HHS Public Access

Author manuscript

J Health Commun. Author manuscript; available in PMC 2020 January 29.

Published in final edited form as:

J Health Commun. 2018 ; 23(10-11): 874–885. doi:10.1080/10810730.2018.1533052.

Assessing the Impact of Conflicting Health Warning Information on Intentions to Use E-cigarettes - An Application of the Heuristic-Systematic Model

Sherri Jean Katz,
Hubbard School of Journalism and Mass Communication, University of Minnesota, 206 Church Street SE Minneapolis, MN 55455

Meghan Erkkinen,
Hubbard School of Journalism and Mass Communication

Bruce Lindgren,
Masonic Cancer Center, University of Minnesota

Dorothy Hatsukami
Department of Psychiatry, Director, Tobacco Research Programs, University of Minnesota

Abstract

The purpose of this study is to determine how nonsmokers perceive conflicting information when a modified risk statement is included along with a warning label on e-cigarette packages. We propose an application of the heuristic-systematic model to test whether this conflicting information leads to more or less active processing. As part of a larger inquiry into e-cigarette labeling, we present an experiment (n=303) in which we test this model with nonsmokers, measuring ambiguity perceptions, counter-arguing, reduced effectiveness of the message, and behavioral intentions. Results demonstrate that the addition of a modified risk statement on the package with the warning label increases ambiguity perceptions which can lead to reduced effectiveness of warning labels and reduced behavioral intentions to avoid using e-cigarettes among nonsmokers. While the systematic and heuristic pathways are both explanatory, heuristic processing provides the better fit.

Keywords

e-cigarettes; warning labels; modified risk statements; heuristic-systematic model

Health communication practitioners tailor messages to the intended audience, recognizing that a message will be most effective if it relates to the needs of the recipient (Noar, Benac, & Harris, 2007). However, a challenge arises when there is more than one audience and different needs are being balanced.

sjkatz@umn.edu.

In the case of e-cigarette warning labels, two audiences have different needs. On the one hand, cigarette smokers might use the product to quit traditional cigarettes, and therefore, they need a message that encourages, or does not discourage, e-cigarette use (Ayers et al., 2017; Brown, Beard, Kotz, Michie, & West, 2014). On the other hand, e-cigarette warning labels should also function to discourage use among non-smokers, including youth, who are increasingly using the product recreationally (Arrazola et al., 2015; Bunnell et al., 2015). For the purposes of health communication, e-cigarettes can be thought about as potentially harm-reducing when used by smokers, and are likely harm-elevating when used by nonsmokers (Bareham, Ahmadi, Elie, & Jones, 2016; Kozlowski & Warner, 2017; Katz, Lindgren, & Hatsukami, 2017). Therefore, the messaging on e-cigarette packaging needs to be tailored to these two completely different groups.

This is a timely topic. The U.S. Food and Drug Administration has deemed regulatory control over the labeling of e-cigarettes, including the warning label and what information will be permissible on the package. The FDA has selected a product warning label: *This product contains nicotine. Nicotine is an addictive chemical.* (U.S. Department of Health and Human Services and FDA, 2016). This message may discourage use by those who are not yet addicted to nicotine, such as nonsmokers. Additionally, the Family Smoking Prevention and Tobacco Control Act (2009) and the FDA's deeming on tobacco products (U.S. Department of Health and Human Services and FDA, 2016) provide a provision for manufacturers to file an application and demonstrate that their product offers a modified risk and should be marketed accordingly. For example, an e-cigarette manufacturer may seek to add text to the packages that states the product *presents a lower risk of tobacco-related disease than traditional cigarettes*. This message might encourage use by those seeking to stop using traditional cigarettes. A key question is what happens to the way non-smokers of traditional cigarettes think about e-cigarette warning labels when this modified risk statement is included on the package.

From a health communication perspective, the warning statement and the modified risk statement can be thought of together as conflicting information because a supporting and opposing statement are paired together (Carpenter et al., 2015; Eisend, 2006). The purpose of this study is to determine how nonsmokers perceive this conflicting information, and whether it leads to more or less active cognitive processing. We draw upon previous literature to propose an application of the heuristic-systematic model (HSM), around the concept of conflicting information and within the substantive domain of e-cigarettes (Figure 1). To test this model through three hypotheses and one research question, we randomly assigned participants to view either the e-cigarette package with just a warning label, the package with both a warning label and a modified risk statement or a control condition with no warning label or modified risk statement. We report dependent measures to determine whether or not adding the modified risk statement to the package leads to systematic or heuristic processing.

Heuristic–Systematic Model (HSM)

Dual process theories, such as the HSM, predict that persuasive cues are processed either systematically, as a result of effortful attention to the arguments in the message, or

heuristically, as a result of more automatic processing of message cues (Chaiken, 1980; Chaiken & Maheswaran, 1994; Flynn, et. al., 2011). The HSM states that people will process a message using the least cognitive effort necessary (Chen & Chaiken, 1999).

Systematic processing involves the conscious scrutiny of claims in the message (Chaiken, 2014; Zuckerman & Chaiken, 1998). When a message contains conflicting information, individuals who are processing that message systematically will engage, debate and counter-argue those claims, seeking to synthesize them and make sense of the opposing views (Chaiken, 2014). Individuals are more likely to process systematically when the topic is important and relevant and when they have a high need for cognition (Maheswaran & Chaiken, 1991).

Heuristic processing does not result in this conscious scrutiny of the arguments in the message, and instead cues prompt automatic processing. Heuristic cues may include: (1) message factors, such as how many arguments are included and whether there is consensus among those arguments; (2) characteristics of the communicator, including likability and expertise; and (3) audience characteristics (Chaiken, 2014; Chaiken, Liberman, & Eagly, 1989; Eisend, 2007). Essentially, when processing heuristically, individuals are not relying on the content of the message, such as the actual arguments, but rather on characteristics of the message, source, or context (Chaiken, Duckworth, & Darke, 1999). Individuals use quick decisions rules, such as “consensus (between arguments in the message) implies correctness” when processing heuristically (Chaiken et al., 1989, p. 216).

HSM and Conflicting Information

Conflicting information refers to when a positive claim and a negative claim are included together within the same message (Eisend, 2006; Fennis & Stroebe, 2016). For example, the message might offer both supporting and opposing positions, and together these can be perceived as ambiguous (Chaiken & Maheswaran, 1994). The concept of ambiguity has been adapted from research in decision science and applied to behavioral health as a type of “confusion” arising from “incomplete or conflicting evidence” in regards to health risks (Han et al., 2007, p. 458). It is distinct from the actual risk assessment (Ellsberg, 1961), and is often operationalized in relation to conflicting health information (Han, Kobrin, et al., 2007; Han, Moser, & Klein, 2007). For example, perceived ambiguity has been measured in numerous ways, including whether one perceives that contradictory information exists (Han, Moser, et al., 2007) and whether one finds contradictory recommendations to be confusing (Han, Kobrin, et al., 2007).

Research about conflicting information has been examined through the framework of systematic processing by considering how claims are evaluated and synthesized (Eisend, 2006, 2007). Conflicting claims in a message can lead to ambiguity, which individuals manage by seeking more information, using one particular claim to bolster an existing attitude, ignoring the message, or through a range of other cognitive and emotional responses (Brashers, 2001). Conflicting information fits into larger frameworks associated with how individuals experience and manage their uncertainty because when they receive discordant information (ie. warning label and a modified risk label), it makes it difficult for

them to accurately judge the probability of specific health outcomes and they "feel insecure" in their own understanding of what is accurate (Brashers, 2001, p. 478). In the case of e-cigarettes, factors associated with the product itself (ie. role in cessation, addictiveness of nicotine, lack of information about long-term effects, and historical use of deception and uncertainty by the tobacco industry) also make it difficult for individuals to make accurate judgments or feel like they have the correct information to do so. Furthermore, individuals have different tolerance levels when exposed to conflicting information (Burgoon, 1971), and in the case of a tobacco-derived product, this is likely related to their prior experience with tobacco itself (ie. whether they are a smoker, whether they have experience with nicotine addiction, and whether they are aware of the historical use of deception within the industry). In a recent focus group with young adults, participants expressed uncertainty in regards to e-cigarette health risks, claiming *I have no idea if that's true*, *we actually don't know if that's true or not*, and *I don't know that anyone knows for sure* (Katz, Erkinnen, Lindgren, & Hatsukami, 2019, page 83).

Systematic and heuristic processing can co-occur (Eisend, 2006), and prior research has shown this can happen when task importance is high (Chaiken and Maheswaran, 1994). They found that individuals were more likely to process conflicting information systematically, even when otherwise unmotivated, because the two-sided message reduced confidence in their own evaluations requiring them to use more cognitive effort to synthesize the arguments. However, at the same time, participants simultaneously utilized peripheral cues, such as credibility of the source. Interestingly, when the message includes risk claims, conflicting information can make the message less effective overall (Chaiken et al., 1989; Nagler, 2014).

Conflicting Health Information and E-Cigarettes

Conflicting information has been investigated within a number of different health and risk persuasion contexts (Carpenter et al., 2015; Nagler, 2014; Naylor, Droms, & Haws, 2009). A review of research on conflicting health information mentioned the importance of researching this topic within substantive domains (Carpenter et al., 2015). In the case of e-cigarettes, there has been very little research to date on the influence of conflicting health claims.

In a study on the public support for e-cigarette regulations, Tan, Lee, and Bigman (2015) surveyed U.S. adults about their exposure to conflicting health information about e-cigarettes, and found that conflicting information was associated with lower support for e-cigarette regulation. They concluded this was because the conflicting information caused confusion, reducing harm perception. When conflicting information in the form of a modified risk statement was investigated in the context of e-cigarettes, participants reported the messages seemed misleading (Wackowski et al., 2016).

In a prior article on this topic using this dataset, nonsmokers who viewed e-cigarette packages with both a warning label and a modified risk statement (conflicting information condition) reported significantly higher perceptions of ambiguity than participants who viewed just the warning label (Katz, Lindgren, & Hatsukami, 2017). This effect was not

found among smokers. The purpose of this current study is to take the next step and test the effect of this increased ambiguity on persuasion processes.

HYPOTHESES AND RATIONALE

The HSM proposes messages can be processed: systematically, as a result of effortful attention to the information in the message; and/or heuristically, as a result of invoking already held schemas (Chaiken, 1980; Chaiken & Maheswaran, 1994; Griffin et al., 2002). When conflicting information is included in the message, unintended message effects can occur due to either heuristic or systematic processing (Chaiken, 1980; Chaiken & Maheswaran, 1994).

This project proposes and tests an application of the heuristic-systematic model (HSM), through the concept of conflicting information in relation to package warning labels on electronic cigarettes. A previous paper from this dataset showed that adding a modified risk statement to the warning message increases ambiguity perceptions in nonsmokers (Katz, Lindgren, & Hatsukami, 2017). The first goal of this article is to test whether ambiguity perceptions decrease the effectiveness of the message among nonsmokers.

> H1: Higher ambiguity perceptions in response to e-cigarette packages are associated with higher ratings of reduced effectiveness of the warning label.

Next, we test which HSM pathway (systematic and/or heuristic) best explains the underlying mechanisms through which this ambiguity leads to reduced effectiveness of the message. At issue is whether the conflicting information introduced by the modified risk statement leads active engagement with the arguments in the message as the conflicting information is counterargued. Therefore, we propose two competing hypotheses based on each of these proposed pathways in Figure 1.

> H2a: Systematic processing will be supported by linear regression and mediation, such that including a modified risk statement (compared to the warning message with no modified risk statement), leads to higher ambiguity perceptions, greater counter-arguing, and rejection of the message, wherein counter-arguing has a relative indirect effect on the relationship between ambiguity perceptions and reduced effectiveness of the message.

> H2b: Heuristic processing will be supported by linear regression and mediation, such that including a modified risk statement (compared to the warning message with no modified risk statement), leads to higher ambiguity perceptions and rejection of the message, wherein ambiguity perception has a relative indirect effect on the relationship between exposure to a modified risk statement and reduced effectiveness of the message.

> RQ1: Will systematic processing or heuristic processing best explain the relationship between exposure to a modified risk statement and reduced effectiveness of the message?

METHOD

Participants and Design

This study is part of a larger experiment on the perceptions of e-cigarette warning labels (Katz, Lindgren, & Hatsukami, 2017), and all study procedures were approved by the Institutional Review Board at The University of Minnesota. This particular set of analyses focuses on non-smoking participants and on how findings from the previous work influence persuasion processes.

This study focuses on 307 nonsmokers who were recruited through Amazon Mechanical Turk, as part of this larger study of 462 traditional cigarette smokers and nonsmokers (Katz, Lindgren, & Hatsukami, 2017). We excluded participants for a timing problem with the study (n=1) and for failing an attention check (n=3) because they inaccurately replied to the question: *For this item, please select the answer Agree to indicate that you are paying attention*. Participants received $2.00 each, and the experiment took the remaining nonsmokers (n=303) an average of 11 minutes and 14 seconds. Recruitment was isolated to participants who had completed at least 100 mTurk assignments, who had an 80% approval rating, and who were based in the United States. We informed participants that they would need to be fluent in reading and writing English, and we collected a writing sample from them. English was the first language for 294 participants, and 302 had spoken it for over 10 years.

Participants (n=303) ranged in age from 18 – 69 (M=34.46, $S.D.$=10.98). 58% (n=177) were male and 42% (n=126) were female. These participants reported that they had not smoked traditional cigarettes in the past 30 days, and 268 (88.4%) reported that they also had not used e-cigarettes in the past 30 days. Of those who had used an e-cigarette in the past 30 days (11.6%), no participants reported daily use of traditional cigarettes. We selected to define non-smoker as those who had not used a traditional cigarette in the past 30 days in order to exclude those individuals who may perceive e-cigarettes as a personal cessation tool. Our sample includes both non-users of e-cigarettes and recreational e-cigarette users. In regards to race, 33 (10.9%) participants identified as Asian, 21 (6.9%) participants identified as Black or African-American, 3 (1%) participants identified as American Indian or Alaskan Native, 3 (1%) participants identified as Native Hawaiian or Pacific Islander, and 234 (80.2%) participants identified as White. Additionally, 21 (6.9%) participants identified as Hispanic in a separate question.

We randomly assigned participants to one of eight experimental conditions in a 4 (warning text) x 2 (modified risk statement), full-factorial experiment. 40 participants were also randomly assigned to a control condition, and those participants did not view warning statements or modified risk statements. We use this control condition as a comparison for the manipulation check, as the other measures are not informative when no warning statement was viewed.

Manipulations

Stimuli.—As displayed in Figure 2, we developed a series of images of e-cigarette cartridge boxes (Katz, Lindgren, & Hatsukami, 2017). We manipulated the warning text statement on

the box (described further below), as well as whether or not the package contained a modified risk statement alongside the warning label. These factors were fully-crossed. Those in the control condition viewed package fronts without a warning label or a modified risk statement. We standardized the box size, font, and style of the labels across conditions. Participants viewed (10 sec. each) nine e-cigarette cartridge box images, displaying 3 brands (3 of each brand). We selected the brands that were launched by big tobacco companies: Vuse, Blu and MarkTen. Together, they represent 66.5% of the market share, not including online stores (Team, 2015). We screen proportioned the size of the boxes to appear optically as they would if they were held in one's hand for those using a desktop or laptop computer (Duchowski, 2009). The vast majority of participants (297) used a desktop or laptop to view the images, while 3 participants used a tablet and 3 used a phone.

Warning text.—As mentioned, this study is part of a larger work evaluating the e-cigarette warning label proposed by the FDA deeming (*This product contains nicotine. Nicotine is an addictive chemical.*), in relation to some alternative warning label text. Therefore, participants either viewed: (1) the FDA warning statement at 30% of the size of the package (FDA required size), (2) the FDA warning statement at 12 point type, (3) the 117-word Mark-Ten warning that mentions several detailed health consequences associated with e-cigarette use, or (4) a more abstract warning (*The long-term health risks associated with this product are unknown*). This factor was fully-crossed with the modified risk statement condition described below.

Modified risk statement.—Participants were randomly assigned to view packages with or without a modified risk statement (*This product presents a lower risk of tobacco-related disease than traditional cigarettes*). This factor was fully-crossed with the warning text variations mentioned above.

Procedure

Participants consented to participate in the online study by indicating agreement with an IRB-approved consent form. Next, they answered questions on demographics and tobacco use. Then, they were randomly assigned to view either the control condition or one of the 8 warning label/ modified risk statement conditions described above. Within the condition they were assigned, participants saw 9 images. They viewed three e-cigarette brands (Blu, Vuse, MarkTen) three times each, each on a separate page. They were not provided the button to advance each page for a full 10 seconds to make certain they had a chance to view the image completely. Once they viewed all 9 images, participants responded to dependent measures. After they completed the study, all participants were debriefed.

Measures

Ambiguity.: As mentioned above, perceived ambiguity has been operationalized in previous research as a perception that contradictory information exists (Han, Moser, et al., 2007) and as an assessment as to whether one finds contradictory recommendations to be confusing (Han, Kobrin, et al., 2007). We adapted this conceptual approach. To measure ambiguity perceptions, participants were asked to respond to four statements on the 7-point scale (1=*not at all* and 7=*very much)* that was used in Katz, Lindgren, & Hatsukami (2017). The

items were: *the packages were confusing* (Uhrig et al., 2012), *the packages were contradictory, the packages were ambiguous*, and *I was confused by the packages I viewed*. These items formed an ambiguity scale (n=263, M=2.23, SD=1.40, α=.84).

Counter-Arguing.: While ambiguity is defined above as a state of confusion that arises as a result of conflicting information, counter-arguing is conceptually understood as active questioning of this information. To measure counter-arguing, participants responded to four statements on a 7-point scale (1=*not at all;* 7=*very much*), adapted from Silvia (2006) that capture active engagement with the message: *how much do you agree with the package* (reverse-coded); *were you criticizing the packages while reading them*; *were you thinking of points that went against them*; and *while reading the packages, were you skeptical of the arguments in them.* These questions formed a counter-arguing scale (n=263, M=3.37, SD=1.58, α=.82).

Reduced Effectiveness.: Perceived message effectiveness refers to an overall perception as to whether or not a message will be successful and can be predictive of actual effectiveness (Dillard, Shen, & Vail, 2007; Noar et al., 2010). To measure perceptions of reduced effectiveness, study participants indicated their agreement with two statements on a 5-point, reverse-coded scale (1=*strongly disagree*, 5=*strongly agree*). These measures have been used in tobacco-labeling research (Byrne et al., 2012; Katz, Lindgren, & Hatsukami, 2014): *the packages I viewed are effective* and *the packages I viewed will have their intended effect* (n=263, M=2.71, SD=.98, α=.91).

Behavioral Intentions.: In order to measure the behavioral intentions of using e-cigarettes, researchers had to control for participants' pre-study intentions. To do so, pre-stimuli responses were subtracted from post-stimuli responses to the same question. The question was: *Do you think you will use an e-cigarette soon?* (National Institutes of Health and US Food and Drug Administration, 2017 – PATH Survey). Participants could answer: *definitely not, probably not, probably yes,* or *definitely yes* (n=263, M=−.08, SD=.44).

Analysis Plan—As mentioned above, the 40 participants who were assigned to the control condition were not used in our analyses of key hypotheses, as they did not see warning labels or modified risk statements, leaving 263 participants available for these analyses. We tested study hypotheses with a series of linear regressions using ordinary least squares (OLS) (H1) and the PROCESS macro for SPSS (Hayes, 2013). The PROCESS macro is often used to demonstrate indirect effects, or mediation, in persuasion experiments featuring random assignment of key predictor variables, wherein participants view a message and then respond to dependent measures (Hayes, 2013; Hayes, 2012). We used the PROCESS procedure to estimate the indirect effects of counter-arguing on the relationship between ambiguity perceptions and reduced effectiveness of the message (H2a) and the indirect effects of ambiguity perceptions on the relationship between exposure to a modified risk statement and reduced effectiveness of the message (H2b). We used structural equation modeling and model fit statistics to compare the systematic and heuristic pathways (RQ1). For the post-hoc analysis, we used (OLS) hierarchical regression. Variance inflation factors

for our dependent measures are: ambiguity perceptions (1.43); counterarguing (1.49); and reduced effectiveness (1.11).

RESULTS

Manipulation Checks

In Katz, Lindgren, & Hatsukami (2017), manipulation checks for the entire sample of smokers and nonsmokers were established. While we acknowledge O'Keefe's (2003) perspective that "intrinsic message features" (i.e. whether there is a modified risk statement mentioned or not) can be used to define the message, rather than simply a "recall" (i.e. manipulation check) of that statement (p. 251–252), we do present manipulation checks for the nonsmoking sample used in this study in order to be consistent with our earlier work.

Modified Risk Statement.—As a manipulation check for modified risk statement, participants responded on a five-point Likert scale, (1) *strongly disagree* to (5) *strongly agree* to the item, *the products you viewed are associated with a lower risk of tobacco-related disease than traditional cigarettes*. Participants in the modified risk statement condition (n=135, M=3.71, SD=.99) scored higher on this item than participants in the no modified risk statement condition (n=128, M=3.35, SD=1.05), F (1,261) = 8.18, p=.005, η_p^2=.03.

Warning Label Statement.—To check the manipulation for warning label statement, we analyzed participants' responses on a 5-point Likert scale, (1) strongly disagree to (5) strongly agree, to statements mentioned in their labeling condition. Participants in the FDA warning statement conditions (n = 66, M = 4.71, SD = .49; n = 70, M = 4.83, SD = .38) agreed more than participants in the control condition (n = 40, M = 3.93, SD = .97) with the statement, *the products you viewed contain nicotine*, F (2,173) = 31.46, p < .001, η_p^2 = .27. Participants in the Mark-Ten warning statement conditions (n = 67, M = 4.46, SD = .82) agreed more than participants in the control condition (n = 40, M = 3.80, SD = .82) with the statement, *the products you viewed can increase your heart-rate*, F (1,105) = 16.25, p < .001, η_p^2 = .13. And participants in the abstract warning statement condition (n = 60, M = 4.33, SD = .97) agreed more than participants in the control condition (n = 40, M = 3.63, SD = 1.28) with the statement, *the long-term health risks associated with the products you viewed are unknown*, F (1,98) = 9.94, p = .002, η_p^2 = .09.

Hypotheses and Research Question

As mentioned above, a previous article based on this dataset illustrated that nonsmokers who viewed e-cigarette packages that included both a warning statement and a modified risk statement reported higher levels of ambiguity perceptions than participants who viewed packages with just the warning statement (Katz, Lindgren, & Hatsukami, 2017). In this study, we predicted that these higher ambiguity perceptions are associated with reduced effectiveness of the warning labels (hypothesis 1). Indeed, using ordinary least squared regression, the data reflects this correlation, F(1,261)=16.10, p<.001, R^2_{adj}=.05.

Support for Systematic Processing.—Hypotheses 2a predicted relationships to establish support for systematic processing. Higher ambiguity perceptions were associated

with greater counter-arguing, F(1,261)=109.51, p<.001, R^2_{adj}=.29, and counter-arguing was associated with reduced effectiveness of the warning message, F(1,261)=26.14, p<.001, R^2_{adj}=.09. In order to test whether counter-arguing had a relative indirect effect on the relationship between ambiguity perceptions and reduced effectiveness of the message, we used PROCESS (Hayes, 2012), and Figure 3 illustrates that this indirect effect represents a full mediation.

Support for Heuristic Processing.—Hypothesis 2b predicted relationships to establish support for heuristic processing. H1 above already demonstrated that ambiguity perceptions directly predicted reduced effectiveness of the warning message. Next, we used PROCESS (Hayes, 2012) to establish a relative indirect effect of ambiguity perceptions on the relationship between exposure to a modified risk statement and reduced effectiveness of the warning message (Figure 4). It is important to note that the direct effect between exposure to a modified risk statement and reduced effectiveness of the message was not previously significant. As Hayes (2012, 2013) has noted, it is possible to have an indirect effect absent of a direct effect.

Heuristic-Systematic Model.—As support was found for both systematic and heuristic processing, structural equation modeling was used to answer Research Question 1. Table 1 provides the zero-order correlations, and Table 2 provides a comparison of these models. In both cases, it was necessary to add a direct relationship between modified risk condition and behavioral intentions to use e-cigarettes. The data was effectively fitted to both models, as displayed in Figure 5, which means that either of these pathways can occur. Both systematic processing and heuristic processing offer suitable model fits. However, as Table 2 reflects, the fit-statistics are considerably better in the case of heuristic processing, and prior research has established that an improvement of 16 points in the BIC, as seen in this case, represents a much stronger model fit (Dillard & Shen, 2005). Therefore, as an answer to RQ1, heuristic processing was supported for nonsmokers, such that including a modified risk statement led to higher ambiguity perceptions and rejection of the message. Counter-arguing does not need to occur.

Post-Hoc Analyses

As a post-hoc analysis, we considered what factors, in addition to a modified risk statement condition, may predict counter-arguing. As noted above, ambiguity perceptions were a very strong predictor. An OLS hierarchical regression was run with counter-arguing as the dependent variable and with age, gender, race, and ethnicity entered into step 1, e-cigarette usage entered into step 2, and modified risk condition and warning label text condition entered into step 3. Only Model 3 was significant (Model 1: F(4, 258) = .53, p = .72; Model 2: F(5, 257) = .60, p = .70; Model 3: F(9,253) = 2.25, p = .02) with modified risk statement condition the only significant factor, t = 3.77, p < .001, Bstand = .23. This test was then run for only those who viewed the modified risk statement, dropping that variable from step 3, and no other factors emerged as significant (Model 1: F(4, 130) = .21, p = .93; Model 2: (5, 129) = .93, p = .47; Model 3: F (8, 126) = .70, p = .69). Therefore, we conclude thatwhether or not participants engaged in systematic or heuristic processing had to do with whether or not they experienced ambiguity as a result of viewing a modified risk statement. However,

we did not test other possible explanations, such as topic importance, issue salience, and need for cognition, which are known to predict systematic processing (Maheswaran & Chaiken, 1991).

DISCUSSION

Review of Findings

The purpose of this article was to test relationships described in a proposed theoretical application of the heuristic systematic model within the context of e-cigarettes package labels and conflicting information among nonsmokers. First, we established that the higher the ambiguity perceptions, the lower the perceived effectiveness of the message. Next, we explored factors in support of the systematic pathway of our proposed model. We demonstrated that higher levels of ambiguity perceptions lead to greater counter-arguing, that counter-arguing reduces effectiveness of the message, and that counter-arguing fully mediates the relationship between ambiguity perceptions and reduced effectiveness of the message. We also explored the factors in support of the heuristic pathway, including that ambiguity perceptions have a relative indirect effect on the relationship between modified risk statement condition and reduced effectiveness of the message. Finally, using structural equation modeling, both pathways were compared. While both of the pathways provided a satisfactory model fit, the heuristic pathway provided a superior fit.

We also conducted a post-hoc analysis. We considered what factors predict counterarguing, testing the role of demographics, e-cigarette usage, and whether or not participants viewed a modified risk statement or particular warning label. Only modified risk statement condition was a significant predictor of the likelihood of counterarguing.

Theoretical Implications

As noted above, a recent theoretical taxonomy on conflicting information and health communication proposed that it can be useful to build theory within particular substantive domains, such as e-cigarette labeling (Carpenter et al., 2015). This suggests that rather than assuming conflicting health information on another topic directly translates to e-cigarettes, we should test the theory within each particular domain. It is important to acknowledge, however, that this argument for bounding theories topically is based on a theoretical taxonomy, rather than a meta-analysis, and therefore, more information is needed before we can conclude whether or not this is true. Of course, one concerning point is that if theory needs to be built within particular substantive domains, we weaken the explanatory power of models that were intended to be more broadly applied.

The key theoretical issue we sought to determine in this work was whether adding conflicting information (a modified risk statement) to the package would lead to more or less systematic processing of the warning message. While we found evidence for both, heuristic processing provided the better model fit. This finding builds on previous research, which has shown that ambiguity can make it more difficult for an individual to engage in elaborative processing (Morris, Mazis, & Brinberg, 1989), and a theoretical contribution of this work is to show this can also occur when the ambiguity is due to conflicting information.

As a post-hoc analysis, we tested possible predictors of counter-arguing. Prior research has shown that issue relevance and salience can influence HSM processes (Trumbo, 2002), and so e-cigarette use (relating to both relevance and salience) was tested, but surprisingly, was not a predictor of counterarguing. Future work seeking to build theory in this area should consider trait psychological processing factors, such as need for cognition.

Practical Implications

In regards to tobacco regulatory recommendations, a number of practical implications have emerged. First, the argument for including modified risk statements on packages is likely to be made on the premise that they can help draw smokers away from traditional, more toxic cigarettes. However, our earlier work found that including the modified risk statement on the package would not have an effect on smokers (Katz, Lindgren, & Hatsukami, 2017), and this work shows that it could lead to cognitive processes that might lower intentions to avoid the product among nonsmokers. As discussed above, a prior study from this dataset demonstrated that smokers who view packages with the warning label and a modified risk statement did not experience greater ambiguity perceptions than those who view the packages with just the warning label (Katz, Lindgren, & Hatsukami, 2017), suggesting that the cognitive processes for smokers might be different. One possible reason for this is that traditional cigarette smokers may perceive less of a conflict between the two statements, as the negative claim (nicotine addiction) is not as negative for them (they are already addicted) and may even be seen as a positive claim (the product can help them quit traditional cigarettes).

Often it is helpful for practitioners to know whether their message is likely to be processed systematically or heuristically, as different message strategies work best for each of these processes. In the case of conflicting information about e-cigarettes, some individuals will process systematically, while others will process heuristically. Therefore, when developing public health campaigns to discourage e-cigarette use among nonsmokers, practitioners should consider the importance of differentiated message strategies – implementing both messages that work best systematically and those that work best heuristically.

Limitations and Future Research

While we sought to implement best practices, this study has limitations. First, we conducted this study on mTurk, with adults. We had checks in place to ensure that participants paid attention, had strong language skills, and responded honestly. For example, we had them do attention checks, collected open-response writing, and asked questions in multiple formats. The strength of this recruitment strategy is that we were able to gather data from both smokers and nonsmokers for the larger project. However, teenagers should be studied in future research. According to the 2015 National Youth Tobacco Survey, 16% (3 million) of high school students report e-cigarette use at least once in the past 30 days (Centers for Disease Control and Prevention, 2016).

In regards to our measures, we drew upon scales from previous work in persuasion and tobacco regulatory science. However, there are many ways to measure concepts, and we could have used other approaches. For example, we did not directly measure perceptions of

credibility, adequacy, or clarity in our operationalization of ambiguity, but rather, we drew upon previous research and focused our conceptual definition on the confusion that arises from conflicting information (Han, Kobrin, et al., 2007; Han, Moser, et al., 2007; Katz, Lindgren, & Hatsukami, 2017). Additionally, our measure of behavioral intentions was a change score measure, subtracting the pre-stimulus response from the post-stimulus response. This facilitated controlling for pre-stimulus intentions, but just seeing the question previously could have primed a response. Another limitation is that we did not control for trait levels of need for cognition, and this may influence the likelihood of counter-arguing. Future research can also directly measure attention and cognitive work as measures of systematic processing.

We also considered as nonsmokers any participants who had not used a traditional cigarette in the past 30 days. This is consistent with our earlier work on this topic (Katz, Lindgren, & Hatsukami, 2017) and also makes a distinction between those who may view e-cigarettes as a cessation product and those who are not personally using them for cessation (both nonusers and recreational users). In future studies, it might be useful to further distinguish between non-users and recreational e-cigarette users.

As mentioned above, this work is part of a larger project on e-cigarette labeling, and the differences in ambiguity perceptions noted in Katz, Lindgren, & Hatsukami (2017) are used to launch the analyses in this manuscript. While we have made every effort to summarize the relevant findings from this earlier project, we do acknowledge that this may be confusing for the reader. It is important to note that these two manuscripts were conceptualized from the very beginning as two separate works, with the current project providing a deeper theoretical consideration of how the differences in ambiguity perceptions influence the overall persuasive process for nonsmokers.

Future research should also consider other forms of conflicting information, such as novelty flavors and the warning label (Katz, Lindgren, & Hatsukami, 2017). We can also test how conflicting information on other topics (not e-cigarettes) applies to the HSM to see whether the model applies more broadly.

CONCLUSIONS

This article applied the HSM to test how conflicting information about e-cigarettes is processed by nonsmokers. While both the systematic and heuristic pathways were both viable explanations for how a modified risk statement can disrupt how nonsmokers process warning messages, the heuristic pathway provided a better model fit. When a modified risk statement is included on the package, nonsmokers can experience increased ambiguity, which may lead to reduced effectiveness of the warning message and reduced intentions to avoid e-cigarettes.

Acknowledgments

Research reported in this paper was supported in part, by the National Institutes of Health/ National Cancer Institute (U19 CA157345), by the National Institute on Drug Abuse/ National Institutes of Health and the FDA Center for Tobacco Products R03-DA043022, by a University of Minnesota Grant-In-Aid of Research, Artistry, and Scholarship, the Institute for New Media Studies, and by funds from the University of Minnesota College of Liberal

Arts and Hubbard School of Journalism and Mass Communication. The content is solely the responsibility of the authors and does not necessarily represent the official views of NIDA/NIH, the FDA, or the University of Minnesota.

REFERENCES

Arrazola RA, Singh T, Corey CG, Husten CG, Linda J, Apelberg BJ, Bunnell RE, Choiniere CJ, King BA, Cox S, McAffee T & Carabello RS (2015). Tobacco use among middle and high school students — United States, 2011–2014. Morbidity and Mortality Weekly Report, 64, 381–385. [PubMed: 25879896]

Ayers JW, Leas EC, Allem J-P, Benton A, Dredze M, Althouse BM, … Unger JB (2017). Why do people use electronic nicotine delivery systems (electronic cigarettes)? A content analysis of Twitter, 2012–2015. PLOS ONE, 12, e0170702 Retrieved from http://dx.doi.org/10.1371%2Fjournal.pone.0170702 [PubMed: 28248987]

Bareham D, Ahmadi K, Elie M, & Jones AW (2016). E-cigarettes: controversies within the controversy. The Lancet Respiratory Medicine, 4, 868–869. 10.1016/S2213-2600(16)30312-5 [PubMed: 27743867]

Brashers DE (2001). Communication and uncertainty management. Journal of Communication, 51, 477–497. 10.1093/joc/51.3.477

Brown J, Beard E, Kotz D, Michie S, & West R (2014). Real world effectiveness of e-cigarettes when used to aid smoking cessation: A cross-sectional population study. Addiction, 109, 1531–1540. 10.1111/add.12623 [PubMed: 24846453]

Bunnell R, Israel A, Apelberg B, Caraballo R, King B, Arrazola R, … Dube S (2015). Intentions to smoke cigarettes among never-smoking U.S. middle and high school electronic cigarette users, National Youth Tobacco Survey, 2011–2013. Nicotine and Tobacco Research, 17, 228–235. [PubMed: 25143298]

Burgoon M (1971). Amount of conflicting information in a group discussion and tolerance for ambiguity as predictors of task attractiveness. Speech Monographs, 38, 121–124.

Byrne S, Guillory J, Mathios A, Avery R, & Hart PS (2012). The unintended consequences of disclosure: The impact of manipulating sponsor identification on the perceived credibility and effectiveness of smoking cessation advertisements. Journal of Health Communication, 17, 1119–37. [PubMed: 23057726]

Carpenter DM, Geryk LL, Chen AT, Nagler RH, Dieckmann NF, & Han PKJ (2015). Conflicting health information: A critical research need. Health Expectations, 19, 1173–1182. 10.1111/hex.12438 [PubMed: 26709206]

Centers for Disease Control and Prevention. (2016). No decline in overall youth tobacco use since 2011 (press release). Available at https://www.cdc.gov/media/releases/2016/p0414-youth-tobacco.html, retrieved August 24, 2018.

Chaiken S (1980). Heuristic versus systematic information processing and the use of source versus message cues in persuasion. Journal of Personality and Social Psychology, 39, 752–766.

Chaiken S (2014). The heuristic model of persuasion In Zanna MP, Olson JM, & Herman CP (Eds.), Social influence: the Ontario symposium (pp. 3–40). New York: Psychology Press.

Chaiken S, Duckworth KL, & Darke P (1999). When parsimony fails. Psychological Inquiry, 10, 118–123. 10.1207/s15327965pl100204

Chaiken S, Liberman A, & Eagly AH (1989). Heuristic and systematic information processing within and beyond the persuasion context In Uleman JS & Bargh JA (Eds.), Unintended Thought (pp. 212–252). New York: The Guilford Press.

Chaiken S, & Maheswaran D (1994). Heuristic processing can bias systematic processing: effects of source credibility, argument ambiguity, and task importance on attitude judgment. Journal of Personality and Social Psychology, 66, 460–473. 10.1037/0022-3514.66.3.460 [PubMed: 8169760]

Chen S, & Chaiken S (1999). The heuristic-systematic model in its broader context In Chaiken S & Trope Y (Eds.), Dual-Process Theories in Social Psychology (pp. 73–96). New York: The Guilford Press.

Dillard JP, & Shen L (2005). On the nature of reactance and its role in persuasive health communication. Communication Monographs, 72, 144–168. 10.1080/03637750500111815

Dillard JP, Shen L, & Vail RG (2007). Does perceived message effectiveness cause persuasion or vice versa? 17 Consistent Answers. Human Communication Research, 33, 467–488. 10.1111/j.1468-2958.2007.00308.x

Duchowski AT (2009). Eye Tracking Methodology (2nd ed.). New York, NY: Springer.

Eisend M (2006). Two-sided advertising: A meta-analysis. International Journal of Research in Marketing, 23, 187–198. 10.1016/j.ijresmar.2005.11.001

Eisend M (2007). Understanding two-sided persuasion: An empirical assessment of theoretical approaches. Psychology and Marketing, 24, 615–640. 10.1002/mar.20176

Ellsberg D (1961). Risk, ambiguity, and the savage axioms. The Quarterly Journal of Economics, 75, 643–669.

Family Smoking Prevention and Tobacco Control Act (2009). 111th United States Congress Available at http://www.govtrack.us/congress/bills/111/hr1256/text, Retrieved August 24, 2018.

Fennis BM, & Stroebe W (2016). Psychology of Advertising (2nd ed.). New York, NY: Routledge, Taylor and Francis Group.

Flynn BS, Worden JK, Bunn JY, Connolly SW, & Dorwaldt AL (2011). Evaluation of smoking prevention television messages based on the elaboration likelihood model. Health Education Research, 26, 976–87. 10.1093/her/cyr082 [PubMed: 21885672]

Griffin RJ, Neuwirth K, Giese J, & Dunwoody S (2002). Linking the heuristic-systematic model and depth of processing. Communication Research, 29, 705–732. 10.1177/009365002237833

Han PKJ, Kobrin SC, Klein WMP, Davis WW, Stefanek M, & Taplin SH (2007). Perceived ambiguity about screening mammography recommendations: Association with future mammography uptake and perceptions, Cancer Epidemiol Biomarkers Prevention, 16, 458–467. 10.1158/1055-9965.EPI-06-0533

Han PKJ, Moser RP, & Klein WMP (2007). Perceived ambiguity about cancer prevention recommendations: Associations with cancer-related perceptions and behaviours in a US population survey. Health Expectations, 10, 321–336. 10.1111/j.1369-7625.2007.00456.x [PubMed: 17986069]

Hayes A (2013). Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. New York, NY: Guilford Press.

Hayes AF (2012). PROCESS: A Versatile Computational Tool for Observed Variable Mediation, Moderation, and Conditional Process Modeling [White Paper] Available at http://www.afhayes.com/public/process2012.pdf, Retrieved August 24, 2018.

Kozlowski LT, & Warner KE (2017). Adolescents and e-cigarettes: Objects of concern may appear larger than they are. Drug and Alcohol Dependence, 174, 209–214. 10.1016/j.drugalcdep.2017.01.001 [PubMed: 29350617]

Maheswaran D, & Chaiken S (1991). Promoting systematic processing in low-motivation settings: Effect of incongruent information on processing and judgment. Journal of Personality and Social Psychology, 61, 13–25. 10.1037/0022-3514.61.1.13 [PubMed: 1890583]

Morris LA, Mazis MB, & Brinberg D (1989). Risk disclosures in televised prescription drug advertising to consumers. Journal of Public Policy & Marketing, 8, 64–80.

Nagler RH (2014). Adverse outcomes associated with media exposure to contradictory nutrition messages. Journal of Health Communication, 19, 24–40. 10.1080/10810730.2013.798384 [PubMed: 24117281]

National Institutes of Health (NIH) and the US Food and Drug Administration (2017). Population Assessment of Tobacco and Health (PATH Survey). Available at: https://pathstudyinfo.nih.gov/UI/StudyOverviewMobile.aspx, Retrieved August 24, 2018.

Naylor RW, Droms CM, & Haws KL (2009). Eating with a purpose: Consumer response to functional food health claims in conflicting versus complementary information environments. Journal of Public Policy and Marketing, 28, 221–233.

Noar SM, Benac CN, & Harris MS (2007). Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. Psychological Bulletin, 133, 673–693. 10.1037/0033-2909.133.4.673 [PubMed: 17592961]

Noar SM, Palmgreen P, Zimmerman RS, Lustria MLA, Lu H, Noar SM, … Lu H (2010). Assessing the relationship between perceived message sensation value and perceived message effectiveness: Analysis of PSAs from an effective campaign. Communication Studies, 61, 21–45. 10.1080/10510970903396477 [PubMed: 26251563]

O'Keefe DJ (2003). Message properties, mediating states, and manipulation checks: Claims, evidence, and data analysis in experimental persuasive message effects research. Communication Theory, 13, 251–274.

Silvia PJ (2006). Reactance and the dynamics of disagreement: multiple paths from threatened freedom to resistance to persuasion. European Journal of Social Psychology,36,673–685.

Tan ASL, Lee C, & Bigman CA (2015). Public support for selected e-cigarette regulations and associations with overall information exposure and contradictory information exposure about e-cigarettes: Findings from a national survey of U.S. adults. Preventive Medicine, 81, 268–274. 10.1016/j.ypmed.2015.09.009 [PubMed: 26400638]

Team T (2015). Who stands to gain from the e-cigarette phenomenon? Forbes Magazine: Investing, 7 23, 2015.

Trumbo CW (2002). Information processing and risk perception: An adaption of the heuristic-systematic model. Journal of Communication, 52, 367–382.

U.S. Department of Health & Human Services and, & Food and Drug Administration. (2016). Deeming tobacco products to be subject to the federal food, drug, and cosmetic act, as amended by the family smoking prevention and control act. Federal Register, 80, 1–195. Retrieved from http://webapps.dol.gov/federalregister/PdfDisplay.aspx?DocId=26927

Uhrig JD, Lewis M. a., Bann CM, Harris JL, Furberg RD, Coomes CM, & Kuhns LM (2012). Addressing HIV Knowledge, Risk Reduction, Social Support, and Patient Involvement Using SMS: Results of a Proof-Of-Concept Study. Journal of Health Communication, 17, 128–145. 10.1080/10810730.2011.649156 [PubMed: 22548606]

Wackowski OA, O'Connor RJ, Strasser AA, Hammond D, Villanti AC, & Delnevo CD (2016). Smokers' and e-cigarette users' perceptions of modified risk warnings for e-cigarettes. Preventive Medicine Reports, 4, 309–312. [PubMed: 27486560]

Zuckerman A, & Chaiken S (1998). A heuristic-systematic processing analysis of the effectiveness of product warning labels. Psychology & Marketing, 15, 621–642. 10.1002/(SICI)1520-6793(199810)15:7<621::AID-MAR2>3.3.CO;2-L

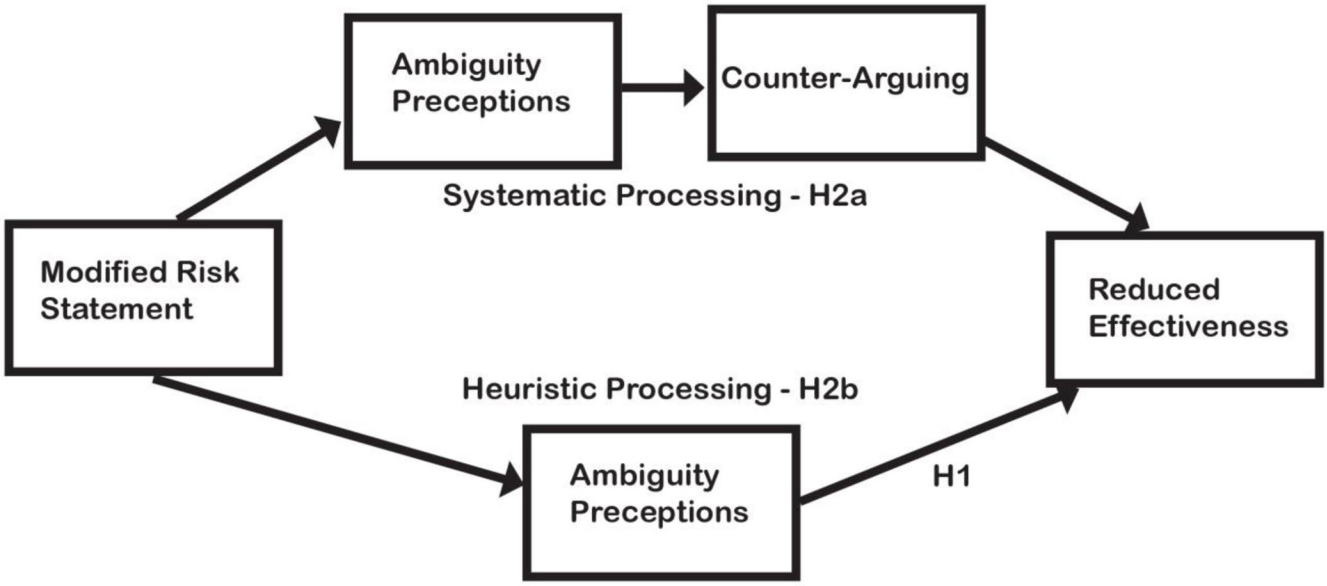

Figure 1.
Proposed Application of the Heuristic-Systematic Model - E-Cigarette Warning Labels and Modified Risk Statements (RQ1).

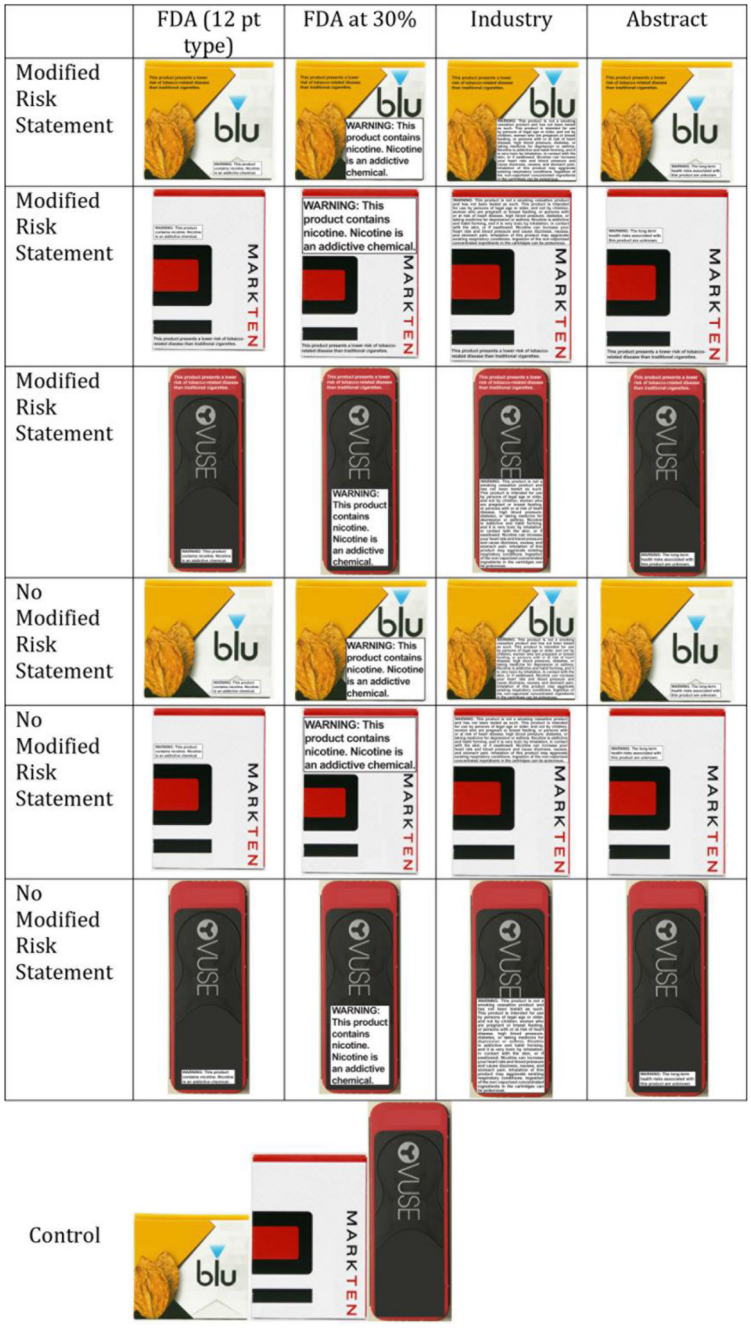

Figure 2.

Participants viewed all three brands in their assigned label and modified risk statement condition.

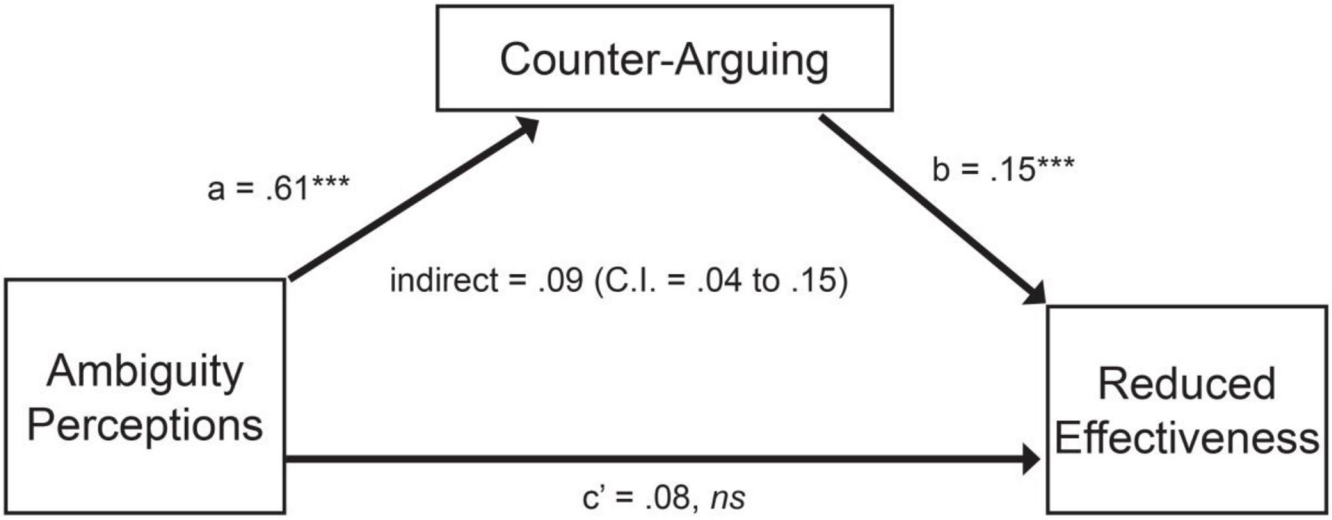

Figure 3.

Indirect effect of counter-arguing on the relationship between ambiguity perceptions and reduced effectiveness of the message (H2a).

Asterisks denote significance: *** p < .001; ** p< .01; * p < .05

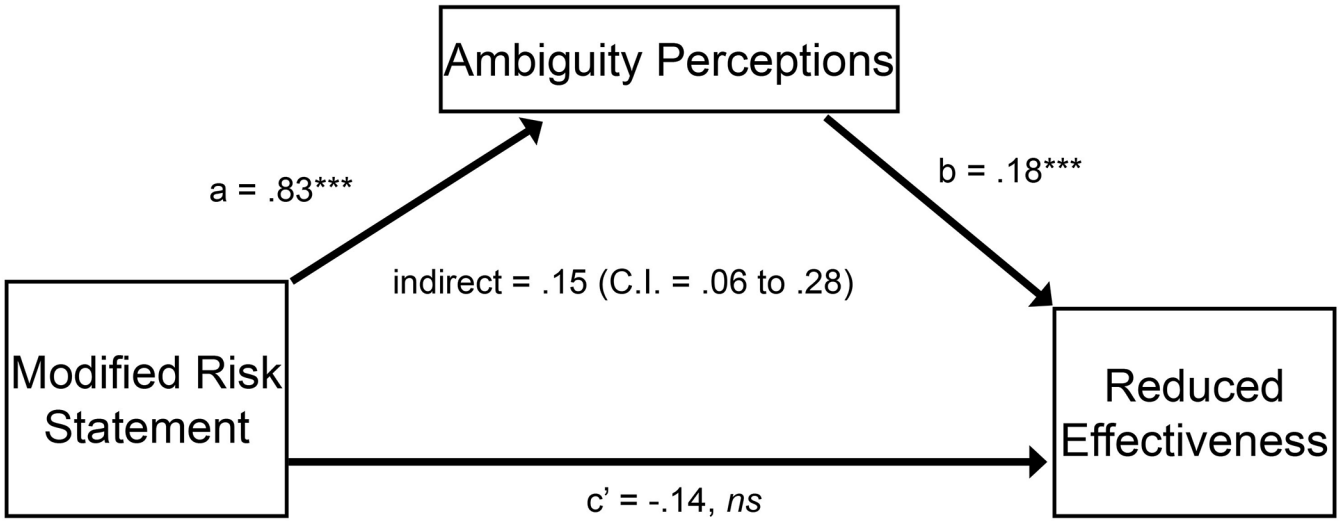

Figure 4.

Indirect effect of ambiguity perceptions on modified risk statement condition and reduced effectiveness of the message (H2b).

Asterisks denote significance: *** p < .001; ** p< .01; * p < .05

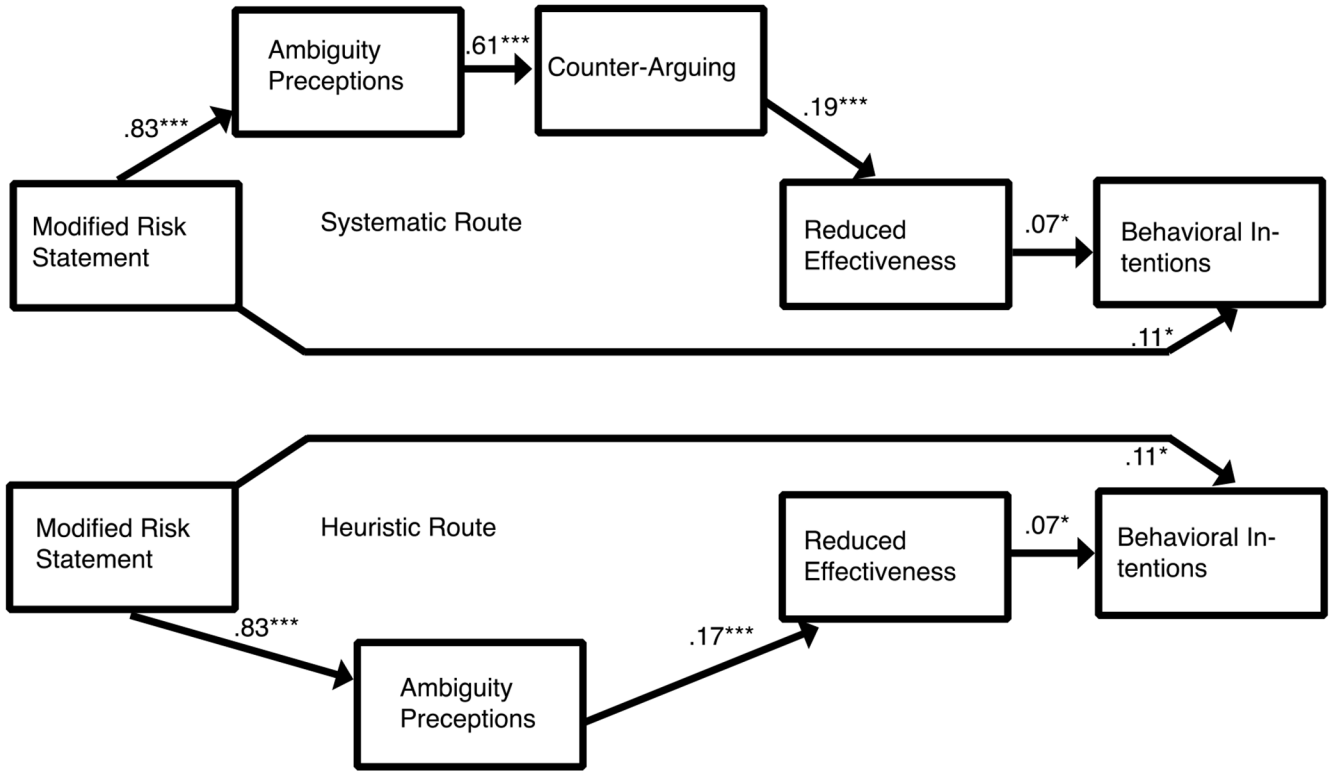

Figure 5.

Fitted Models, Applying the Heuristic-Systematic Model to E-Cigarette Warning Labels and Modified Risk Statements among Nonsmokers (RQ2)

Asterisks denote significance: *** p < .001; ** p< .01; * p < .05

Table 1.

Zero-Order Correlations For Nonsmokers (RQ1)

Variable	Mean (S.D.) No Modified Risk	Mean (S.D.) Modified Risk	Total Mean (S.D.)	1	2	3	4	5
1. Modified Risk Statement (manipulation)	0	1	0.51 (.50)	1.00				
2. Ambiguity Perceptions	1.81 (1.17)	2.64 (1.48)	2.23 (1.40)	0.30	1.00			
3. Counter-arguing	3.00 (1.46)	3.71 (1.61)	3.37 (1.58)	0.23	0.54	1.00		
4. Reduced Effectiveness	2.71 (.99)	2.72 (.96)	2.71 (.98)	0.01	0.24	0.30	1.00	
5. Behavioral Intentions	−.13 (.44)	−.02 (.43)	−0.08 (0.44)	0.13	0.13	0.06	0.15	1.00

Table 2.

Model Comparisons – E-Cigarette Warning Labels and Modified Risk Statement (RQ1)

Models	df	Chi-Sq	P-Value	CFI	AGFI	RMSEA	BIC	BIC Diff.
Systematic Pathway	5	7.73	0.17	0.98	0.96	0.05	63.46	
Heuristic Pathway	2	2.20	0.33	1.00	0.98	0.02	46.78	16.68

When the models are combined, the relationship between ambiguity perceptions and reduced effectiveness of the message becomes non-significant, consistent with the finding in H2a, that counter-arguing fully mediates the relationship between ambiguity perceptions and reduced effectiveness of the message. The fit statistics for the combined model are: df: 4; chi sq.: 5.30; p = .26, CFI = .99, AGFI = .97, RMSEA = .04, BIC = 66.59