPENDIX 6: PERCEIVED MESSAGE FEATURES

Rate the news coverage you just read on the following features.

1-Strongly disagree 2-

Disagree

3-Neither agree nor disagree

4-Agree

5-Strongly agree

1. Interesting
2. Easy to understand
3. Believable
4. Easy to read

APPENDIX 7: UNDERSTANDING OF SCIENCE

Understanding of Scientific Study

When you read news stories, you see certain sets of words and terms. We are interested in how many people recognize certain kinds of terms. For example, some articles refer to the results of a scientific study. When you read or hear the term scientific study, you have

- A clear understanding of what it means to study something scientifically.
- A general understanding of what it means to study something scientifically.
- Little understanding of what it means to study something scientifically.

Understanding of Experimental Method

Two scientists want to know if a certain drug is effective against high blood pressure.

The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many of them experience lower blood pressure levels.

The second scientist wants to give the drug to 500 people with high blood pressure and not give the drug to another 500 people with high blood pressure, and see how many in both groups experience lower blood pressure levels.

Which is the better way to test this drug?

- The first way.
- The second way.

Understanding of Probability

A doctor tells a couple that their genetic makeup means that they've got one in four chances of having a child with an inherited illness.

Does this mean that if their first child has illness, the next three will not have the illness?

- Yes.
- No.

Does this mean that each of the couple's children will have the same risk of suffering from the illness?

- Yes.
- No.

APPENDIX 8: PRIOR ISSUE INVOLVEMENT

How much would you say you have thought about the following issues?

A great deal Some A little bit Hardly at all

1. GMO-related health issues.
2. Vaccine-related health issues.
3. E-cigarettes-related health issues.

How interested would you say you are in the following issues?

Very interested Somewhat interested Slightly interested Not interested at all

1. GMO-related health issues.
2. Vaccine-related health issues.
3. E-cigarettes-related health issues.

How much do you disagree/agree with the following statements?⁴

Strongly disagree Disagree Agree Strongly agree

1. GMOs pose a risk to my health.
2. Non-vaccinated people pose a risk to my health.
3. E-cigarettes pose a risk to my health.

I actively seek the most recent information about the following issues.

Strongly disagree Disagree Agree Strongly agree

1. GMO-related health issues.
2. Vaccine-related health issues.
3. E-cigarettes-related health issues.

⁴ This question was in the survey, but it was removed for analysis because of the low correlation it had with the other 3 questions.

APPENDIX 9: PRIOR ISSUE KNOWLEDGE

Answer the following questions regarding your knowledge about e-cigarettes.

1. How familiar are you with e-cigarettes' health effects?

Unfamiliar 1 2 3 4 5 6 7 Familiar

2. How capable do you feel if you are asked to give advice to a friend/family member who wants to use e-cigarettes to quit smoking?

Incapable 1 2 3 4 5 6 7 Capable

3. How confident do you feel if you are asked to vote on whether to promote or regulate e-cigarettes as a way to help people quit smoking?

Unconfident 1 2 3 4 5 6 7 Confident

4. How do you rate your knowledge regarding e-cigarettes' addictiveness as it compared with traditional cigarettes?

Poor 1 2 3 4 5 6 7 Excellent

5. How do you rate your knowledge about chemical composition of e-cigarettes?

Poor 1 2 3 4 5 6 7 Excellent

6. How do you rate your knowledge about clinical safety of e-cigarettes?

Poor 1 2 3 4 5 6 7 Excellent

7. How do you rate your knowledge about association between use of e-cigarettes and use of traditional cigarettes?

Poor 1 2 3 4 5 6 7 Excellent

APPENDIX 10: TOLERANCE FOR AMBIGUITY

Respond to the following statements by indicating the extent to which you agree or disagree with them.

- 1=Strongly disagree
- 2=Moderately disagree
- 3=Slightly disagree
- 4=Neither agree nor disagree
- 5=Slightly agree
- 6=Moderately agree
- 7=Strongly agree

1. An expert who doesn't come up with a definite answer probably doesn't know too much.
2. There is really no such thing as a problem that can't be solved.
3. A good job is one where what is to be done and how it is to be done are always clear.
4. In the long run it is possible to get more done by tackling small, simple problems rather than large and complicated ones.
5. What we are used to is always preferable to what is unfamiliar.
6. A person who leads an even, regular life in which few surprises or unexpected happenings arise, really has a lot to be grateful for.
7. I like parties where I know most of the people more than ones where all or most of the people are complete strangers.

APPENDIX 11: EPISTEMIC BELIEF

To what extent do you agree/disagree with the following statements?

- 1=strongly disagree
- 2= disagree
- 3= neither agree nor disagree
- 4= agree
- 5=strongly agree

1. What is true today will be true tomorrow.
2. The moral rules I live by apply to everyone.
3. If two people are arguing about something, at least one of them must be wrong.
4. Science is easy to understand because it contains so many facts.

APPENDIX 12: NEWS READING FREQUENCY

How often do you read news stories?

- Never
- Rarely
- Occasionally
- Sometimes
- Frequently
- Usually
- Every time

APPENDIX 13: CIGARETTE USE AND E-CIGARETTE USE

Please answer the following questions.

Do you use e-cigarettes?

- Yes.
- No.

Do you smoke regular cigarettes?

- Yes.
- No.

APPENDIX 14: DEMOGRAPHIC VARIABLES

What year were you born? (a drop-down choice box)

What is your gender?

- Male
- Female
- Other

What do you consider to be your ethnicity? Select all that apply.

- White/Caucasian/European
- Black/African
- East Asian e.g., Chinese, Japanese, South-East Asian
- Pacific Islander
- Hispanic/Latino
- Arabic, Egyptian or Maghreb
- American Indian
- Australian Aboriginal
- Other

Please type in your major(s). (Answers could exceed the size of the box.)

Your student status is

- freshman.
- sophomore.
- junior.
- senior.

APPENDIX 15: MANIPULATION CHECK

In the news coverage you just read, was there an **outright** mention of a **specific** limitation of either scientific study? A limitation of a scientific study is defined as a potential flaw in the way scientists carried out their study and it could influence the results of a study.

- Yes (Please describe what the outright-mentioned specific limitation(s) was/were in the box below.)

- No (Please describe why you chose "No" in the box below.)

- I don't know. (Please describe why you chose "I don't know" in the box below.)

APPENDIX 16: DEBRIEFING MESSAGE

“Health Information in the News”

Dear Participant:

During this study, you were asked to take part in online research. You were told that the purpose of the study was to investigate health information in the news. The actual purpose of the study was to manipulate the presentation (i.e., one news story or two news stories) and the content of the health stories (i.e., the presence or absence of study limitations) to see whether these manipulations made a difference in how uncertain people feel about the health issue and how credible they think the sources are.

We did not tell you everything about the purpose of the study because disclosing too much about the nature of the study could have influenced how you responded to the stimuli. Please feel free to discuss this with us. In light of this disclosure, you may decide that you do not want your data used in this research. We will be happy to provide any information we can to help answer questions you have about this study. If you would like your data removed from the study and permanently deleted, please email Hui Zhang at hui.zhang@colostate.edu with your name and CSU ID number.

We kindly ask you not to talk about this study to anyone in your class for 3 weeks. This will help us obtain findings that are more valid.

If you have questions about this research or your participation in the study, please contact me at hui.zhang@colostate.edu or my faculty advisor, Marilee Long, at marilee.long@colostate.edu. If you would like to receive a copy of the final report of this study (or a summary of the findings) when it is completed, please feel free to contact us.

Further Reading(s):

If you would like to learn more about the communication of health topics in the news, please see the following reference:

Nagler, R. H. (2014). Adverse outcomes associated with media exposure to contradictory nutrition messages. *Journal of Health Communication*, 19, 24-40.

If you have questions about your rights as a research participant, you may contact the CSU IRB at: RICRO_IRB@mail.colostate.edu; 970-491-1553.

Hui Zhang, Ph.D. Candidate

Marilee Long, Ph.D.

3/11/2015

APPENDIX 17: STIMULUS MATERIALS

Stimulus Material 1

The following is the material for participants who were assigned to hedged one-article pro-first condition.

Please read the following news carefully as you will answer questions about it afterwards.

Studies Disagree On Whether E-Cigarettes Help Smokers Quit

BOSTON(AP) -- Two science journals are reporting conflicting results about whether e-cigarettes help smokers quit. While one group of researchers published in **Addiction** found that e-cigarette users were more likely to kick the tobacco habit, another team whose research was published in **JAMA Internal Medicine** found e-cigarettes had no impact on quitting.

The studies are published at a time when there are already many differing opinions about e-cigarettes' effectiveness in helping smokers kick the tobacco habit.

The study published in **Addiction** suggests that "there's a reason to be cautiously optimistic about the effects of e-cigarettes on helping smokers quit," said Jamie Brown, University College London researcher, who led the study.

The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

The study concluded that outside of seeking professional support, smokers using e-cigarettes were more successful at quitting than those using nicotine replacement therapies (such as a patch) or no aid at all.

"We will continue to monitor success rates in people using e-cigarettes to stop smoking to see whether there are improvements as the devices become more advanced," Brown said.

The researchers did mention in their paper a limitation to their study. Everyone in their study tried to quit and some reported that they were still not smoking when the researchers surveyed them again. But of those who were still not smoking, the researchers did not ask if they had lapsed at anytime. So it's unknown if the rate of lapsing was associated with the method of quitting. "Future studies should assess that," Brown said.

The other study, published in **JAMA Internal Medicine**, made significantly different conclusions about the effectiveness of e-cigarettes.

"We did not find a relationship between using an e-cigarette and reducing cigarette consumption," said Rachel A. Grana, the study's lead researcher, from University of California in San Francisco.

The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

"Regulations should prohibit advertising claiming or suggesting that e-cigarettes are effective smoking cessation devices until claims are supported by scientific evidence," said Grana.

The study also reported limitations, including a caveat that the study had relatively few e-cigarette users, 88 in total. Of the 88 users, only 9 quit smoking tobacco. This number might be too small to detect the effectiveness that may exist. If the effect of using e-cigarettes is really strong, then a smaller sample size is not a problem. If it's subtle, however, you need more participants to show that. "Statistically, with a smaller sample size, researchers are less able to find smaller effects," Grana said. "Nonetheless, our data add to the current evidence that e-cigarettes did not increase rates of smoking cessation."

Stimulus Material 2

The following is the material for participants who were assigned to hedged one-article con-first condition.

Please read the following news carefully as you will answer questions about it afterwards.

Studies Disagree On Whether E-Cigarettes Help Smokers Quit

BOSTON (AP) -- Two science journals are reporting conflicting results about whether e-cigarettes help smokers quit. While one group of researchers published in **JAMA Internal Medicine** found e-cigarettes had no impact on quitting, another team whose research was published in **Addiction** found that e-cigarette users were more likely to help kick the tobacco habit.

The studies are published at a time when there are already many differing opinions about e-cigarettes' effectiveness in helping smokers kick the tobacco habit.

The study published in **JAMA Internal Medicine** suggests that "there is not a relationship between using an e-cigarette and reducing cigarette consumption," said Rachel A. Grana, University of California in San Francisco researcher, who led the study.

The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

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The other study, published in **Addiction**, made significantly different conclusions about the effectiveness of e-cigarettes.

"The finding suggests that there's a reason to be cautiously optimistic about the effects of e-cigarettes on helping smokers quit," said Jamie Brown, the study's lead researcher, from

University College London.

The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

The study concluded that outside of seeking professional support, smokers using e-cigarettes were more successful at quitting than those using nicotine replacement therapies (such as a patch) or no aid at all.

“We will continue to monitor success rates in people using e-cigarettes to stop smoking to see whether there are improvements as the devices become more advanced,” Brown said.

The researchers also mentioned in their paper a limitation to their study. Everyone in their study tried to quit and some reported that they were still not smoking when the researchers surveyed them again. But of those who were still not smoking, the researchers did not ask if they had lapsed at anytime. So it's unknown if the rate of lapsing was associated with the method of quitting. "Future studies should assess that," Brown said.

Stimulus Material 3

The following is the material for participants who were assigned to hedged two-article pro-first condition.

Please read the following news carefully as you will answer questions about it afterwards.

Study Reports E-Cigarettes Help Smokers Quit

LONDON (AP) -- A group of researchers report that e-cigarettes are more effective in helping smokers quit than patches or using no aids at all. The study is published in the science journal *Addiction*.

“The finding suggests that there’s a reason to be cautiously optimistic about the effects of e-cigarettes on helping smokers quit,” said University College London researcher Jamie Brown, who led the study.

The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

The study concluded that outside of seeking professional support, smokers using e-cigarettes were more successful at quitting than those using nicotine replacement therapies (such as a patch) or no aid at all.

“We will continue to monitor success rates in people using e-cigarettes to stop smoking to see whether there are improvements as the devices become more advanced,” Brown said.

The researchers did mention in their paper a limitation to their study. Everyone in their study tried to quit and some reported that they were still not smoking when the researchers surveyed them again. But of those who were still not smoking, the researchers did not ask if they had lapsed at anytime. So it's unknown if the rate of lapsing was associated with the method of quitting. "Future studies should assess that," Brown said.

Study Reports E-Cigarettes Do Not Help Smokers Quit

SAN FRANCISCO (AP) -- A group of researchers report that e-cigarettes are no more effective in helping smokers quit than using other aids or no aid at all. The study, published in the science journal **JAMA Internal Medicine**, found that e-cigarette users were no more likely to kick the tobacco habit than those who did not use the electronic cigarettes.

"We did not find a relationship between using an e-cigarette and reducing cigarette consumption," said Rachel A. Grana, the study's lead researcher, from the University of California in San Francisco.

The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

"Regulations should prohibit advertising claiming or suggesting that e-cigarettes are effective smoking cessation devices until claims are supported by scientific evidence," Grana said.

The study reported limitations, including a caveat that the study had relatively few e-cigarette users, 88 in total. Of the 88 users, only 9 quit smoking tobacco. This number might be too small to detect the effectiveness that may exist. If the effect of using e-cigarettes is really strong, then a smaller sample size is not a problem. If it's subtle, however, you need more participants to show that. "Statistically, with a smaller sample size, researchers are less able to find smaller effects," Grana said. "Nonetheless, our data add to the current evidence that e-cigarettes did not increase rates of smoking cessation."

Stimulus Material 4

The following is the material for participants who were assigned to hedged two-article con-first condition.

Please read the following news carefully as you will answer questions about it afterwards.

Study Reports E-Cigarettes Do Not Help Smokers Quit

SAN FRANCISCO (AP) -- A group of researchers report that e-cigarettes are no more effective in helping smokers quit than using other aids or no aid at all. The study, published in the science journal **JAMA Internal Medicine**, found that e-cigarette users were no more likely to kick the tobacco habit than those who did not use the electronic cigarettes.

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The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

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The study reported limitations, including a caveat that the study had relatively few e-cigarette users, 88 in total. Of the 88 users, only 9 quit smoking tobacco. This number might be too small to detect the effectiveness that may exist. If the effect of using e-cigarettes is really strong, then a smaller sample size is not a problem. If it's subtle, however, you need more participants to show that. "Statistically, with a smaller sample size, researchers are less able to find smaller effects," Grana said. "Nonetheless, our data add to the current evidence that e-cigarettes did not increase rates of smoking cessation."

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The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

The study concluded that outside of seeking professional support, smokers using e-cigarettes were more successful at quitting than those using nicotine replacement therapies (such as a patch) or no aid at all.

“We will continue to monitor success rates in people using e-cigarettes to stop smoking to see whether there are improvements as the devices become more advanced,” Brown said.

The researchers did mention in their paper a limitation to their study. Everyone in their study tried to quit and some reported that they were still not smoking when the researchers surveyed them again. But of those who were still not smoking, the researchers did not ask if they had lapsed at anytime. So it's unknown if the rate of lapsing was associated with the method of quitting. "Future studies should assess that," Brown said.

Stimulus Material 5

The following is the material for participants who were assigned to non-hedged one-article pro-first condition.

Please read the following news carefully as you will answer questions about it afterwards.

Studies Disagree On Whether E-Cigarettes Help Smokers Quit

BOSTON (AP) -- Two science journals are reporting conflicting results about whether e-cigarettes help smokers quit. While one group of researchers published in **Addiction** found that e-cigarette users were more likely to kick the tobacco habit, another team whose research was published in **JAMA Internal Medicine** found e-cigarettes had no impact on quitting.

The studies are published at a time when there are already many differing opinions about e-cigarettes' effectiveness in helping smokers kick the tobacco habit.

The study published in **Addiction** suggests that "there's a reason to be cautiously optimistic about the effects of e-cigarettes on helping smokers quit," said Jamie Brown, University College London researcher, who led the study.

The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

The study concluded that outside of seeking professional support, smokers using e-cigarettes were more successful at quitting than those using nicotine replacement therapies (such as a patch) or no aid at all.

"We will continue to monitor success rates in people using e-cigarettes to stop smoking to see whether there are improvements as the devices become more advanced," Brown said.

E-cigarettes are battery-powered nicotine delivery devices that heat a liquid to produce a vapor that users inhale. All e-cigarettes work basically the same way. Features and costs vary. Some are disposable. Others have a rechargeable battery and refillable cartridges. The costs of e-cigarettes can vary. Starter kits usually run between \$30 and \$100, and refill packs cost between \$20 and \$40.

The electronic cigarette was invented in the 1960s, but it didn't really take off until a decade ago. Currently it accounts for 1% of the \$80 billion U.S. cigarette market.

The other study, published in **JAMA Internal Medicine**, however, made significantly different conclusions about the effectiveness of e-cigarettes.

"We did not find a relationship between using an e-cigarette and reducing cigarette consumption," said Rachel A. Grana, the study's lead researcher, from University of California in San Francisco.

The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

"Regulations should prohibit advertising claiming or suggesting that e-cigarettes are effective smoking cessation devices until claims are supported by scientific evidence," said Grana.

There are 42.1 million tobacco smokers in the United States, according to the Centers for Disease Control and Prevention. Many smokers want to quit, but few successfully give up in the long term, according to studies.

Nicotine patches and gum are standard aids for smoking cessation, but recently e-cigarettes have significantly overtaken these products in popularity among smokers.

The Tobacco Vapor Electronic Cigarette Association estimates about 4 million Americans now use battery-powered cigarettes. They project sales of the devices to cross the 1 billion mark by the end of this year.

Stimulus Material 6

The following is the material for participants who were assigned to non-hedged one-article con-first condition.

Please read the following news carefully as you will answer questions about it afterwards.

Studies Disagree On Whether E-Cigarettes Help Smokers Quit

BOSTON (AP) -- Two science journals are reporting conflicting results about whether e-cigarettes help smokers quit. While one group of researchers published in **JAMA Internal Medicine** found e-cigarettes had no impact on quitting, another team whose research was published in **Addiction** found that e-cigarette users were more likely to help kick the tobacco habit.

The studies are published at a time when there are already many differing opinions about e-cigarettes' effectiveness in helping smokers kick the tobacco habit.

The study published in **JAMA Internal Medicine** suggests that "there is not a relationship between using an e-cigarette and reducing cigarette consumption," said Rachel A. Grana, University of California in San Francisco researcher, who led the study.

The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

"Regulations should prohibit advertising claiming or suggesting that e-cigarettes are effective smoking cessation devices until claims are supported by scientific evidence," said Grana.

There are 42.1 million tobacco smokers in the United States, according to the Centers for Disease Control and Prevention. Many smokers want to quit, but few successfully give up in the long term, according to studies.

Nicotine patches and gum are standard aids for smoking cessation, but recently e-cigarettes have significantly overtaken these products in popularity among smokers.

The Tobacco Vapor Electronic Cigarette Association estimates about 4 million Americans now use battery-powered cigarettes. They project sales of the devices to cross the 1 billion mark by the end of this year.

The other study, published in **Addiction**, made significantly different conclusions about the effectiveness of e-cigarettes.

“The finding suggests that there’s a reason to be cautiously optimistic about the effects of e-cigarettes on helping smokers quit,” said Jamie Brown, the study’s lead researcher, from University College London.

The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

The study concluded that outside of seeking professional support, smokers using e-cigarettes were more successful at quitting than those using nicotine replacement therapies (such as a patch) or no aid at all.

“We will continue to monitor success rates in people using e-cigarettes to stop smoking to see whether there are improvements as the devices become more advanced,” Brown said.

E-cigarettes are battery-powered nicotine delivery devices that heat a liquid to produce a vapor that users inhale. All e-cigarettes work basically the same way. Features and costs vary. Some are disposable. Others have a rechargeable battery and refillable cartridges. The costs of e-cigarettes can vary. Starter kits usually run between \$30 and \$100, and refill packs cost between \$20 and \$40.

The electronic cigarette was invented in the 1960s, but it didn't really take off until a decade ago. Currently it accounts for 1% of the \$80 billion U.S. cigarette market.

Stimulus Material 7

The following is the material for participants who were assigned to non-hedged two-article pro-first condition.

Please read the following news carefully as you will answer questions about it afterwards.

Study Reports E-Cigarettes Help Smokers Quit

LONDON (AP) -- A group of researchers report that e-cigarettes are more effective in helping smokers quit than patches or using no aids at all. The study is published in the science journal *Addiction*.

“The finding suggests that there’s a reason to be cautiously optimistic about the effects of e-cigarettes on helping smokers quit,” said University College London researcher Jamie Brown, who led the study.

The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

The study concluded that outside of seeking professional support, smokers using e-cigarettes were more successful at quitting than those using nicotine replacement therapies (such as a patch) or no aid at all.

“We will continue to monitor success rates in people using e-cigarettes to stop smoking to see whether there are improvements as the devices become more advanced,” Brown said.

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The electronic cigarette was invented in the 1960s, but it didn't really take off until a decade ago. Currently it accounts for 1% of the \$80 billion U.S. cigarette market.

Study Reports E-Cigarettes Do Not Help Smokers Quit

SAN FRANCISCO (AP) -- A group of researchers report that e-cigarettes are no more effective in helping smokers quit than using other aids or no aid at all. The study, published in the science journal **JAMA Internal Medicine**, found that e-cigarette users were no more likely to kick the tobacco habit than those who did not use the electronic cigarettes.

"We did not find a relationship between using an e-cigarette and reducing cigarette consumption," said Rachel A. Grana, the study's lead researcher, from the University of California in San Francisco.

The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

"Regulations should prohibit advertising claiming or suggesting that e-cigarettes are effective smoking cessation devices until claims are supported by scientific evidence," Grana said.

There are 42.1 million tobacco smokers in the United States, according to the Centers for Disease Control and Prevention. Many smokers want to quit, but few successfully give up in the long term, according to studies.

Nicotine patches and gum are standard aids for smoking cessation, but recently e-cigarettes have significantly overtaken these products in popularity among smokers.

The Tobacco Vapor Electronic Cigarette Association estimates about 4 million Americans now use battery-powered cigarettes. They project sales of the devices to cross the 1 billion mark by the end of this year.

Stimulus Material 8

The following is the material for participants who were assigned to non-hedged two-article con-first condition.

Please read the following news carefully as you will answer questions about it afterwards.

Study Reports E-Cigarettes Do Not Help Smokers Quit

SAN FRANCISCO (AP) -- A group of researchers report that e-cigarettes are no more effective in helping smokers quit than using other aids or no aid at all. The study, published in the science journal **JAMA Internal Medicine**, found that e-cigarette users were no more likely to kick the tobacco habit than those who did not use the electronic cigarettes.

"We did not find a relationship between using an e-cigarette and reducing cigarette consumption," said Rachel A. Grana, the study's lead researcher, from the University of California in San Francisco.

The study surveyed smokers both in November 2011 and in a follow-up survey in November 2012. Researchers found that a greater proportion of e-cigarette users had their first tobacco cigarette less than 30 minutes after waking compared to non-users, and e-cigarette use didn't significantly predict quitting tobacco-smoking one-year later.

"Regulations should prohibit advertising claiming or suggesting that e-cigarettes are effective smoking cessation devices until claims are supported by scientific evidence," Grana said.

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Study Reports E-Cigarettes Help Smokers Quit

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“The finding suggests that there’s a reason to be cautiously optimistic about the effects of e-cigarettes on helping smokers quit,” said University College London researcher Jamie Brown, who led the study.

The study surveyed smokers who attempted to quit smoking. These smokers either used e-cigarettes only, nicotine replacement therapy (NRT) bought over-the-counter only, or no aid at all between 2009 and 2014. E-cigarette users were more likely to quit smoking than either those who used NRT bought over-the-counter or no aid.

The study concluded that outside of seeking professional support, smokers using e-cigarettes were more successful at quitting than those using nicotine replacement therapies (such as a patch) or no aid at all.

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The electronic cigarette was invented in the 1960s, but it didn't really take off until a decade ago. Currently it accounts for 1% of the \$80 billion U.S. cigarette market.

APPENDIX 18: CODING SCHEME FOR MANIPULATION CHECK

This coding scheme is developed for the open-ended question included in the survey after stimulus exposure. The question asks participants to describe the specific limitations if they think there is an outright mention of a specific limitation of either scientific study.

There are two limitations. One limitation is that the number of e-cigarette users in the study might be too small to detect the effectiveness of e-cigarettes that may exist; the other limitation is that the study did not measure if people had lapsed at anytime.

Variable Name: LimitationCorrect

Variable Label: Manipulation check for hedging using an open-ended question

Read each answer to the open-ended question to determine the code for the variable, LimitationCorrect.

If the answer identified **what** one of the two limitations is or the two limitations are, code it as "1"; if the answer did not identify any of the two limitations, code it as "0".

- Below are some examples of what should be coded as "1".

1 = If answers indicated that **sample size** might be too small to detect the effect, they should be counted. Some examples are "sample size", "small sample size", "few e-cig users", "number of participants is not big enough", "of 88 e-cig users, only 9 quit", "limited participants", or any similar variants.

1 = If answers indicated that **lapse/relapse**⁵ data are missing, they should be counted. Some examples are "no data on relapse", "didn't follow up on lapse", "didn't measure/ask whether smokers lapsed", or any similar variants.

- Below are some examples of what should be coded as "0".

0 = If answers indicated **only where** the limitation(s) is/are without saying what they are or it is, they should be counted. For example, answers indicating that limitation is at the bottom or end of the article(s) or study should be included.

0 = If answers **only emphasized** that there is/are limitation(s) without saying what they are or it is. For example, "the articles did mention some limitations, (but I can't remember exactly what they are)." or "I did see a limitation mentioned, (but I can't recall)."

⁵Technically, lapse and relapse are different terms when referring to smoking cessation. Given that participants used them interchangeably, both terms are considered valid identification of this limitation.

0 = If the participant **only mentioned the research method is flawed** in general without identifying sample size or lapse data. For example, "it is the method their data is collected."

0 = If the participant **did not give any response to the question** (i.e. blank).

0 = If the participant said "**I don't know.**" Answers indicating other variants of "I don't know" should also be coded as "0". For example, "I don't remember/understand/recall." The objects that participants don't know about can include any of the following: the limitation/variables/articles/report, the question (e.g., what the question is asking), and the subject or science in general (e.g., I'm not educated in this topic.)

0 = If the participant said he/she **needs to read it again** or **did not read it carefully**. Answers indicating that no processing or reading occurs, for example, "I skimmed it." "I need to read it again." "I must have skipped it." "I cannot look back."

0 = If the participant provided **other limitation(s)**. Answers indicating limitations of the following examples should be coded as "0". For example, more research should be done, no control group was used, correlation does not equal causation, age, gender, some people are still smoking, the study only tested people who want to quit, longer time is needed to get a conclusion, every study is flawed, the time the research was conducted, and any other limitations that are not about sample size or data on lapse/relapse.

0 = If the participant gave **any other answers that are not categorized above**. Answers that are irrelevant, indicating limitation is implied (not outright mention), e.g., "There are many factors lead to limitations." "Limitation is implied, but not mentioned." "It is a valid research." "Scientists use different definitions."

**APPENDIX 19: DESCRIPTION OF PARTICIPANTS USING THE LOW- AND
MEDIUM- AWARENESS APPROACHES**

Low-Awareness Approach

The sample (N = 491) was 41.1% male, 58.7% female, and 0.2% other. The sample was largely Caucasian (see Table 2). Participants ranged from 19 to 51 years of age, with a mean of 22.18 years (SD = 3.50). The majority of the participants were 24 years or younger (91.2%).

Ethnicity Composition of Participants Using the Low-Awareness Approach (N = 491)

Ethnicity	Number	Percent
Caucasian	414	84.3%
Hispanic, Latino, or Spanish Origin	51	10.4%
Asian or Pacific Islander	41	8.3%
African American	16	3.3%
Arabic, Egyptian or Maghreb	12	2.4%
American Indian or Native American	10	2%
Other	7	1.4%
	Total 551 ^a	

^a There are more than 491 because participants of multiple ethnicities consisted of 8.8% of the sample.

Twenty-three percent of the participants were science majors. Student status refers to the year in which a student is in his or her program of study. Half of the participants were in their third year (50.1%), 26.6% were fourth-year students, 22.9% were second-year and 0.4% were first-year students.

Medium-Awareness Approach

The sample (N = 290) was 37.9% male and 62.1% female. The sample was largely Caucasian (see Table 3). Participants ranged from 19 to 51 years of age, with a mean of 22.38 years (SD = 4.14). The majority of the participants were 24 years or younger (89.2%).

Ethnicity Composition of Participants Using the Medium-Awareness Approach (N = 290)

Ethnicity	Number	Percent
Caucasian	255	87.9%
Hispanic, Latino, or Spanish Origin	25	8.6%
Asian or Pacific Islander	24	8.3%
Arabic, Egyptian or Maghreb	2	0.7%
African American	10	3.4%
American Indian or Native American	6	2.1 %
Other	2	0.7%
	Total 324 ^a	

^a There are more than 290 because participants of multiple ethnicities consisted of 11.4 % of the sample.

Twenty-nine percent of the sample were science majors, and 0.3% were first-year, 21.7% were second-year, 49.7% were third-year, and 26.9% were fourth-year students.

APPENDIX 20: DESCRIPTIVE STATISTICS AND RELIABILITY MEASURES FOR
VARIABLES USING THE LOW- AND MEDIUM- AWARENESS APPROACHES

Low-Awareness Approach

Descriptive Statistics and Reliability for Variables Using the Low-Awareness Approach

Variables	Cronbach's alpha	M	SD
Perceived Issue Uncertainty	0.83	4.56	1.28
Individual Scientists' Competence	0.87	5.01	0.93
Individual Scientists' Trustworthiness	0.89	4.82	0.97
Group Scientists' Competence	0.91	5.35	1.03
Group Scientists' Trustworthiness	0.92	5.02	1.01
Individual Journalists' Competence	0.88	4.52	1.07
Individual Journalists' Trustworthiness	0.92	4.45	1.06
Group Journalists' Competence	0.87	4.54	1.05
Group Journalists' Trustworthiness	0.92	4.40	1.03
Prior Issue Involvement	0.70	2.13	0.72
Understanding of Science	0.44	4.13	0.91
Prior Issue Knowledge	0.90	2.96	1.28
Tolerance for Ambiguity	0.58	3.96	0.88
Epistemic Beliefs	0.65	3.84	0.72
Perceived Message Easiness	0.76	3.60	0.81
Perceived Message Believability*		3.24	0.88
Perceived Message Interestingness*		3.24	0.95

* Variables with * in this table were one-item scale measures. Only their *M* and *SD* were reported in this table.

News reading frequency. Eleven participants (2.2%) reported that they never read news stories, 73 participants (14.9%) rarely read news stories, 132 participants (26.9%) occasionally read news stories, 106 participants (21.6%) read news stories sometimes, 115 participants (23.4%) frequently read news stories, 37 participants (7.5%) usually read news stories, and 17 participants (3.5%) read news every time.

Use of regular cigarettes. Twenty-five participants (5.2%) reported that they smoke cigarettes, 459 participants (94.8%) reported that they do not smoke cigarettes, and 7 (1.4%) did not answer the question

Use of e-cigarettes. Twenty-two participants (4.5%) reported that they use e-cigarettes, 464 participants (95.5%) reported that they do not use e-cigarettes, and 5 (1.0.9%) did not answer the question.

Seven participants (1.4%) reported that they use both regular cigarettes and e-cigarettes.

Medium-Awareness Approach

Descriptive Statistics and Reliability for Variables Using the Medium-Awareness Approach

Variables	Cronbach's alpha	M	SD
Perceived Issue Uncertainty	0.82	4.59	1.23
Individual Scientists' Competence	0.89	5.14	0.96
Individual Scientists' Trustworthiness	0.90	4.94	1.00
Group Scientists' Competence	0.92	5.53	1.00
Group Scientists' Trustworthiness	0.94	5.16	1.03
Individual Journalists' Competence	0.91	4.63	1.15
Individual Journalists' Trustworthiness	0.94	4.56	1.14
Group Journalists' Competence	0.90	4.65	1.13
Group Journalists' Trustworthiness	0.94	4.54	1.11
Prior Issue Involvement	0.69	2.21	0.65
Understanding of Science	0.44	4.24	0.84
Prior Issue Knowledge	0.90	2.92	1.29
Tolerance for Ambiguity	0.58	3.85	0.90
Epistemic Beliefs	0.67	3.85	0.73
Perceived Message Easiness	0.80	3.73	0.78
Perceived Message Believability*		3.24	0.93
Perceived Message Interestingness*		3.30	0.94

* Variables with * in this table were one-item scale measures. Only their *M* and *SD* were reported in this table.

News reading frequency. Five participants (1.7%) reported that they never read news stories, 37 participants (12.8%) rarely read news stories, 78 participants (26.9%) occasionally read news stories, 64 participants (22.1%) read news stories sometimes, 74 participants (25.5%) frequently read news stories, 24 participants (8.3%) usually read news stories, and 8 participants (2.7%) read news every time.

Use of regular cigarettes. Eleven participants (3.8%) reported that they smoke cigarettes, 278 participants (95.9%) reported that they do not smoke cigarettes, and 1 (0.3%) did not answer the question.

Use of e-cigarettes. Twelve participants (4.1%) reported that they use e-cigarettes, and 278 participants (95.9%) reported that they do not use e-cigarettes.

Two participants (0.7%) reported that they use both regular cigarettes and e-cigarettes.

APPENDIX 21: EFFECTS OF PRESENTATION ORDER USING THE LOW- AND
MEDIUM- AWARENESS APPROACHES

Low-Awareness Approach

One-Way ANOVA Results for Effects of Presentation Order on Dependent Variables Using the Low-Awareness Approach (N = 491)

DV _s	Presentation Order						F	p
	Positive-first			Negative-first				
	M	SD	n	M	SD	n		
Perceived Issue Uncertainty	4.49	1.31	212	4.46	1.16	219	0.06	0.81
Individual Journalists' Competence	4.58	1.10	209	4.47	1.04	217	1.04	0.31
Individual Journalists' Trustworthiness	4.50	1.05	212	4.39	1.08	217	1.24	0.27
Individual Scientists' Competence	5.04	0.96	213	4.98	0.90	220	0.44	0.51
Individual Scientists' Trustworthiness	4.84	1.00	210	4.80	0.94	217	0.21	0.65
Group Journalists' Competence	4.60	1.06	208	4.51	1.02	221	0.76	0.39
Group Journalists' Trustworthiness	4.47	1.03	208	4.39	1.05	218	0.56	0.46
Group Scientists' Competence	5.32	1.03	212	5.32	1.04	212	0.00	0.96
Group Scientists' Trustworthiness	5.03	1.01	210	4.99	1.00	215	0.12	0.73

Medium-Awareness Approach

One-Way ANOVA Results for Effects of Presentation Order on Dependent Variables Using the Medium-Awareness Approach (N = 290)

DV _s	Presentation Order						F	p
	Positive-first			Negative-first				
	M	SD	n	M	SD	n		
Perceived Issue Uncertainty	4.62	1.31	118	4.55	1.15	114	0.17	0.68
Individual Journalists' Competence	4.70	1.21	118	4.57	1.08	114	0.79	0.37
Individual Journalists' Trustworthiness	4.56	1.16	118	4.55	1.12	114	0.00	0.97
Individual Scientists' Competence	5.18	0.99	118	5.10	0.92	114	0.42	0.52
Individual Scientists' Trustworthiness	4.94	1.07	118	4.94	0.92	113	0.00	0.98
Group Journalists' Competence	4.67	1.16	117	4.63	1.10	115	0.09	0.77
Group Journalists' Trustworthiness	4.55	1.10	116	4.53	1.12	114	0.01	0.92
Group Scientists' Competence	5.55	1.02	117	5.51	1.00	114	0.11	0.74
Group Scientists' Trustworthiness	5.17	1.06	116	5.15	1.00	114	0.03	0.86

APPENDIX 22: EFFECTIVENESS OF RANDOM ASSIGNMENT TO EXPERIMENTAL
CONDITION USING THE LOW- AND MEDIUM AWARENESS APPROACHES

Low-Awareness Approach

Effectiveness of Randomization for Predisposition Variables with Scale Measures
Using the Low-Awareness Approach (N = 491)

Scale DVs	Hedging								Presentation Format							
	Hedged			Non-hedged					One-Article				Two-Article			
	M	SD	n	M	SD	n	F	p	M	SD	n	M	SD	n	F	p
Prior Issue Involvement	2.25	0.62	219	2.30	0.58	208	0.61	0.43	2.28	0.58	219	2.27	0.63	208	0.07	0.80
Understanding of Science	4.18	0.86	202	4.07	0.92	193	1.67	0.20	4.24	0.82	198	4.02	0.95	197	6.20	0.01*
Prior Issue Knowledge	2.91	1.29	221	3.05	1.25	210	1.23	0.27	2.91	1.27	219	3.05	1.28	212	1.26	0.26
Tolerance for Ambiguity	3.90	0.85	219	3.81	0.92	210	1.05	0.31	3.91	0.89	218	3.79	0.87	211	1.87	0.17
Epistemic Belief	3.84	0.74	222	3.79	0.70	211	0.50	0.48	3.80	0.72	221	3.84	0.72	212	0.28	0.60

* $p < 0.05$

Effectiveness of Randomization for Predisposition Variables, Demographic
Variables, and Behavioral Variables with Nominal Measures Using the Low-Awareness
Approach (N = 491)

Nominal DVs	Hedging		Presentation Format	
	χ^2	p	χ^2	p
Major	1.71	0.51	1.02	0.74
Student Status	1.50	0.09	1.70	0.64
Use of Cigarettes	0.12	0.73	1.00	0.32
Use of E-Cigarettes	0.01	0.92	0.01	0.93
News Reading Frequency	5.10	0.53	1.41	0.97

Medium-Awareness Approach

Effectiveness of Randomization for Predisposition Variables with Scale Measures Using the Medium-Awareness Approach (N = 290)

Scale DVs	Hedging						Presentation Format									
	Hedged			Non-hedged			One-Article			Two-Article						
	M	SD	n	M	SD	n	F	p	M	SD	n	M	SD	n	F	p
Prior Issue Involvement	2.22	0.58	130	2.29	0.57	101	0.86	0.36	2.29	0.55	123	2.21	0.61	108	0.94	0.33
Understanding of Science	4.37	.072	121	4.15	0.85	92	4.12	0.04*	4.35	0.70	110	4.19	0.86	103	2.23	0.14
Prior Issue Knowledge	2.87	1.29	130	3.03	1.26	101	0.97	0.33	2.89	1.23	122	2.99	1.34	109	0.38	0.54
Tolerance for Ambiguity	3.86	0.86	130	3.81	0.96	101	0.14	0.71	3.89	0.92	122	3.79	0.89	109	0.75	0.39
Epistemic Belief	3.90	0.70	131	3.73	0.76	102	3.44	0.07	3.81	0.67	123	3.84	0.79	110	0.13	0.72

* $p < 0.05$

Effectiveness of Randomization for Predisposition Variables, Demographic Variables, and Behavioral Variables with Nominal Measures Using the Medium-Awareness Approach (N = 290)

Nominal DVs	Hedging		Presentation Format	
	χ^2	p	χ^2	p
Major	2.06	0.71	1.43	0.35
Student Status	4.94	0.18	7.76	0.06
Use of Cigarettes	0.10	0.75	3.19	0.07
Use of E-Cigarettes	0.06	0.81	0.03	0.86
News Reading Frequency	6.52	0.37	7.29	0.30

APPENDIX 23: VARIANCE IN DEPENDENT VARIABLES EXPLAINED BY
 POTENTIAL COVARIATES USING THE LOW- AND MEDIUM AWARENESS
 APPROACHES

Low-Awareness Approach

Variance in Dependent Variables Explained by Potential Covariates Using Low-Awareness Approach (N = 491)

	Individual Journalists' Competence	Individual Journalists' Trustworthiness	Individual Scientists' Competence	Individual Scientists' Trustworthiness	Group Journalists' Competence	Group Journalists' Trustworthiness	Group Scientists' Competence	Group Scientists' Trustworthiness
Prior Issue Knowledge	0.000	0.000	0.001	0.002	0.001	0.000	0.000	0.001
Understanding of Science	0.007	0.008	0.015	0.029	0.009	0.009	0.048	0.030
Prior Issue Involvement	0.003	0.003	0.002	0.000	0.000	0.000	0.000	0.000
Tolerance for Ambiguity	0.000	0.003	0.006	0.007	0.000	0.005	0.007	0.019
Epistemic Belief	0.013	0.009	0.017	0.010	0.013	0.003	0.029	0.026
News Reading Frequency	0.043	0.042	0.039	0.025	0.043	0.029	0.027	0.018
Use of Cigarettes	0.000	0.001	0.001	0.001	0.002	0.000	0.001	0.000
Use of E-Cigarettes	0.001	0.001	0.000	0.002	0.001	0.001	0.000	0.000
Student Status	0.024	0.029	0.008	0.009	0.024	0.021	0.012	0.017
Student Major	0.012	0.013	0.003	0.002	0.017	0.013	0.002	0.001
Perceived Message Believability	0.14*	0.16*	0.14*	0.14*	0.12*	0.15*	0.08	0.14*
Perceived Message Interestingness	0.029	0.036	0.056	0.046	0.031	0.043	0.045	0.061
Perceived Message Easiness	0.050	0.040	0.074	0.040	0.042	0.037	0.074	0.053

*Variance in dependent variables explained by potential covariates is over 0.10.

Medium-Awareness Approach

Variance in Dependent Variables Explained by Potential Covariates Using Medium-Awareness Approach (N = 290)

	Individual Journalists' Competence	Individual Journalists' Trustworthiness	Individual Scientists' Competence	Individual Scientists' Trustworthiness	Group Journalists' Competence	Group Journalists' Trustworthiness	Group Scientists' Competence	Group Scientists' Trustworthiness
Prior Issue Knowledge	0.002	0.003	0.009	0.012	0.000	0.000	0.001	0.001
Understanding of Science	0.000	0.006	0.011	0.022	0.001	0.000	0.012	0.010
Prior Issue Involvement	0.002	0.002	0.003	0.001	0.000	0.002	0.000	0.000
Tolerance for Ambiguity	0.005	0.010	0.009	0.010	0.001	0.011	0.006	0.023
Epistemic Belief	0.012	0.006	0.007	0.001	0.012	0.004	0.014	0.012
News Reading Frequency	0.056	0.062	0.048	0.024	0.050	0.033	0.012	0.005
Use of Cigarettes	0.004	0.002	0.001	0.000	0.002	0.001	0.000	0.000
Use of E-Cigarettes	0.009	0.005	0.001	0.004	0.006	0.009	0.001	0.000
Student Status	0.044	0.040	0.003	0.007	0.051	0.034	0.003	0.006
Student Major	0.005	0.005	0.002	0.005	0.001	0.002	0.002	0.003
Perceived Message Believability	0.13*	0.17*	0.17*	0.17*	0.13*	0.14*	0.11*	0.18*
Perceived Message Interestingness	0.019	0.048	0.056	0.076	0.013	0.041	0.040	0.059
Perceived Message Easiness	0.063	0.056	0.086	0.047	0.051	0.053	0.058	0.069

*Variance in dependent variables explained by potential covariates is over 0.10.

APPENDIX 24: MESSAGE ATTRIBUTES' DIRECT EFFECTS ON SOURCE
CREDIBILITY

DV's	Low-Awareness Approach					
	Presentation Format			Hedging		
	<i>b</i>	SE	<i>t</i>	<i>b</i>	SE	<i>t</i>
Individual journalists' competence	-0.245	0.103	-2.379*	0.042	0.098	0.430
Individual journalists' trustworthiness	-0.227	0.101	-2.256*	0.007	0.097	0.073
Individual scientists' competence	0.285	0.088	3.225*	-0.118	0.084	-1.396
Individual scientists' trustworthiness	0.129	0.093	1.392	-0.005	0.089	-0.060
Group journalists' competence	-0.134	0.100	-1.334	0.017	0.096	0.181
Group journalists' trustworthiness	-0.176	0.100	-1.770	-0.011	0.095	-0.118
Group scientists' competence	0.122	0.104	1.174	-0.167	0.098	-1.710
Group scientists' trustworthiness	0.158	0.095	1.657	-0.165	0.092	-1.798

DV's	Medium-Awareness Approach					
	Presentation Format			Hedging		
	<i>b</i>	SE	<i>t</i>	<i>b</i>	SE	<i>t</i>
Individual journalists' competence	-0.270	0.143	-1.889	-0.021	0.156	-0.132
Individual journalists' trustworthiness	-0.157	0.139	-1.134	-0.076	0.147	-0.518
Individual scientists' competence	0.434	0.114	3.816*	-0.068	0.127	-0.534
Individual scientists' trustworthiness	0.245	0.121	2.022*	0.097	0.129	0.747
Group journalists' competence	-0.134	0.140	-0.956	-0.032	0.151	-0.214
Group journalists' trustworthiness	-0.104	0.139	-0.749	-0.061	0.149	-0.407
Group scientists' competence	0.152	0.128	1.194	-0.163	0.138	-1.181
Group scientists' trustworthiness	0.213	0.125	1.711	-0.179	0.134	-1.341

DV's	High-Awareness Approach					
	Presentation Format			Hedging		
	<i>b</i>	SE	<i>t</i>	<i>b</i>	SE	<i>t</i>
Individual journalists' competence	-0.324	0.155	-2.094*	-0.045	0.170	0.267
Individual journalists' trustworthiness	-0.169	0.153	-1.107	-0.115	0.163	-0.705
Individual scientists' competence	0.414	0.122	3.406*	-0.074	0.136	-0.546
Individual scientists' trustworthiness	0.253	0.131	1.926	0.111	0.142	0.786
Group journalists' competence	-0.160	0.150	-1.066	-0.063	0.164	-0.386
Group journalists' trustworthiness	-0.067	0.150	-0.446	-0.072	0.163	-0.444
Group scientists' competence	0.144	0.135	1.069	-0.116	0.147	-0.788
Group scientists' trustworthiness	0.167	0.134	1.242	-0.152	0.145	-1.043

* indicates significant findings.

APPENDIX 25: MESSAGE ATTRIBUTES' INDIRECT EFFECTS ON SOURCE
CREDIBILITY VIA PERCEIVED ISSUE UNCERTAINTY

DV's	Low-Awareness Approach					
	Presentation Format			Hedging		
	<i>b</i>	SE	Z	<i>b</i>	SE	Z
Individual journalists' competence	-0.004	0.009	-0.426	0.007	0.010	0.651
Individual journalists' trustworthiness	-0.077	0.010	-0.749	0.009	0.011	0.857
Individual scientists' competence	-0.003	0.008	-0.376	-0.002	0.007	0.329
Individual scientists' trustworthiness	-0.001	0.007	-0.127	0.002	0.008	0.230
Group journalists' competence	-0.007	0.010	-0.677	0.010	0.011	0.889
Group journalists' trustworthiness	0.002	0.008	0.285	-0.001	0.008	-0.056
Group scientists' competence	-0.011	0.012	-0.913	0.014	0.013	1.117
Group scientists' trustworthiness	0.002	0.008	0.263	-0.001	0.009	-0.147

DV's	Medium-Awareness Approach					
	Presentation Format			Hedging		
	<i>b</i>	SE	Z	<i>b</i>	SE	Z
Individual journalists' competence	-0.004	0.016	-0.250	0.030	0.029	1.019
Individual journalists' trustworthiness	-0.004	0.015	-0.243	0.028	0.028	1.016
Individual scientists' competence	-0.002	0.009	-0.202	0.011	0.021	0.518
Individual scientists' trustworthiness	-0.001	0.008	-0.027	0.003	0.020	0.147
Group journalists' competence	-0.002	0.013	-0.187	0.020	0.026	0.768
Group journalists' trustworthiness	-0.001	0.009	-0.020	0.001	0.025	0.017
Group scientists' competence	-0.002	0.014	-0.141	0.032	0.028	1.144
Group scientists' trustworthiness	-0.001	0.008	-0.007	0.007	0.024	0.299

DV's	High-Awareness Approach					
	Presentation Format			Hedging		
	<i>b</i>	SE	Z	<i>b</i>	SE	Z
Individual journalists' competence	-0.014	0.021	-0.661	0.043	0.040	1.089
Individual journalists' trustworthiness	-0.011	0.019	-0.595	0.038	0.038	1.020
Individual scientists' competence	-0.003	0.014	-0.223	0.001	0.028	0.041
Individual scientists' trustworthiness	-0.001	0.012	-0.010	-0.007	0.029	-0.243
Group journalists' competence	-0.010	0.018	-0.570	0.033	0.037	0.904
Group journalists' trustworthiness	0.002	0.014	-0.129	0.003	0.035	0.090
Group scientists' competence	-0.008	0.015	-0.492	0.026	0.035	0.758
Group scientists' trustworthiness	0.004	0.014	0.319	-0.012	0.035	-0.344

* indicates significant findings.

APPENDIX 26: PRESENTATION FORMAT'S INDIRECT EFFECTS ON SOURCE
CREDIBILITY VIA PERCEIVED MESSAGE BELIEVABILITY

Low-Awareness Approach

DVs	<i>b</i>	SE	Z
Individual journalists' competence	-0.064	0.043	-1.482
Individual journalists' trustworthiness	-0.067	0.040	-1.480
Individual scientists' competence	-0.048	0.035	-1.382
Individual scientists' trustworthiness	-0.038	0.034	-1.100
Group journalists' competence	-0.049	0.040	-1.228
Group journalists' trustworthiness	0.050	0.040	-1.254
Group scientists' competence	-0.036	0.030	-1.198
Group scientists' trustworthiness	-0.040	0.036	-1.125

Medium-Awareness Approach

DVs	<i>b</i>	SE	Z
Individual journalists' competence	-0.128	0.059	-2.172*
Individual journalists' trustworthiness	-0.146	0.065	-2.225*
Individual scientists' competence	-0.138	0.059	-2.332*
Individual scientists' trustworthiness	-0.124	0.059	-2.117*
Group journalists' competence	-0.122	0.059	-2.066*
Group journalists' trustworthiness	-0.124	0.058	-2.128*
Group scientists' competence	-0.099	0.050	-1.997*
Group scientists' trustworthiness	-0.127	0.062	-2.059*

High-Awareness Approach

DVs	<i>b</i>	SE	Z
Individual journalists' competence	-0.149	0.064	-2.337*
Individual journalists' trustworthiness	-0.178	0.073	-2.430*
Individual scientists' competence	-0.171	0.067	-2.573*
Individual scientists' trustworthiness	-0.157	0.067	-2.348*
Group journalists' competence	-0.140	0.063	-2.242*
Group journalists' trustworthiness	-0.148	0.064	-2.315*
Group scientists' competence	-0.118	0.054	-2.181*
Group scientists' trustworthiness	-0.149	0.065	-2.281*

* indicates significant findings.