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Source-specific Exposure to Contradictory Nutrition Information: Documenting Prevalence and Effects on Adverse Cognitive and Behavioral Outcomes

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Abstract

Communication scholars have raised concerns that the media present contradictory or conflicting information on health, science, and political issues, speculating that such information may have adverse effects on public cognitions, affect, and behaviors. However, the evidence base for the effects of contradictory messages remains thin. Using nutrition as a case example, this study builds upon this nascent literature by employing a three-wave panel dataset from a survey with a nationally representative sample of American adults. We found that exposure to contradictory nutrition messages from television increases nutrition confusion, whereas exposure from print media decreases confusion. Moreover, nutrition confusion was positively associated with nutrition backlash, and nutrition backlash decreased engagement in fruit and vegetable consumption. Implications for campaigns and other communication interventions are discussed.

Communication scholars are increasingly concerned about media messages that broadcast contradictory or conflicting information regarding health, science, and political issues to the public, speculating that such messages may negatively influence public cognitions, affect, and behaviors. Although there are some data to substantiate such concerns, the evidence base remains thin. Researchers have identified contradictory information about topics such as climate change (Nisbet, Hart, Myers, & Ellithorpe, 2013), cancer (Clarke & Everest, 2006; Smith, Kromm, & Klassen, 2010), and nutrition (Houn et al., 1995; Nagler, 2014) in the media. Both quantitative and qualitative studies have found that people perceive conflict about these and other topics (Carpenter, Elstad, Blalock, & DeVellis, 2014; Vardeman & Aldoory, 2008), which may drive them to seek more information (Weeks, Friedenberg, Southwell, & Slater, 2012) and influence their behavior decisions (Gibson et al., 2015). Yet few studies have explicitly assessed media exposure to contradictory information (Nagler, 2014; Nagler & Hornik, 2012; Tan, Lee, & Bigman, 2015), and research examining the

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effects of such exposure is limited (Chang, 2013, 2015; Dixon & Clarke, 2012; Jensen & Hurley, 2012; Nan & Daily, 2015). Health and scientific controversies are increasingly prominent in the media. Given that a key feature of many of these controversies is conflicting information, researchers have called for greater scientific attention to this understudied phenomenon (Carpenter et al., 2015; Nagler, Gollust & Fowler, 2015).

The current study builds upon this nascent literature by asking two overarching questions. First, using nutrition as a case example, we assess the extent to which people are exposed to contradictory information from media, interpersonal, and medical sources. Prior research has found substantial self-reported media exposure to contradictory nutrition information in a nationally representative sample of U.S. adults (Nagler, 2014; Nagler & Hornik, 2012). However, these studies did not distinguish among media sources, nor did they ask about interpersonal or medical sources—even though there is reason to believe that some sources may be particularly important vehicles of contradictory information exposure (Lee & Niederdeppe, 2011; Niederdeppe et al., 2014).

In fact, we know little about whether the effects of contradictory exposure vary across communication modes, which leads to our second question: what is the relative contribution of media, interpersonal, and medical exposure to adverse cognitive and behavioral outcomes? Previous cross-sectional work linked contradictory media exposure to two theoretically important cognitions—nutrition confusion (defined as perceived ambiguity about nutrition recommendations and research) and nutrition backlash (defined as negative beliefs about nutrition recommendations and research)—and found evidence that such cognitions were associated with lower intentions to engage in recommended health behaviors (e.g., fruit/vegetable consumption, exercise) (Nagler, 2014). Using a three-wave panel dataset from a population-based survey of U.S. adults, the current study assesses whether there is longitudinal evidence for such associations. Finding such evidence would provide stronger causal claims for observed associations, as well as greater understanding of the mechanisms that underlie the effects of source-specific exposure to contradictory media information.

Contradictory Information: Conceptualizations and Evidence for Media Effects

Given that conflict and controversy occur across different health, science, and political domains, it may not be surprising that contradictory (also called "conflicting," "inconsistent," "mixed," or "divergent") information has been conceptualized in distinct ways. First, contradictory information has referred to information that is *two-sided*. Two-sided coverage provides both supporting (or positive) information and opposing (or negative) information about a particular issue or research finding. For example, Nan and Daily (2015) examined the effects of mixed online information about the HPV vaccine—specifically, information found in user-generated blogs—on perceived vaccine efficacy and safety. Participants were randomly assigned either to a no-blog control or two-blog treatment (one positive and one negative blog featuring opposing views about the vaccine). Similarly, Jensen and Hurley (2012), in a study on the effects of news coverage of two scientific controversies, dioxin regulation and wolf reintroduction, randomly assigned participants to view either two news stories that were consistent with one another on the issue (convergent condition), two stories that conflicted (divergent condition), or one story plus a filler article (control condition). They found that exposure to conflicting stories had effects on perceived uncertainty and scientists' perceived credibility, but the pattern of effects varied by controversial issue.

Research on exposure to two-sided information has also been conducted in the nutrition context. In two experimental studies, participants read either a one-sided story that discussed positive research findings about and/or positive health outcomes associated with a food or supplement (e.g., tofu, vitamin B6, milk), or a two-sided story that provided both positive and negative findings and/or outcomes associated with the food/supplement (Chang, 2013, 2015). Chang (2013) found that exposure to two-sided nutrition information increased ambivalence about consuming the food/supplement in question, increased negative attitudes toward the advocated food/supplement, and decreased intentions to consume the advocated food/supplement. She also found that two-sided exposure increased uncertainty about health research, increased negative attitudes toward health research, and lowered perceptions of news credibility (Chang, 2015).

Another line of research has examined two-sided coverage under conditions of scientific consensus—namely, in the context of the autism-vaccine controversy—where the journalistic norm of balanced coverage may, in fact, more accurately be termed "false balance" (Dixon & Clarke, 2012). Participants were randomly assigned to a news story that presented balanced claims (pro- and anti-link between vaccines and autism), a story presenting anti-link claims, a story presenting pro-link claims, or unrelated information. Those who saw the balanced, or two-sided, story reported greater uncertainty about the vaccine-autism link and believed experts were divided about whether a link exists (Dixon & Clarke, 2012).

The conceptualization and operationalization of conflicting exposure in these two-sided studies is perhaps most similar to competitive framing, a growing area of research within political and science communication that examines how divergent perspectives on an issue may influence public opinion (Borah, 2011; Chong & Druckman, 2007; Niederdeppe, Gollust, & Barry, 2014; Nisbet et al., 2013; Wise & Brewer, 2010). Indeed, in their seminal article calling for increased study of competitive framing effects, Chong and Druckman (2007) refer to competitive frames—which are either "dual (exposure to both frames in equal quantities)" or "asymmetric (exposure to both frames in unequal quantities)"—as two-sided, in contrast to asymmetric one-sided frames, which involve exposure to only one frame (p. 103). That said, competitive framing effects studies have not typically described these frames as offering conflicting or contradictory information, specifically.

Importantly, the aforementioned studies of two-sided exposure are all experiments, and therefore assess forced exposure to contradictory information. Substantially less is known about the extent to which people notice conflicting information in their routine interactions with the public information environment. In an effort to assess such exposure, Nagler (2014) advanced a different conceptualization of contradictory information: "messages that offer information about a single behavior producing two distinct outcomes" (p. 25). For example, one might come across different news stories about wine (a single behavior) being linked to both heart health (outcome #1) and increased breast cancer risk (outcome #2). This conceptualization is not altogether distinct from the two-sided descriptions advanced in other studies—certainly, in the wine example provided, one would be exposed to both positive (supporting) and negative (opposing) information about the health effects of wine—but it provides greater specificity. It suggests that people might be confronted by *decisional conflict*: the information itself might not conflict (in fact, wine and other alcohol has legitimately been linked with both heart health and cancer risk), but one might perceive conflict and therefore question whether he/she ought to drink wine and, if so, how much. Ultimately, Nagler (2014) found that media exposure to contradictory information about nutrition topics such as wine, fish, and coffee consumption was prevalent, and significantly associated with confusion about what foods are best to eat (nutrition confusion), the belief that nutrition scientists keep changing their minds (nutrition backlash), and, in turn, lower intentions to engage in health behaviors about which there is little conflicting information (e.g., fruit/vegetable consumption, exercise).

More recently, Carpenter and colleagues (2015) have proposed another conceptualization of conflicting information: "two or more health-related propositions [statements or assertions about a health-related issue] that are logically inconsistent with one another" (p. 3). Whereas Nagler's conceptualization reflects decisional conflict, Carpenter et al.'s conceptualization reflects *informational conflict*. Here, people are confronted by two or more divergent propositions that they cannot simultaneously engage in or believe. For example, faced with ongoing expert disagreement about the age at and frequency with which women should begin mammography screening for breast cancer, a woman cannot decide to initiate screening at age 40, age 45, and age 50. These are logically inconsistent (and thus conflicting) recommendations issued by different clinical and professional organizations, and a woman, in conversations with her provider, must choose which recommendation to follow.

Future research will need to provide greater clarity around these distinct conceptualizations and, perhaps more importantly, assess whether effects of conflicting exposure vary across conceptualizations. For our purposes, since the current study builds most directly on Nagler's (2014) cross-sectional examination of contradictory nutrition messages—specifically, we aim to address several limitations of that study, including the absence of source-specific exposure assessment—we rely on the decisional conflict conceptualization detailed above.

Theorizing Effects of Exposure to Contradictory Information

Across conceptualizations, then, there is growing evidence that contradictory information has effects on a range of outcomes. How do we account for these findings? One theoretical rationale for why exposure to such messages may lead to effects derives from decision theory and, in particular, the concept of ambiguity. Decision theorist Daniel Ellsberg (1961) argued that an important condition under which ambiguity may be high is "where there is *conflicting* opinion and evidence" [emphasis in original]" (p. 659). Thus conflicting information exposure may give rise to perceived ambiguity, and this state of uncertainty is uncomfortable for many (though not all) people. Such discomfort has been called "ambiguity aversion" (Han, Kobrin, et al., 2007; Han, Moser, & Klein, 2007) and in a series of studies, Han and colleagues demonstrated that such aversion can take the form of negative beliefs toward the subject of the ambiguity. For example, when people perceived ambiguity about cancer prevention recommendations, many interpreted those recommendations pessimistically—specifically, by reporting lower cancer preventability beliefs (Han, Kobrin, et al., 2007; Han, Moser, et al., 2007). In the case of nutrition, when people reported perceived ambiguity about nutrition recommendations and research (or nutrition confusion), many similarly evaluated these pessimistically by reporting more negative beliefs about such recommendations and research (or greater nutrition backlash) (Nagler, 2014). Importantly, however, these associations between conflicting exposure and cognitive outcomes such as confusion and backlash have only been observed using cross-sectional data. The current study therefore builds on previous findings—in particular, the nutrition-related findings (Nagler, 2014)—using longitudinal data to test the following hypotheses: contradictory or conflicting information exposure at Wave 1 will be positively associated with nutrition confusion at Wave 2 (H1); nutrition confusion at Wave 2 will be positively associated with nutrition backlash at Wave 2 (H2); and there will be a significant indirect path from Wave 1 contradictory information exposure to Wave 2 backlash through Wave 2 confusion (H3).

Ultimately, scholarly interest is not confined to cognitive outcomes of contradictory exposure. Rather, a central question is whether exposure to contradictory information may produce cognitive effects which, in turn, may have effects on enactment of actual behaviors. If people perceive uncertainty about health recommendations, and report lower trust in such recommendations, are they less likely to subscribe to subsequent health recommendations—even those about which there is little conflicting information, such as fruit/vegetable consumption and exercise? This possibility, which has been referred to as carryover (Nagler, 2014) or spillover (Gollust, Dempsey, Lantz, Ubel, & Fowler, 2010) effects, has received little scholarly attention to date. However, there is some indication that cognitive outcomes such as confusion and backlash could have behavioral carryover effects, including on cancer screening (Han, Kobrin, et al., 2007; Han, Moser, et al., 2007) and prevention behaviors (e.g., fruit/vegetable consumption, exercise) (Niederdeppe & Levy, 2007). Theoretically, such carryover effects could be explained via excitation transfer (Zillman, 1983) and priming (Roskos-Ewoldsen, Roskos-Ewoldsen, & Dillman Carpentier, 2009). As Nagler (2014) argued, to the extent that backlash is a form of negative affect, it might extend to other health recommendations about which little conflict or controversy exists, building over time via priming with each subsequent exposure to conflicting information. Again, we seek to extend Nagler's (2014) work by testing such behavioral effects over time. We hypothesize that Wave 2 confusion will be negatively associated with two recommended health behaviors at Wave 3, fruit and vegetable consumption (H4) and exercise (H5)—neither of which is characterized by conflicting information. We hypothesize the same negative associations between backlash at Wave 2 and fruit and vegetable consumption (H6) and exercise (H7) at Wave 3. Last, we predict that there will be a significant indirect path from Wave 2 confusion to both Wave 3 behaviors through Wave 2 backlash (H8, fruit and vegetable consumption; H9, exercise).

Considering the Potential for Source-specific Effects

Another unanswered question is whether contradictory exposure effects on cognitive and behavioral outcomes vary across communication modes. Overall, few studies have specifically assessed whether people are exposed to contradictory information—whether through the media or other sources—during their routine interactions (Nagler, 2014; Nagler & Hornik, 2012; Tan et al., 2015). To our knowledge, only one study (Tan et al., 2015) has assessed source-specific exposure to contradictory information, which found that, in the context of e-cigarettes, the primary sources of contradictory exposure were television, print newspapers or magazines, and interpersonal sources such as friends, family, and co-workers.

In fact, there is evidence that media sources vary in their coverage of health. Most germane to the current study, research suggests that local television news may be an important vehicle of conflicting information, insofar as such source exposure was associated with cancer fatalistic beliefs (Lee & Niederdeppe, 2011). More recently, Niederdeppe and colleagues (2014) found additional evidence that local television news cancer coverage does, in fact, differ from other source coverage in important and likely harmful ways—for example, by providing less hedging and less information about how to reduce cancer risk. Moreover, research has shown that conflicting health information has been identified in a wide range of sources, including social media and medical sources (see Carpenter et al., 2015 for a review). The current study therefore examines contradictory nutrition information exposure across distinct sources, and asks whether source-specific exposure may have varying effects on cognitive and behavioral outcomes (RQ1).

Method

Data Collection and Sample

Data used in the current analyses were collected through a three-wave longitudinal survey administered by the GfK group (formerly Knowledge Networks). Participants were English-language survey takers aged 18 years or older, and were enrolled in GfK's probability-based web panel designed to be representative of the entire U.S. adult population. All three waves of survey were conducted in 2014, with an interval of three months between waves. A total of 796 participants completed the first wave of survey (completion rate = 58.0%), and they were invited to participate in the second and third waves of survey. Six hundred and twenty-six participants completed the second wave of survey (complete rate = 80.0%), and 571 completed the third wave (completion rate = 76.0%). E-mail reminders were sent to non-responders. Since multiple imputation was employed to handle missing data within each wave (see analytic procedure section), the total sample size equaled the sample size of the first wave of survey ($N = 796$).

Based on recent data from the Current Population Survey (CPS), post-stratification weights were applied to adjust for non-response, non-coverage, and under- and/or over-sampling. Benchmarks used for the adjustment included age, gender, race/ethnicity, household income, education, census region (Northeast, Midwest, South, or West), Metropolitan area, Internet access, and primary language. Without weighting, the Wave 1 survey data was 48.1% male ($n = 383$), and 72.5% of the participants self-identified as non-Hispanic White ($n = 577$), followed by 10.93% non-Hispanic Black (*n* = 87), 9.92% Hispanic (*n* = 79), 4.27% multi-racial (*n* = 34), and 2.39% other (*n* = 19). The mean age of the sample was 50.73 years (*SD* = 16.76). A majority of participants had a high school diploma or the equivalent (*n* = 263, 33%), 10.4% had education lower than high school (*n* = 83), 27.4% had some college education (*n* = 218), and 25.1% received a bachelor or higher degree (*n* = 232). Among the 796 participants, 41.2% came from households with yearly income less than $50,000.

Measures

To answer our hypotheses and research question, we used measures of exposure to contradictory nutrition information at Wave 1, nutrition confusion and nutrition backlash at Wave 2, and reports of healthy behaviors at Wave 3. See Table 1 for means, standard deviations, and bivariate correlations of the study variables.

Source-specific exposure to contradictory nutrition information (Wave 1).— Participants were asked to think about how much contradictory or conflicting information on food and nutrition (e.g., red wine or other alcohol, fish, coffee, vitamins/supplements) they heard from eight sources in the past 12 months: (1) online news (e.g., New York Times website, CNN.com); (2) social media (e.g., Facebook, YouTube, Twitter, or blogs); (3) medical or health websites (e.g., WebMD, American Cancer Society website, National Cancer Institute website); (4) television; (5) print newspapers or magazines; (6) family, friends or co-workers; (7) doctor or other health care professional; and (8) other source. Responses were rated on a four-point scale ranging from 1 (*a lot*) to 4 (*not at all*). Exposure to contradictory nutrition information via the Internet was created by averaging respondents' answers to the following three items: online news, social media, and medical or health websites (Cronbach's alpha = .79).

Nutrition confusion (Wave 2).—On a five-point scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*), participants responded to the following three items borrowed from Nagler (2014): "It is not always clear to me what foods are best for me to eat," "I find nutrition recommendations to be confusing", and "I find nutrition research studies hard to follow" (Cronbach's alpha = .69).

Nutrition backlash (Wave 2).—The following measures of nutrition backlash were adopted from Nagler (2014): "I am tired of hearing about what foods I should or should not eat," "Dietary recommendations are rarely useful", "Scientists really don't know what foods are good for you," "The evidence about healthy food choices is growing," "Scientific research provides good guidance about the best foods to eat," and "I pay attention to new research on food and nutrition." (Cronbach's alpha = .73). The last three items were reverse coded. Responses were on a five-point scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*).

Healthy behaviors (Wave 3).—Using two items, participants were asked to report their fruit and vegetable consumption on a five-point scale ranging from 0 (*less than one serving per day*) to 5 (*5 or more servings per day*): "In the past week, on average, how many servings of [fruit, vegetables] did you eat or drink per day?" Participants were told that fruit and vegetables included 100% fruit/vegetable juice and fresh, frozen, or canned fruits/vegetables. The score of fruit/vegetable consumption was calculated by obtaining the mean of the two items. In addition, participants were asked to report their frequency of exercise by answering one question: “During an average week, how often do you exercise?” (1 = *never* to 5 = *6 or more times a week*).

Control variables.—We controlled for several potentially confounding variables. First, participants reported their annual household income on a 19-point scale (1 = *less than $5,000* to 19 = *$175,000 or more*); it was then recoded as a ratio variable, which ranged from 5 to 175 (M = 72.61, SD = 47.44). Our controls included health-related variables as well. Participants reported their health status on a five-point scale (1 = *excellent* to 5 = *poor*). Self-reported health status was reverse coded so that the higher scores represent better health status (M = 3.45, SD = .98). Participants also indicated their degree of health consciousness by answering three questions (e.g., “I think a lot about my health”) on a four-point scale (1 = *strongly agree* to 4 = *strongly disagree*). Health consciousness was recoded so that higher scores indicate higher health consciousness (M = 4.22, SD = .79).

Measures of past healthy behaviors also served as controls in the model, which included past exercise frequency (1 = *never* to 5 = *6 or more times a week*; M = 3.09, SD = 1.18) and fruit/vegetable consumption in the second wave of survey (0 = *less than one serving per day* to 5 = *5 or more servings per day;* M = 1.79, SD = 1.23). Direct paths were drawn from control variables to the mediating and dependent variables with which they were significantly correlated. Specifically, we included the direct paths from household income to nutrition confusion; from health consciousness to nutrition backlash; from Wave 2 fruit/vegetable consumption and health consciousness to Wave 3 fruit/vegetable consumption; and from past exercise, household income, health status, and health consciousness to Wave 3 exercise.

Analytic Procedure

First, we calculated means and standard deviations for all study variables; we also calculated weighted frequencies of exposure to contradictory nutrition information by source. Then, to validate our measures and test our hypotheses, structural equation modeling (SEM) was conducted using the *lavaan* package in the software R. The fitness of a model was evaluated based on the following criteria: A model considered as well-fitting ought to have a root mean square error of approximation (RMSEA) ≤.06 and a comparative fit index (CFI) ≥.95 (Hu & Bentler, 1999). An RMSEA < .08 and a CFI >.90 indicate an acceptably fitting model (Hu & Bentler, 1999). In addition, the standardized root mean square residual (SRMR) should be < .08 (Hu & Bentler, 1999).

Estimation was performed using maximum likelihood estimates with standard errors that were robust to nonnormality (MLR). The multivariate imputation by chained equations (MICE) approach in R was used to handle data missingness. Forty imputed values were created for each missing point using the “predictive mean matching” function (Little, 1988). Multiple imputation is a better strategy than listwise deletion to handle missing data, because the latter often leads to reduced analytic power and biased estimates of coefficients (Graham, 2009). We inspected whether the imputations were plausible by comparing the distributions of the original and the imputed data, and there was no salient discrepancy. Next, in R, we analyzed the imputed datasets and obtained pooled estimates of the coefficients.

In the hypothesized model, nutrition confusion and nutrition backlash were modeled as latent variables, while the source-specific exposure to contradictory nutrition information measures, the two measures of healthy behaviors, and the control variables were treated as observed variables. The source-specific exposure to contradictory nutrition information variables were correlated with each other in the model. Prior to examining the hypothesized model, confirmatory factor analyses (CFAs) were performed to examine the measurement model comprised of two latent factors (nutrition confusion and nutrition backlash). After establishing the measurement model, we proceeded to examine the complete structural model. All indirect effects were assessed using bootstrapping analysis in *lavaan* with 1000 samples randomly drawn from the dataset.

Results

Reported Exposure to Source-specific Contradictory Nutrition Information

Table 2 summarizes the weighted distributions of source-specific exposure to contradictory or conflicting nutrition information. Across sources, most respondents reported having been exposed to at least some contradictory information about nutrition, with only 22.3% reporting no such exposure. A majority (75.6%) reported noticing contradictory information about nutrition in the media, which is consistent with prior population-based estimates (Nagler, 2014). Television was the most frequently reported media source of contradictory exposure (67.9%), while 60.9% reported exposure from interpersonal sources (family, friends or co-workers) and 40.4% reported exposure from medical sources (doctor or other health care professional).

Associations between Source-specific Contradictory Exposure, Cognitive Outcomes, and Behavioral Outcomes: Structural Equation Model Results

A categorical CFA consisted of the two latent factors (nutrition confusion and nutrition backlash) and the corresponding measured indicators showed that the measurement model did not fit the data well: χ^2 (26) = 218.77, $p < .001$; RMSEA = .11, 90% CI = .10, .13; CFI = .98; SRMR = .07. Scholars have suggested that negatively worded items may be associated with a “method factor,” because even though the items may tap only one theoretical construct, the negative wordings of some items may contribute to a different pattern of participants’ responses (Weijters, Baumgartner, & Schillewaert, 2013). To account for a potential “method factor” we correlated the error terms of the three negatively worded items in the nutrition backlash scale. The CFA with the correlated error terms provided good model fit: χ^2 (23) = 57.51, $p < .001$; RMSEA = .05, 90% CI = .03, .07; CFI = 1.0; SRMR = .04.

The complete structural model yielded good fit: χ^2 (150) = 570.69, $p < .001$; RMSEA = .059, 90% CI = .054, .065; CFI = .92; SRMR = .07. As shown in Figure 1, exposure to contradictory nutrition information via television was positively associated with nutrition confusion over time ($b = .17$, $SE = .07$, $p < .05$), whereas exposure to contradictory nutrition information via print media, such as newspaper and magazines, was negatively associated with nutrition confusion overtime ($b = -.15$, $SE = .08$, $p < .05$). Exposure to contradictory nutrition information via other sources, including the Internet, interpersonal sources, and medical sources, was not significantly related to nutrition confusion. H1 was therefore partially supported, insofar as, in response to RQ1, we observe varying source-specific effects on confusion.

As expected in H2, nutrition confusion had an immediate and positive relationship with nutrition backlash ($b = .70$, $SE = .08$, $p < .001$). Nutrition confusion was not significantly associated with fruit/vegetable consumption ($b = .01$, $SE = .05$, *ns*) or frequency of exercise ($b = .04$, $SE = .06$, *ns*); thus, H4 and H5 were not supported. After controlling for a series of potential confounds, nutrition backlash significantly reduced an individual's amount of fruit/vegetable consumption ($b = -.16$, $SE = .05$, $p < .001$; H6); however, nutrition backlash was not significantly associated with the frequency of exercise ($b = -.09$, $SE = .05$, *ns*; H7).

As for hypothesized indirect effects, nutrition confusion was a significant mediator for the indirect path from exposure to contradictory nutrition information via television to nutrition backlash ($b = .12$, $SE = .05$, $p < .05$; H3), as well as for the indirect path from exposure via print media to nutrition backlash ($b = -.11$, $SE = .05$, $p < .05$; H3). Moreover, nutrition backlash was a significant mediator for the association between nutrition confusion and fruit/vegetable consumption ($b = -.11$, $SE = .04$, $p < .01$; H8), but the mediating effect of backlash was not significant for an association between confusion and exercise ($b = -.06$, $SE = .04$, *ns*; H9).

Discussion

Despite growing concerns about the prevalence of contradictory or conflicting information regarding health, science, and political issues in the media and other sources, little is known about the extent to which people notice such information and, if they do, whether such exposure has adverse effects. Consistent with prior research (Nagler, 2014; Nagler & Hornik, 2012), the current study finds that many people report exposure to contradictory information about topics such as red wine or other alcohol, fish, coffee, vitamins/supplements. This exposure occurs across media, interpersonal, and medical sources, and data suggest that some sources—such as television—may be particularly important vehicles of conflicting information. Moreover, we found longitudinal evidence for cross-sectional relationships previously observed between contradictory exposure and cognitive and behavioral outcomes (Nagler, 2014). Specifically, results show that exposure to contradictory nutrition information produces greater nutrition confusion and backlash, which ultimately reduces engagement in a recommended nutrition behavior (fruit and vegetable consumption). Importantly, such exposure appears to exert distinct influences across sources. While people who reported noticing contradictory nutrition information on television had *greater* nutrition confusion over time, those who reported reading such information via print media experienced *less* confusion. This finding is consistent with prior work linking television viewing with problematic health-related beliefs or behaviors (Lee & Niederdeppe, 2011; Niederdeppe et al., 2014; Northup, 2014).

We also detected lagged carryover effects of nutrition backlash on fruit/vegetable consumption, but not on exercise. Given the dearth of research on carryover or spillover effects to date, we can only speculate on possible explanations for this finding. It could be that carryover effects operate within certain boundaries. Our results show that exposure to contradictory information about nutrition topics such as wine, coffee, and fish consumption generates confusion about what foods are best to eat and a belief that nutrition recommendations are ever-changing. However, while experiencing negative confusion- and backlash-related beliefs may extend to nutrition topics about which there is little conflict, such as fruit and vegetable consumption, it might not extend to non-nutrition-related behaviors such as exercise. Indeed, in one study Gollust and colleagues (2010) found that exposure to HPV vaccine controversy was linked with less support for HPV vaccination policy, but this did not translate into less support for immunizations more generally. Future attention on carryover effects is essential if we are to understand the scope of and conditions under which these effects may occur.

Implications of our findings should be discussed in recognition of several study limitations. First, although our measures of exposure to contradictory nutrition information were more specific and comprehensive than measures employed in previous studies (Nagler, 2014; Nagler & Hornik, 2012), four of the five source-specific exposure variables consisted of single items. Second, the frequency of exercise was measured using a single item; to improve measurement reliability, future research should adopt multi-item measures. Third, in our SEM model, we did not have any time lag between nutrition confusion and backlash. Although this analytical choice was made based on our assumption that the effect of nutrition confusion on backlash is very immediate and short-lived, we were unable to test the causal order between these two variables. Thus, conducting an experiment or a longitudinal survey with a much shorter time span across waves may be worthwhile. Fourth, panel attrition across survey waves may compromise our claim of representativeness. However, to some extent we were able to adjust for possible bias due to attrition by applying post-stratification weights. Fifth, when examining the effects of exposure to conflicting nutrition information via a certain medium, we did not control for use of that medium in general. Last, individuals who consume fewer fruits and vegetables and exercise less frequently may be more likely to report higher levels of exposure to conflicting information, nutrition confusion, and backlash, as they may rely upon conflicting information, confusion, or backlash beliefs to justify or rationalize their unhealthy behaviors. Future research should adopt a cross-lagged design to explore such bi-directional influences among media use, health-related beliefs, and pro-health behaviors.

Despite these limitations, the current study deepens our understanding of the influence of contradictory health information on health-related cognitions and behaviors. Perhaps most noteworthy, we used source-specific measures of contradictory information exposure that reveal where people come across such information and how exposure to a specific information source affects nutrition confusion and backlash. Two findings on source-specific effects are worth mentioning. First, we did not observe an association between exposure to contradictory nutrition information via the Internet and nutrition confusion. Previous studies have reported mixed findings about the impact of Internet use on people's health-related beliefs and behaviors. For instance, some studies have demonstrated positive effects of online health information acquisition, such as reduction of fatalistic beliefs about cancer prevention (Lee, Niederdeppe, & Freres, 2012). In contrast, others have shown that most health-related information obtained from the Internet is misleading or confusing and therefore can increase information overload or confusion (Hungerford, 2009). This is because factually inaccurate and/or out-of-date information can be easily posted and shared on the Internet. Our results suggest that the Internet may not play an important role in creating and diffusing contradictory nutrition information; that said, future research should continue to examine the effects of Internet use in other health contexts.

Second, it is worth highlighting that television and print media have contrasting effects on confusion. Individuals often *passively* learn about health-related issues from television, meaning they may “run into” health information without actively engaging with it (Dutta-Bergman, 2004). When encountering conflicting information about nutrition from television, one might not have the opportunity to reflect on the information because it is transient and fleeting. Perhaps more importantly, television viewers may be more influenced by a message’s peripheral cues (e.g., characteristics of the communicator, such as a news anchor’s physical appearance or voice), and thus are likely to process the message heuristically (Chaiken & Eagly, 1983); indeed, there is some evidence that people do not process health information conveyed via television in depth (Dutta, 2007). Absent elaborative issue-relevant thinking, then, a television viewer may be more apt to perceive greater ambiguity about nutrition recommendations and research. In contrast, people devote *active* attention and cognitive efforts to process, interpret, and learn from health information conveyed through print media (Dutta-Bergman, 2004). Where non-verbal peripheral cues (e.g., a communicator’s physical characteristics or image) are present in televised messages, these are less salient in print messages, increasing the likelihood that the audience will attend to message content instead and, in turn, engage in systematic processing (Chaiken & Eagly, 1983). Moreover, print media allow individuals to read, store, and revisit health-related materials over an extended period of time. If a reader encounters conflicting nutrition information in print media, he/she can carefully read the article and even analyze the messages by seeking information from other sources (e.g., the Internet, past newspaper issues). It is therefore plausible that people will think more critically about conflicting information and reach an informed judgment about it when exposed to print rather than other media. Such different information processing patterns based on communication mode may explain the contrasting effects reported here (Chaiken & Eagly, 1983).

In conclusion, this study not only provides longitudinal evidence for the effects of exposure to contradictory media information, but it finds that such influence is not uniform across information sources. These findings lead us to contend that communication scholars should pay greater attention to contradictory information in addition to misinformation (see Southwell & Thorson, 2015). We also need to better understand whether such information differentially affects certain subpopulations. Research on communication inequalities suggests that underserved populations, who already suffer a disproportionate burden of disease, may be particularly susceptible to conflicting health information, whether due to lower health literacy or limited clinical interactions (Viswanath et al., 2012). In addition, communication researchers and practitioners need to consider how best to intervene to address contradictory nutrition and other health information and limit its adverse effects. For example, to limit potential carryover effects, it may be important to acknowledge conflicting research or recommendations in our healthy eating campaigns and interventions, if they are to prove effective. This may involve providing information to help people to make sense of conflicting findings or advice (e.g., bolstering understanding of scientific research and health literacy). It also may be important to develop clinical interventions (e.g., decision aids) to support health care providers in their efforts to help patients understand conflicting nutrition and other health information. Last, it may be necessary to intervene at the institutional level —for instance, by developing a toolkit that would help health journalists (perhaps television news journalists in particular) to report on nutrition and other health research while also providing contextual information. Taken together, such efforts could better equip the public to negotiate seemingly contradictory research findings and recommendations.

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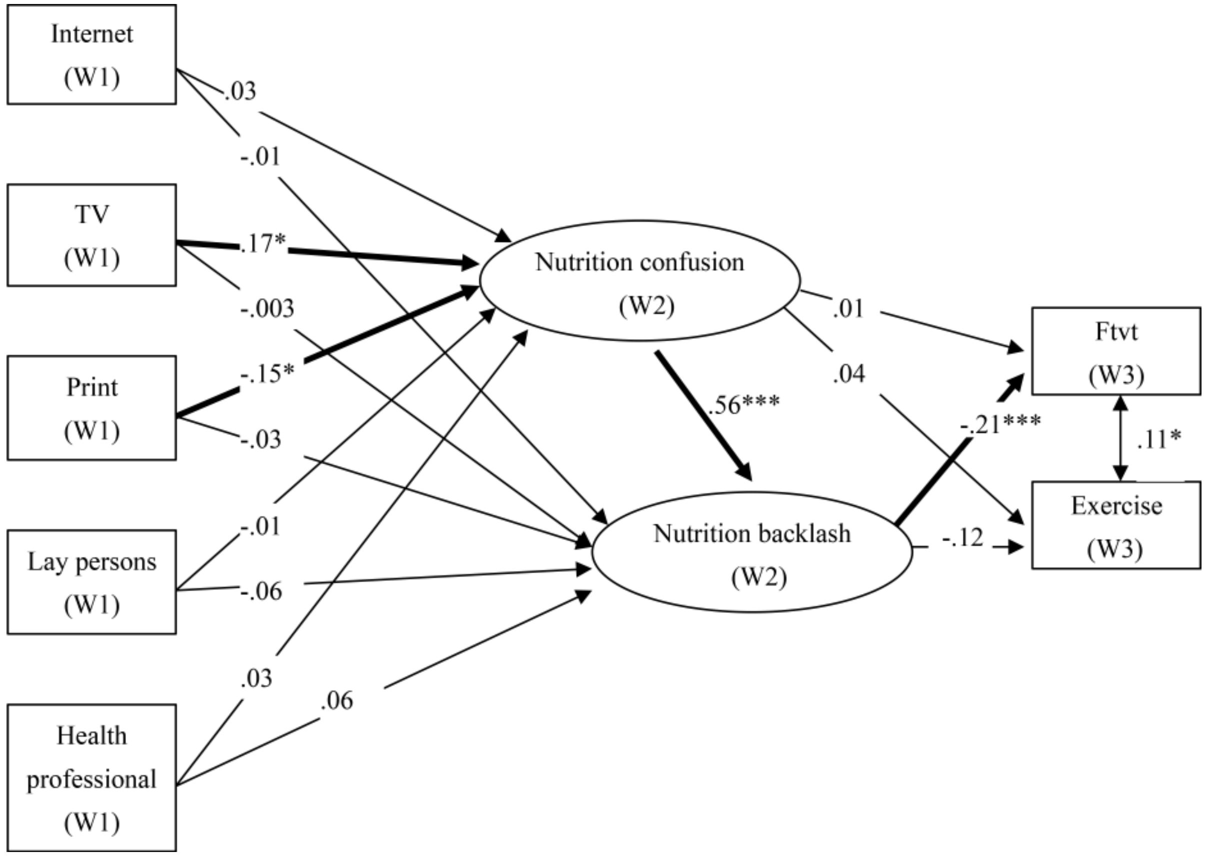

Figure 1. A structural model predicting healthy behaviors over time

Note. *$p < .05$, **$p < .01$, ***$p < .001$. W1 = Wave 1, W2 = Wave 2, W3 = Wave 3. Ftvt = fruit/vegetable consumption. χ^2 (150) = 570.69, $p < .001$; RMSEA = .059, 90% CI = .054, .065; CFI = .92; SRMR = .07. Standardized estimates are shown in this figure. All the channel-specific exposure variables were correlated in the model. For visual clarity, control variables and the correlations between exposure variables are not shown. Significant paths are indicated by bold lines.

Table 1

Means, standard deviations and correlations of study variables

Variables	*M (SD)*	1a	1b	1c	1d	1e	2	3	4
1. Exposure to contradictory health information									
1a. Internet (W1)	1.68 (.77)								
1b. television (W1)	2.13 (.98)	.54% ***							
1c. print (W1)	1.81 (.92)	.60% ***	.66% ***						
1d. lay persons (W1)	1.96 (.94)	.56% ***	.59% ***	.51% ***					
1e. health professional (W1)	1.61 (.88)	.50% ***	.43% ***	.48% ***	.54% ***				
2. Nutrition confusion (W2)	7.64 (3.17)	.05	.12 **	.02	.10 *	.12 **			
3. Nutrition backlash (W2)	15.40 (4.47)	−.01	.03	−.03	.02	.04	.46% ***		
4. Fruit/vegetable consumption (W3)	1.97 (1.24)	.11 **	.10 *	.13 **	.11 *	.04	−.21% ***	−.28% ***	
5. Exercise (W3)	3.14 (1.20)	.14 **	.07	.10 *	.05	.04	−.11 *	−.18% ***	.37% ***

Note.

* $p < .05$

** $p < .01$

*** $p < .001$. W1 = Wave 1, W2 = Wave 2, W3 = Wave 3. Internet exposure to contradictory nutrition information was created by averaging respondents' answers to the following three items: online news (M = 1.77, SD = .95), social media (M = 1.63, SD = .93), and medical or health websites (M = 1.63, SD = .86; Cronbach's alpha = .79). The scores of nutrition confusion and nutrition backlash were calculated by summing up the scores of all the items.

Table 2

Exposure to contradictory nutrition information by channel (Wave 1)

			Frequencies [*n* (%)]			
	Mean	**SD**	***Not at all***	***A little***	***Some***	***A lot***
Online news	1.77	.95	407 (51.1)	159 (20.0)	153 (19.3)	40 (5.0)
Social media	1.63	.93	476 (59.8)	126 (15.8)	113 (14.2)	41 (5.2)
Medical or health websites	1.63	.86	441 (55.4)	171 (21.5)	118 (14.9)	23 (2.9)
Television	2.13	.98	256 (32.1)	214 (26.9)	220 (27.7)	66 (8.2)
Print newspapers or magazines	1.81	.92	373 (46.9)	193 (24.2)	161 (20.3)	35 (4.4)
Family, friends or co-workers	1.96	.94	311 (39.1)	204 (25.6)	210 (26.4)	36 (4.5)
Your doctor or other health care professional	1.61	.88	474 (59.6)	134 (16.9)	126 (15.8)	26 (3.3)
Other source	1.38	.73	550 (69.1)	101 (12.7)	70 (8.8)	13 (1.7)